

Production of Nonferrous Metals in the Katanga Region of the Democratic Republic of Congo: 1906-2012

John Ngoy Kalenga*

Graduate School of Economics and Business Administration, Hokkaido University, Sapporo, Japan

*Corresponding author: John Ngoy Kalenga, Graduate School of Economics and Business Administration, Hokkaido University, Sapporo, Japan, Tel: (+81) 8032957822; E-mail: jnkalenga@econ.hokudai.ac.jp

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Abstract

This paper investigates the production of nonferrous metals in the Katanga region of the Democratic Republic of Congo (DR Congo) from the colonial period to the independent Congo. It focuses specifically on the major enterprise known initially as Union Minière du Haut Katanga (UMHK) in the period of Belgian rule and Gecamines during the independent era. It aims to estimate the economic value of the processed metals from a historical perspective. This study builds on sources that include internal documents, archives of companies, and in-depth interviews with managers. The findings reveal that during the colonial period, the copper industry alone generated a total income of US\$ 5.5 billion that represented twice the Congolese nominal GDP of 1960. This revenue financed exclusively Belgian interests. The UMHK provided strategic metals to the Western Allies during the two World Wars making the company a big supplier of metals on the world market. After nationalization of the UMHK in 1967, the copper industry generated a total income of about US\$ 52.6 billion under the Congolese ownership and management. Gecamines contributed an average of 11.6 percent to the Congolese GDP per year.

Keywords: Copper; UMHK; Gecamines; Cobalt; Katanga; DR Congo

Introduction

This paper examines the history of industrial processing of nonferrous metals in the Katanga region of the Democratic Republic of Congo from the colonial times to the present. It focuses specifically on the major enterprise known initially as UMHK in the period of Belgian rule and Gecamines during the independent era. It aims to estimate the economic value of the processed metals from a historical perspective. The paper builds on primary sources including annual reports of the UMHK, Gecamines, the annual reports of the Central Bank of Congo, and statistics of exports from the Ministry of Mines. The archives of Gecamines are detailed, complete, and reliable. In addition to archives, in-depth interviews with managers of Gecamines were conducted.

This paper contributes to the existing body of literature on the role of Katanga region as supplier of nonferrous metals on the global market. The paper seeks answers to the following questions: What are the economic values of nonferrous metals processed and exported in Katanga? What is the share of the copper industry of the Congolese gross domestic product? The paper takes into consideration the fact that mineral resources show different patterns in terms of economic contribution because, in contrast to labor and man-made capital whose supply is potentially unlimited, minerals occur in the Earth's crust in finite stocks. Minerals are therefore the principal potential limit to economic growth [1].

The DR Congo is the second largest country in Africa by land area. Regardless of its huge potential in natural resources, the DR Congo is classified among the poorest countries in the world. This situation was due to inappropriate economic and financial policies that led to the decline in output and income levels [2]. Furthermore, the DR Congo

has been governed by a persistently corrupt system that caused the slowdown of economic growth [3].

The land of the DR Congo is endowed with many natural resources [4]. Mineral resources of the DR Congo include: copper, cobalt, diamonds, gold, zinc, tin, uranium, silver, colombo-tantalum (coltan), manganese, coal, tungsten, germanium, cadmium, iron, methane gas, and crude oil. This study focuses on three of the major metals processed in the Katanga region including copper, cobalt and zinc [5]. Man discovered copper in the prehistoric times when Stone Age people in the Mediterranean beat the red stones found on the island of Cyprus to make tools for multiple activities [6]. Copper is the most important nonferrous metal, both in quantity and value of world output [7]. Among all metals, and measured by weight, copper is the third most important metal used by man standing behind iron and aluminum. Copper is one of the most widely known and used non-ferrous metals as a component in hundreds of alloys that make the red metal an essential product for industrial production. Historical evidence shows that people in the Katanga region manually processed copper before their contact with Europeans [8].

The mineralization is essentially a copper-cobalt ore which occurs mainly as three distinct types: sulfides, oxides, and migrating copper [9]. The sulfides are found in the alteration zone below 70 to 150 meters. The grade of copper varies between 4 to 6% and usually remains unformed in the same deposit. It has been observed that high grade ores are extracted first while low grade remain throughout the life time of a mine. Thus, the ore grade of copper decreases in time with exploitation [10]. In contrast to sulfides, the oxide ores are found mainly in the zones close to the surface. These oxides are mined in open pits while the sulfides are extracted in underground mines. In some deposits of Katanga, copper is found together with other minerals such as gold, silver, germanium, cadmium, barium, and platinum [11].

The historical prices of copper, cobalt, zinc and tin were retrieved from the U.S. Geological Survey with 1990 as the base year [12]. The coal average price was retrieved from the U.S. Energy Information Administration [13]. Cobalt was one of the metals not listed on the global metal markets. Cobalt was traded in the free market with few companies showing their cobalt prices [14]. The London Metal Exchange added cobalt to its listed metals from February 2010. The economic value of cobalt is estimated by multiplying the output per year by the historical prices. The estimation of economic value of zinc was determined by multiplying the output by the average annual price. Zinc was listed on the London Metal Exchange. Historical prices of both cobalt and zinc were retrieved from the U.S. Geological Survey [15]. The recorded data of output and prices of key metals processed at Gecamines from 1967 to 2012 were analyzed with Stata Software to estimate the descriptive statistics in order to measure the contribution capacity of each metal to the national income.

Production of the Union Miniere du Haut Katanga: 1906-1966

The prelude to the emergence of copper was the worldwide quest to find gold. In the global economy, the nineteenth century was characterized by the emergence of the industrial revolution in the United Kingdom and its diffusion to neighboring countries of Western Europe and across the United States. These newly industrialized countries increased their mass production capacities. They sought markets for their products, raw materials for their industries, and foodstuffs for their rapidly growing populations [16]. European capitalists invested their capital surpluses into different regions of the world to secure the supply sources. Cecil Rhodes, an imperialist-financier of the 19th century, believed that empire, investment and profits combined as a set would maximize European interests in Africa. Hobson argued that capitalism expanded because of the surplus of capital in Western Europe that was invested overseas searching for higher returns on investment. There is an extensive debate on the motives of imperialism [17]. In the natural resources sector, the United States has been producing gold before the California gold rush. On January 24, 1848, gold was discovered in California. This discovery of gold in the Western region was the event that attracted people from many parts of the world toward to gold fields [18]. In 1851, gold was first discovered in New South Wales of Australia. The Australian colonial government regulated the digging activities for private mining and it charged a monthly license-fee to each gold miner during the gold rushes of 1850s [19]. The gold rushes in United States and Australia motivated European powers to search for precious metal in Africa.

The existence of gold in the Western region of Africa was known for centuries [20]. A shift toward Central Africa occurred during the 1860s with the discovery of gold in Rhodesia by the German adventurer Karl Mauch [21]. This event raised the European interest into Central Africa. The Belgian King Leopold II who sought to secure a colony in the Central Africa encouraged his partners to invest in a prospection project in Katanga region. They believed in the possibility of discovering gold in Katanga. In 1892, in the Belgian Congo, the Belgian geologist, Jules Cornet discovered huge copper ore deposits in the Katanga province of the DR Congo [22]. At that time, the discovery of copper instead of gold disappointed investors who financed the exploration of Katanga [23]. Although Belgians showed more interest in discovering gold than copper initially, Stengers found

that the exploitation of copper resources in the Belgian Congo generated a higher income and profits [24].

Today, resource-rich developing countries produce the larger share of the total output of non-ferrous metals for exportation. The demand and supply of copper and cobalt are operated on international commodity markets. The London Metal Exchange (LME) constitutes the world's premier non-ferrous metals market. Established in 1870, the market is located in the heart of the City of London [25]. The LME provides three main services such as transparent pricing, risk management, and delivery points at last resort. There are two major categories of pricing systems for refined copper. First, the free market prices quoted on the two major exchanges, the London Metal Exchange (LME) and the New York Commodity Exchange (Comex). Dealers on the LME sell and buy standard copper grades and shapes on a competitive basis, with prices changing continuously. Both UMHK and Gecamines used the LME prices for their selling contracts. Second, the domestic producers' prices charged by copper refineries to local fabricators were changing frequently at the initiative of the sellers [26].

The industrial extraction and processing of Congolese minerals started in the colonial era. In the early twentieth century, Leopold II shifted from the exploitation of ivory and rubber to the mining industry. He believed in the high potential of mineral resources. He told his partners in the colony that: "The Congo is richer than what you may know: Work hard!" [25]. On October 28, 1906, Leopold II signed the decree creating the Union Miniere du Haut Katanga [27]. The creation of UMHK was a mystery in Katanga because Leopold II wished to keep secret his projects in Congo Free State to avoid competition with other European powers [28]. The objective of UMHK was the exploration and exploitation of mineral resources in Katanga. The capital of the company was composed of 100,000 shares of 100 Francs divided between La Societe Generale de Belgique and the Tanganyika Concessions Limited as shareholders. In addition, Leopold II obtained 100,000 shares in nature as the government participation by providing the concessions to extract minerals.

The company experienced many challenges at the beginning due to the lack of infrastructures, labor force, and other inputs in the region of Katanga. By 1959, the UMHK increased its stocks up to 1,242,000 shares [29]. During the colonial period, the activities of the UMHK made both Belgium and Belgian Congo attracted the interest of international newspapers. The volume of production ranked the company among the world's big producers of red metal.

During the early period of the UMHK, the extractive activities of minerals occurred in three districts including the eastern district of Lufira with the mine of Etoile, Kambove mine in the central district and the western district of Kolwezi for mines of Ruwe and Mutoshi. During the First World War, the UMHK invested into the mechanization of extractive and metallurgical processes in order to increase the output because copper became an important metal for war equipment. The "Waters Jacket" equipment was installed to process metals. During the second half of the 1920s the UMHK increased the output of red metal because the demand increased in Europe to reconstruct the basic infrastructures destroyed during the First World War. In 1924, for the first time a new technology was introduced to produce cobalt byproduct processing of copper [30].

The Great Depression of the 1929 had a dramatic impact on the output of the UMHK. In 1932, the copper output dropped by half from its level of 138,949 tons per year in the 1930 after the financial

crash reaching 54,000 tons [31]. Mines were closed and the layoff of workers became so severe that the unemployment rate rose significantly. Expatriate employees returned back to Europe. During the 1930s, the UMHK diversified its products. A new policy of huge investment was taken to overcome the effects of the financial crisis on the world market. UMHK began to produce gold, uranium, industrial cement, zinc, and steel. In 1934 the uranium mine of Shinkolobwe was opened [31]. The UMHK extracted uranium ores that were kept secret by Belgians. The UMHK increased progressively the output in the second half of the 1930s [32]. The company became a big supplier of copper on the world market until the eruption of the Second World War in August 1939.

During the Second World War, the UMHK played an important role on world market as supplier of copper and other metals. In 1939, American diplomacy succeeded in negotiating the importation of uranium ores from the Belgian Congo. In 1941, the stock of uranium kept in New York helped to make the atomic bombs dropped on the two Japanese cities of Hiroshima and Nagasaki in 1945 [28]. From June 1940 the colonial government in the Belgian Congo took control of the mineral production, especially the strategic metals such as copper, uranium, and cobalt for military use. The government organized a Special War Committee to deal with the special circumstances of war. The Belgian government requested a support from its colony for the war effort. As a colonial company, the UMHK mobilized human and financial resources to respond to the government's request. Again, the UMHK provided huge quantities of strategic products and financial support to the Belgian government as it did during the First World War. The period from 1940 to 1945 marked the high expansion of the output for the UMHK with an annual average growth rate of about 13 percent. The output of cobalt doubled from 1941 to 1942 and remained high during the war period. The UMHK gained trust on the international market because of its contribution to war efforts in favor of the Western Allies. The UMHK developed a close commercial relationship with the Western countries that consumed its metals.

From 1946 the UMHK made huge investments that led to a steady expansion for the entire decade up to the eve of independence of the Belgian Congo [33]. It introduced new productive machines such as the electric digger, and the transportation of minerals by electric trains that improved considerably the production capacity of the company. It was during this period that a large reserve of sulfide ores was discovered at the Kambove mine. This discovery was followed by the underground mine construction to extract the copper ores. In 1949 the colonial government in the Belgian Congo initiated a Ten Year Plan for economic and social development which made a favorable environment for business [34]. This period has been the most prosperous for the copper industry.

The colonial archives reveal that the Union Minière du Haut Katanga (UMHK) produced from 1906 to 1966 the year of nationalization the total output of metals shown in Table 1.

It is important to note that the revenue generated by the exportation of these metals in Table 1 financed exclusively Belgian interests. This is an estimation of the economic value of metals produced by the UMHK alone in the Belgian Congo during the colonial period. The Congo obtained the international sovereignty on June 30, 1960. On July 11, 1960, Moise Tshombe, who received support from Belgian military troops on the one hand and financial resources from the UMHK on the other, proclaimed the

Period	Mineral	Quantity	Price / ton	Value \$US
1906-1966	Copper	7,806,199	713	4,026,737,823
1924-1960	Cobalt	170,024	3,390.00	679,855,530
1953-1960	Zinc	644,933	286.00	177,230,045
1939-1960	Tin	327,655	2,240.00	633,027,946
1930-1960	Coal	4,501,606	2.29	10,583,478
Total				5,557,434,950

Table 1: Total output in tons of UMHK until 1966.

independence of Katanga province by secession from the central government of Patrice Lumumba who was the Prime Minister [27]. The above events affected negatively the performance of the copper company. The UMHK interfered in the conflict between the Prime Minister Lumumba who sought support from the Soviet Union and the President Kasavubu who remained faithful to the capitalist regimes of Belgium, France, and the United States. The capitalists would not accept that the independent DR Congo with its abundant natural resources should fall into the hands of a communist regime. They put pressure on Lumumba until he was assassinated in January 1961. Expatriate employees left the country during the early 1960s. In addition, there was the destruction of productive infrastructures of the UMHK, especially the energy and transportation facilities in Katanga [35]. The history of the UMHK reveals that the capitalists tried to secure their interests in DR Congo by all means during the colonial and post-colonial regimes.

After the independence of the country, by the law of June 7, 1966 known as "Bakajika law", the central government of Congo decided to take over all concessions granted to foreign firms under the colonial regime. In fact, the Congolese government became the sole owner of concessions, forest, and mineral resources [36]. The Belgian government and foreign investors would not look at the situation the same way. The Congolese government initiated some negotiations to clear up any conflict of ownership in Kinshasa with former shareholders of the UMHK. Mobutu moved forward to pass the law of December 31, 1966 that nationalized the colonial company into a government owned company, Gecamines.

Processing of Nonferrous Metals at Gecamines: 1967-2012

After nationalization, Gecamines inherited the assets, liabilities, plants, machines and mine concessions from UMHK. Today the Congolese government focuses on five products as a source of foreign currency and budget revenues: copper, cobalt, diamond, zinc and crude petroleum. Three of them are processed at Gecamines, in Katanga province of the DR Congo. Katanga has been portrayed as the greatest mining region of the country that provides the biggest share of foreign currencies to the national economy [37]. In 1967, Gecamines signed a commercial agreement with the Belgian firm la Societe Generale des Mineraiis (SGM) to sell refined copper [27]. In 1967, Gecamines paid 6% of its annual income to the Societe Generale des Mineraiis. This charge has been renegotiated to 1.5% in 1968 [38]. In fact, Gecamines found that the commercialization cost was very expensive to bear. A few years later the contract was cancelled. In

1974, President Mobutu created a Congolese Metal Selling Company (Sozacom) to sell the total output of all mining companies [39].

A Belgian businessman who lived in DR Congo for thirty years emphasizes the economic role of Gecamines in this way: "Even if Congo (Zaire)'s political problems were solved tomorrow, without Gecamines's profits, they're dead, kaput. "Without Gecamines, they're back in the stone age" [40]. This statement may be controversial. On one hand, President Mobutu in an interview with French journalists in 1969 stated that during the three years of Katanga secession from 1961 to 1963, UMHK did not contribute financially to the income of the central government but the country survived thanks to income generated by the agricultural sector. On the other hand, the collapse of Gecamines's output in 1993 had drastic decline of national GDP per capita so that the majority of Congolese people did not have another choice than to enter the informal sector in order to survive. The importance of the copper industry in the Congolese economy cannot be over stated. The country is the leading producer of cobalt in the world.

Industrial operations and processing of metals at Gecamines

When prospection projects confirm the existence of mineral ores in quantities that are economically extractable, the choice of exploitation method depends on the current economic and technological conditions. There are two choices of exploitation either in open pits or underground mines. Gecamines developed in the western district of Kolwezi the open pits of Kamoto, Musonoi, Ruwe and the underground mine of Kamoto. In 1976 the extraction capacity of Kamoto mine was about 3,000,000 tons of ores per year [41]. The central district of Likasi has the open pits of Kakanda, Sesa and the underground mine of Kambove. In 1972 Gecamines extracted 1,200,000 tons of ores per year at Kambove mine [42]. The southern district has one underground mine, Kipushi. The extraction of ores requires the use of large equipment for excavating, loading, and transportation. Gecamines acquired mechanical shovels of 4 cubic meters and 12 cubic meters for digging and loading. One mechanical shovel costs about US\$ 910,000, which is a huge investment. Gecamines uses transportation equipment of 45 and 100 tons to move ores from mines to concentrators and refining plants. One truck of 100 tons costs US\$ 262,000.

Taking into consideration the fact that Gecamines had eight mines in operation, this implies that the company has made a huge investment in production equipment. The investment and technology levels in production process at Gecamines were similar to that made by copper companies in the United States in order to gain economies of scales as highlighted in Chandler's analysis [43]. Gecamines invested in modernization of Lubumbashi smelter to increase its capacity. Furthermore, Gecamines invested in refining process of copper and cobalt. Refining plant of Luilu underwent subsequent modifications and extensions to produce 175,000 tons of copper and 8,000 tons of cobalt per year. The concentrator of Kamoto realizes concentration operations by automation.

Technological innovation has made possible the extraction and processing of low grade ores of copper and cobalt. Concentration is an industrial process that produces concentrates as feeds for further metallurgical treatment. Methods of concentration depend on types of ores and tailing. The concentrators of Kolwezi, Kambove and Kakanda treat the oxide ores of copper and cobalt by simple flotation. They treat also the mixed oxide-sulfide ores in two separate stages in order to produce oxide and sulfide concentrates. The Concentrator of Kipushi

treats the mixed ore of copper-zinc in two stages to produce the concentrates of copper and zinc. These concentrates are processed in metallurgical plants to produce metals of copper, cobalt, zinc and precious metals [44].

Gecamines produces metals by two processes of smelting and hydrometallurgy. Sulfide concentrates of Kipushi and Kambove are processed at Lubumbashi smelting plant constructed in 1911. Some innovations have been made to increase the processing capacity of the smelter. The smelter produces copper metal in three successive operations. First, concentrates from Kipushi and Kambove are roasted in a Dwight Lloyd roaster. Second, the roasted concentrate is smelted with the addition of rich concentrates, silica, converter slag, and other chemicals to produce a copper matte in the water jacket furnaces. Third, the matte is then fed to a converter to produce a blister copper of 98%. The blister is cast in ingots of 150 kgs and 200 kgs as final product for exportation. The Lubumbashi smelting plant was closed in 1993 when Gecamines faced financial crisis.

Gecamines produces copper, cobalt and zinc in hydrometallurgical plants of Shituru, Luilu, and Kolwezi. Three successive operations of lixiviation, electrolyte and refining allow the production of copper and cobalt metals. Concentrates are dissolved into sulfuric acid to produce sulfates of copper and cobalt. Reverberate furnaces refine sulfates to produce cathodes of 99.4% at Shituru plant. Cathodes are refined by electrolytic method to produce copper wire bars of 99.95% as final product for exportation. The Shituru plant produces cobalt metal of 99.6% as granulates. Granulates of Shituru are sent to Luilu plant for further refining to remove the gaz. Luilu plant refines cobalt at 99.9% as final product for exportation.

Gecamines extracts sulfate ores of zinc from the Kipushi mine in the southern east of the DR Congo [45]. The zinc concentrates produced at Kipushi concentrator are roasted at the acid division of the Shituru plant in Likasi. The roasted concentrates are the feed of the Kolwezi zinc plant to obtain zinc in the solution. Zinc concentrates contain other metals such as copper, cobalt, cadmium and arsenic which are dissolved separately. The Kolwezi zinc plant produces zinc metal by electrolyte method. The Kolwezi zinc plant has an installed capacity to produce 65,000 tons of zinc per year.

Production and demand for copper

During the 1980s, the DR Congo ranked as the world's leading supplier of cobalt metal and the sixth of copper [46]. The DR Congo disappeared in world statistics when activities of Gecamines dropped in 1990s. Copper is the most important product that generates revenues to the Congolese economy. Copper and cobalt were the main products extracted and processed at Gecamines since the nationalization of the company in 1967. Since the collapse of Gecamines's output in the early 1990s, new partner companies and Gecamines produce the total output of Congolese copper and cobalt as joint ventures from 2006. In most cases of partnerships Gecamines possesses 25% of capital shares.

Gecamines has been considered as the main contributor to the public budget in the DR Congo. It provided jobs to around thirty five thousand workers and employees [47]. It provided education and health services to its employees and dwellers around the company's facilities. The sharp decline of output observed from 1991 was the result of political, economic, technological and social factors that affected Gecamines. Gecamines produced about ninety percent of total

output of copper and cobalt until 1996 when it signed joint venture contracts.

The economic value of copper on the world market is determined by its industrial application. Copper is listed on the London Metal Exchange. For many centuries, copper has been used for different purposes such as decorative, coinage and warfare instruments. During the mid-nineteenth century, copper became an important component in industrial production especially with the intensive usage of electricity as the main source of energy for industries. Considering its malleability, ductility, conductivity of heat and electricity, ability to withstand corrosion, and its esthetic characteristics, copper has established numerous crucially important uses in virtually all branches of mature industries. The quasi-total output of Congolese copper was exported to developed countries. The estimation of the total output of Gecamines in tons from 1967 to 2012 was 13.2 million tons of metal copper representing US\$ 36.3 billion.

Production and demand for cobalt

Cobalt is a bluish-gray, shiny, brittle metallic element [48], and is a strategic and critical metal for its applications in defense-related industries. It is especially important due to the fact that developed countries rely on imported cobalt from developing nations to feed their manufacturing plants [49]. In nature, cobalt is a metallic element that occurs in the earth's crust almost exclusively as the stable isotope cobalt. Generally, many mines produce cobalt as a byproduct of copper or nickel. Some deposits allow the mining and processing of cobalt alone [50].

The cobalt reserves are found in Katanga province of the DR Congo. At the UMHK, the term cobalt was used for the first time on June 6, 1913 to refer to an impurity metal (cobalt) of 2 or 3% contained in copper metal. Three months later, on September 6, 1913, Jules Cousin, the Director of the company in Lubumbashi (known as Elisabethville) at that period reported to the headquarters in Brussels the discovery of important cobalt reserves around Luishia mine [22]. In terms of optimum grade and tonnage, the mineralized sedimentary rocks of Central African copper belt are the richest in the world [49]. The amount of cobalt varies considerably in the various mines. These reserves constitute 36% of world known resources of cobalt located in the DR Congo [48].

Cobalt has economic value because of its use in many industries. As a chemical compound, cobalt finds its final use in pigments, enamels, rubber, driers, catalysts and radiology. In its metallic form, cobalt is used mainly in rechargeable batteries for electric cars. It is also used in permanent magnets, cement carbides, hard facing alloys, and super alloys.

Until recently, the Central African Copper Belt of DR Congo and Zambia has been the predominant supplier of cobalt on world market [51]. The source of supply has changed in the last few years when other producers such as Australia, Brazil, Cuba, Russia, and China started to produce cobalt as a by-product of nickel or copper. The DR Congo is a leading world producer of cobalt. Cobalt is the second most important product in terms of revenues to the gross domestic product after copper.

Cobalt production peaked in the year 2011 with 107,000 tons. The steady rise of output was intended to meet the high demand from emerging economies, especially China. Historical estimation shows that the total output of cobalt was 737,330 tons, which generated a total revenue of US\$ 22.5 billion from 1967 to 2012. Surprisingly the

economic contribution of cobalt was closer to that of copper because the price of cobalt has been higher than that of copper.

Production and demand for zinc

Zinc is a bluish-white metal when freshly cast, but on exposure to air it develops a thin corrosion-resistant gray oxide, an important characteristic in its use by industry [49]. The zinc reserves are identified at Kipushi mine in the southeastern region of Katanga copper belt near the border with Zambia [52]. This zinc deposit is one of the most promising identified sub-economic resources in the world with 17.5 million tons of ores that can produce after processing 2.9 million tons of metal zinc and 405 thousand tons of metal copper [11]. Kipushi mine is predominantly a zinc mine. The ratio of zinc to copper increases as far as the mine goes deep. The chief ore mineral of zinc is sphalerite. Most of the zinc ores also contain economically recoverable quantities of lead, copper, silver, cadmium, germanium, gold, barium, sulfur, or fluorine. Most zinc ores contain 2.5 to 20% zinc. In practice, if the zinc ore contains 3 to 10%, then it is extractable. Kipushi mine produces the quasi-total zinc output of the DR Congo. In 1938, the UMHK produced 11,500 tons of concentrated zinc at 52.5% from Kipushi concentrator plant [22].

Zinc is one of the major nonferrous metals required in an industrial economy. Zinc is an essential element to produce super alloys. Zinc constitutes the fourth product that contributes to the Congolese GDP. The same causes that influenced the output of copper and cobalt would have been relevant to influence the zinc trend. A total output of zinc from 1967 to 2012 estimated at 1.5 million tons generated a total value of US\$ 1.3 billion. The share of zinc in the Congolese GDP was low compared to the other metals processed at Gecamines for the same period under study. Table 2 summarizes the total output and income of the three metals processed at Gecamines.

Period	Mineral	Quantity	Average Price	Income in \$US
1967-2012	Copper	13,225,163.00	7,949.40	28,752,194,451.00
1967-2012	Cobalt	737,330.00	28,084.00	22,504,674,022.00
1967-2012	Zinc	1,591,178.00	1,947.70	1,345,289,230.75
Total				52,602,157,703.75

Table 2: Total output in tons and value of key metals 1967-2012.

As aforementioned, the total output and income from the export of Congolese minerals during the colonial period contributed mainly to Belgian rather than domestic economic growth. The economic theory of comparative advantage discovered by David Ricardo constitutes the basis of the case of specialization on the part of nations and for freedom of trade. Analysis of the copper industry shows that the DR Congo has a comparative advantage in cobalt than other metals.

The fairness of trade in order to balance commercial relationship between the northern and southern dealers on the global market of non-ferrous metals constitutes a subject of debate. When a country relies on a single commodity, the fluctuations in commodity prices lead directly to internal instability and to the interruption of development funds for developing countries [53]. In developing countries, the government owned companies apply the policy of job security even if they are going through an underperformance period. The government advised Gecamines to maintain its employees in the 1990s even though output had collapsed. This policy of job security

increased the fixed cost because the output per worker had increased considerably. Gecamines experienced strikes and pressures on management because of unpaid salaries due for months.

The Congolese government has relied on the exportation of cobalt and copper as the main sources of income to the GDP. Copper and cobalt provide important revenues to the Congolese economy. Figure 1 depicts the share of Gecamines in the GDP for the period from 1967 to 2012.

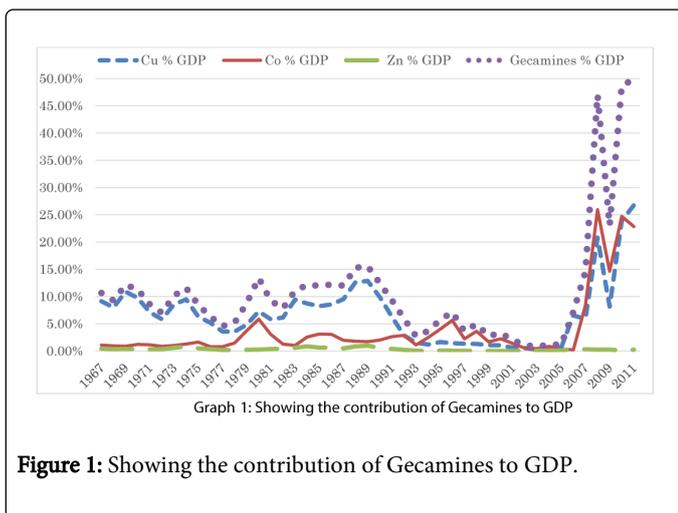


Figure 1: Showing the contribution of Gecamines to GDP.

The share of these products decreased in the 1990s when output collapsed. The government has shifted from copper and cobalt in favor of diamond and crude oil as sources of income. Copper and cobalt remain the most important metals that contribute about 10% to the national wealth.

Conclusions

During the second half of the nineteenth century, the Belgian King Leopold II hoped to discover gold in Katanga when he invested his personal fund in the mining project. The prospection results revealed the existence of huge copper resources instead of yellow metal. Since the colonial era, the Union Minière du Haut Katanga produced the major metals of copper, cobalt and zinc. The UMHK produced the uranium ores to make the first atomic bombs dropped on the Japanese cities of Hiroshima and Nagasaki during the Second World War. During the inter war period, the Katanga region became a great supplier of nonferrous metals of the world market.

Historical evidence shows that the industrial production of copper and its related metals generated sufficient revenue to finance the economic growth of Belgium during the colonial era. After nationalization, Gecamines continued to provide an average of eleven percent of revenue to the Congolese GDP. The production of copper and cobalt made the DR Congo rank as the fifth and leading supplier respectively on the global market.

This paper shows that activities of mining companies that produced nonferrous metals in the Katanga region from the colonial era to the present played an important role on both global market and national economy.

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References

1. Kneese AV, Sweeney JL (1993) Handbook of natural resource and energy economics. Elsevier Science Pub. Co., New York.
2. Akitoby B, Cinyabuguma M (2004) Sources of Growth in the Democratic Republic of the Congo: A Cointegration Approach. International Monetary Fund, 32.
3. Mpereng HP (2012) Histoire du Congo Kinshasa Independant. L'Harmattan, Paris.
4. Turner T (2007) The Congo wars: conflict, myth and reality. Zed Books, London.
5. Kalenga JN (2013) Economic and Toxicological aspects of copper industry in Katanga, DR Congo. Japanese Journal of Veterinary Research 61 (Supplement), 23-32.
6. Radetzki M (2009) Seven thousand years in the service of humanity: the history of copper, the red metal. Resources Policy 34:176-184.
7. Svedberg P, Tilton JE (2006) The real, real price of nonrenewable resources: copper 1870-2000. World Development 34: 501-519.
8. Ndaywel IeN, (1998) Histoire Generale du Congo: De l'heritage ancien a l'indpendance. Bruxelles, De Boeck & Lacier, 72:676-32.
9. Cailteux JLH, Kampanzu AB, Lerouge C, Kaputo AK, Milesi JP (2005) Genesis of sediment-hosted stratiform copper cobalt deposits, central African Copperbelt. Journal of African Earth Sciences 42:134-158.
10. Crowson P (2012) Some observations on copper yields and ore grades. Resources Policy 37:59-72.
11. Mupepele LM (2012) L'Industrie Minerale Congolaise: Chiffres et defis. L'Harmattan, Paris.
12. Survey USG (2012) Copper, Cobalt, Zinc and Tin statistics, in Kelly, T.D., and Matos, G.R., comps., Historical statistics for mineral and material commodities in the United States: U.S. Geological Survey Data Series 140.
13. Administration USEI (2012) U.S Energy Information Administration, Annual Energy Review 2011, September 2012. U.S. Department of Energy, Washington.
14. Ecorys (2012) Mapping resource prices: the past and the future, Final Report. Ecorys, Rotterdam, pp. 307.
15. Survey USG (2013) Cobalt statistics, 2012, in Kelly, T.D., and Matos, G.R., comps., Historical statistics for mineral and material commodities in the United States (2013 version): U.S. Geological Survey Data Series 140, 4 p.
16. Jones G (2005) Multinationals and Global Capitalism: from the nineteenth to the twenty-first century. Oxford University Press, New York.
17. Foeken D (1995) On the causes of the partition of Central Africa, 1875-1885. Political Geography 14:80-100.
18. Umbeck J (1977) The California gold rush: A study of emerging property rights. Explorations in Economic History 14:197-226.
19. La Croix SJ (1992) Property rights and institutional change during Australia's gold rush. Explorations in Economic History 29:204-227.
20. Mainguy C (2010) Natural resources and development: The gold sector in Mali. Resources Policy 36:123-131.
21. Gann LH, Duignan P (1969) The history and politics of colonialism, 1870-1914. Cambridge University Press, Cambridge [Cambridgeshire].
22. Katanga UMDH, (1957) Union Minière du Haut Katanga 1906-1956.

23. Joye P, Lewin R (1961) *Les Trusts au Congo*. Societe Populaire d'Editions, Bruxelles.
24. Stengers J (1957) *Combien le Congo a-t-il coûté à la Belgique?* Gembloux : J. Duculot, Bruxelles.
25. Exchange LM (2007) *London Metal Exchange 130th Anniversary Supplement*. LME, London, pp. 9.
26. Mikesell RF (1979) *The world copper industry: Structure & Economic Analysis*. The Johns Hopkins University Press, Baltimore.
27. Saquet JJ (2000) *De l'Union Miniere du Haut Katanga a la Gecamines*. L'Harmathan, Paris.
28. D'Ydewalle C (1960) *L'Union Miniere du Haut Katanga de l'age colonial a l'indépendance*. Plon, Paris.
29. Katanga UMdH, (1911) *Rapports du Conseil d'Administration et du College des Commissaires, Assamblee generale du 4 Decembre 1911* Union Miniere du Katanga, Bruxelles.
30. Katanga UMdH (1929) *Rapports du Conseil d'Administration et du College des Commissaires a l'Assemblee generale ordinaire du 8 Juillet 1929*. Union Miniere du Haut Katanga, Bruxelles, pp. 13.
31. Katanga UMdH (1934) *Rapports du Conseil d'Administration et du College des Commissaires a l'Assemblee generale ordinaire du 9 Juillet 1934*. Union Miniere du Haut Katanga, Bruxelles, pp. 5.
32. Katanga UMdH (1938) *Rapports du Conseil d'Administration et du College des Commissaires a l'Assemblee generale ordinaire du 11 Juillet 1938*. Union Miniere du Haut Katanga, Bruxelles, pp. 5.
33. Katanga UMdH (1949) *Rapports du Conseil d'Administration et du College des Commissaires a l'Assemblee generale ordinaire du 23 Juin 1949*. Union Miniere du Haut Katanga, Bruxelles, pp. 7.
34. Belge C (1949) *Plan Decenal pour le developpement Economique et Social du Congo Belge*. Congo Belge, Bruxelles, pp. 2.
35. Katanga UMdH (1962) *Rapport Annuel 1961: Rapports presentes a l'assemblee generale ordinaire du 24 Mai 1962 par le Conseil d'Administration, par le College des Commissaires, et par le Commissaire Reviseur*. Union Miniere du Haut Katanga, Bruxelles, pp. 7.
36. Kake IB (1990) *Conflit belgo-zairois: fondements historiques, politiques, economiques et culturels*. Presence Africaine, Paris.
37. Mukena AN (2004) *Ma vision du Katanga: Un nouveau regard sur une cite natale a rebatir*. Editions Lajino, Lubumbashi.
38. Mulumba L (1974) *La GECAMINES: Generale des Carrieres et des Mines du Zaire*. Zaire-Afrique 81.
39. Inoue S (2007) *Mobutsu Sese Seko Monogatari*. Shinfusha, Tokyo.
40. Noble KB (1994) *Zaire's Rich Mines are Abandoned to Scavengers* New York Times. New York Times, New York.
41. Gecamines (1976) *Contemporary History Library Catalogue, Rapport Annuel 1976*. Gecamines, Lubumbashi, pp. 14.
42. Gecamines (1972) *Contemporary History Library Catalogue, Rapport Annuel 1972*. Gecamines, Lubumbashi, pp. 18.
43. Chandler AD, Hikino T (1990). *Scale and Scope: the dynamics of industrial capitalism*. Belknap Press of Harvard University Press, Cambridge, Mass.
44. Gecamines (1974) *Contemporary History Library Catalogue, Annual report 1974*. Gecamines, Lubumbashi, pp. 13, 21.
45. Gecamines (1975) *Contemporary History Library Catalogue, Annual Report 1975*. Gecamines, Lubumbashi.
46. Prasad MS (1989) *Production of copper and cobalt at Gecamines, Zaire*. *Journal of Mineral Engineering* 2:521-541.
47. Gecamines (1996) *Annual Report 1996*. Gecamines, Lubumbashi.
48. Taylor CD, Schulz KJ, Doebrich JL, Orris GJ, Denning DG, et al. (2009) *Geology and nonfuel mineral deposits of Africa and the Middle East*: U.S. Geological Survey Open-File Report 2005-1294-E.
49. Carr DD, Herz N (1989) *Concise encyclopedia of Mineral Resources*. Pergamon Press, Oxford.
50. Dill HG (2010). *The Chessboard classification scheme of mineral deposits: Mineralogy and geology from aluminum to zirconium*. *Earth-Science Reviews* 100:1-420.
51. Rumbu R (2010) *Metallurgie Extractive des Non-Ferreux Pratiques Industrielles*. New Voices Publishing, Cape Town.
52. Intiomale MM (1982) *Le gisement Zn-Pb-Cu de Kipushi (Shaba-Zaire)*, Universite Catholique de Louvain, Louvain-La-Neuve.
53. Hallett AJH (1987) *Would commodity market stabilization agreements redistribute economic resources to developing countries?: The case of copper*. *Resources Policy* 13:103-112.