

RESEARCH ARTICLE

Gold price volatility, tax revenue, and employment: can Burkina Faso's adaptation strategy avoid the natural resource curse?

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Abstract

Since 2007, Burkina Faso's mining sector has grown quickly, with gold replacing cotton as the country's biggest export. The decline in gold prices since 2012, however, has hit the Burkina Faso economy hard. Using a static computable general equilibrium model, we assess whether – in a context of gold-price decline and volatility – an increase in the tax burden on the mining sector, as implemented by the government of Burkina Faso, is the appropriate way to avoid the natural resource curse. The results show that a tax policy based solely on increasing taxes on the gold sector brings only limited economic benefits, notably in terms of employment, and fails to significantly mitigate the effects of gold-price volatility.

Keywords: CGE; labor market; mining boom; resource curse; tax reform

1. Introduction

Since 2007, Burkina Faso has placed its hopes in the mining sector's strong potential for productive investment and economic growth, implementing a sector-wide mining policy intended to attract foreign investment. Although the country registered a satisfactory 6.7 per cent annual growth between 2011 and 2013, growth decelerated to 4 per cent in 2014, which led the International Monetary Fund (IMF) to place doubt in the capacity of the Burkina Faso government to meet poverty-reduction goals (IMF, 2014).

This economic underperformance can be explained largely by the 15 per cent drop in international gold prices at the end of 2012 and the consequent negative effects on public finances in terms of revenue and investments (World Bank, 2015). In 2016, the Burkina Faso government budget included a CFAF 239 billion deficit that remained high because of irreducible expenditures, such as the public wage bill and social spending (transportation, electricity, justice, health, and education).

According to the IMF (2014), the failure of the mining sector to meet poverty-reduction goals can also be traced to the lack of government capacity to convert

mining revenues into spending on development in support of other economic sectors and of job creation. Thus, is Burkina Faso already experiencing the resource curse?

Actually, despite an abundant literature on the so-called ‘resource curse’, there is no consensus on the direction of effects (positive or negative) of mining-sector development on economic growth and poverty reduction (Frankel, 2010; Mainguy, 2013; Lippert, 2014; Betz *et al.*, 2015). According to some authors, a mining boom may have positive or negative effects, depending, for example, on the quality of institutions (Caselli, 2006; van der Ploeg, 2011), and good management of revenue from natural resources. Moreover, van der Ploeg and Poelhekke (2009) provide convincing empirical evidence that the resource curse is mainly related to price volatility. They found that landlocked resource-rich countries whose financial systems are poorly developed, as is the case of Burkina Faso, suffer much more from volatility and are, therefore, more prone to experience the resource curse. Still, they argue that ‘to get round such natural resource curses, the government could resort to stabilization and saving policies and improve the efficiency of financial markets’ (van der Ploeg and Poelhekke, 2009: 736).

Given the uncertainty associated with international gold prices and projected levels of public revenue, the government of Burkina Faso was aware of the risk that public spending would grow faster than revenue. In a pessimistic scenario, the share of mining revenues in public revenue may decline and jeopardize public spending for development of the country. To address this budget gap, the 2003 mining code was revised in 2014 to improve collection of fiscal revenues from mining.

According to KPMG (2013), however, the revision of the mining code may reduce the net present value of mining projects by 56 per cent, assuming a gold price of US\$1,500 per ounce. Furthermore, the revision could also lead to an increase in the profitability threshold of mining projects from US\$1,425 per ounce to US\$1,465 per ounce. In terms of revenues drawn by investors, Burkina Faso risks becoming a less attractive destination for investment than other countries in the region such as Ghana or Mali (KPMG, 2013).

Most of the empirical studies that examine the impact of a natural-resources boom on developing countries rely on econometric methods (van der Ploeg, 2011; Badeeb *et al.*, 2017). Nonetheless, a recent trend recognizes the importance of general-equilibrium mechanisms in the empirical assessment of the impact of natural-resource utilization on the economies of developing countries. These studies, as a result, employ macroeconomic models, including computable general equilibrium (CGE) models, to capture these mechanisms appropriately (for example, Wiebelt *et al.*, 2011; Sangaré *et al.*, 2015). This paper adopts precisely such a CGE approach to analyze the tax-policy options that the government of Burkina Faso plans to implement in order to maintain public spending despite persistent declines and volatility in tax revenue from mining. To our knowledge, our analysis is the first of its kind for Burkina Faso.

Thus, our main objective is to assess whether, in a context of gold-price volatility, an increase in tax burden on the mining sector is the appropriate way to avoid or mitigate the resource curse in Burkina Faso. This research is politically and economically relevant, as it is consistent with the Burkinabe authorities’ actual vision of collecting and managing public resources, establishing a budget and fighting poverty. We find that a tax policy based solely on increasing taxes on the gold sector brings only limited economic benefits, notably in terms of employment, and significantly fails to mitigate the effects of gold-price volatility.

Section 2 presents a brief description of the mining sector in Burkina Faso. Section 3 provides a brief literature review on mineral-price volatility and the resource curse.

Section 4 describes the detailed methodology of the study and the data used. Section 5 presents the results of the study and section 6 concludes.

2. The Burkina Faso mining sector and its impact on the economy

Since 2007, Burkina Faso has been engaged in an externally-oriented development strategy based on exports of primary products such as gold. In consequence, gold mining has received special attention from the public authorities, notably with liberalization of the mining sector and tax-incentive provisions (2003 mining code), making Burkina Faso the fourth-largest producer of gold in Africa after South Africa, Ghana, and Mali (EITI, 2014). The gold sector in Burkina Faso is characterized by two subsectors: a modern, large-scale mining sector with high capital intensity; and a small-scale, more labor-intensive artisanal sector (MME, 2013). Reliable statistical data on the artisanal sector are unavailable, and our paper thus focuses on modern industrial mining.

Between 2000 and 2007, Burkina Faso's gold production was insignificant and averaged about 0.95 t per year; that figure rose to 36.4 t in 2015 (Tassimbedo *et al.*, 2013; MEF, 2016). Production gained momentum after 2008 with the discovery of new deposits, a 2003 mining code attractive to investors, and especially high international gold prices, which rose by 139 per cent, from US\$698 per ounce in 2007 to US\$1,669 per ounce in 2012 (IMF, 2014; INSEE, 2017). Because of the small scale of mining and the low content of deposits, the high price of fuel oil (35 per cent of production costs), and wage costs (KPMG, 2013), the production costs of industrial gold mining in Burkina Faso (US\$756 per ounce) are generally higher than the world average (US\$656 per ounce).

Despite these handicaps, gold has become the country's largest export, ahead of cotton. Although cotton constituted 80 per cent of exports, and gold production was insignificant in 2007, gold accounted for about 75 per cent of exports in 2012 (IMF, 2014, 2016). The mining subsector is now the pillar of the primary sector and is considered one of the most dynamic subsectors of the economy, accounting for 13 per cent of GDP.

Revenues¹ drawn from the gold sector by the government of Burkina Faso are mainly composed of dividends from its profit-sharing stake with private companies and public revenues from mining. Table 1 shows that Burkina Faso has lower mining taxation than Mali or Ghana.

The Burkina Faso state holds 10 per cent of shares (a direct stake in the capital of mining companies) in each mining firm, as per Article 18 of the 2003 and 2014 mining codes.

The 2014 revision of the mining code mostly involved:

- removal of the tax exemption on mining-company profits to bring the tax to 27.5 per cent;

¹The sources of state revenues are primarily tax revenues (taxes on income and profits, domestic taxes, and other taxes), non-tax revenues (land-surface taxes and proportional royalties), revenues from capital, and exceptional revenues including donations and loans. Royalties and rents for use of the state's public or private property are considered products of state domain. Revenues from capital are dividends paid out by private companies in which the state is a shareholder. They are considered dividends and similar revenues. See <http://www.vie-publique.fr/decouverte-institutions/finances-publiques/ressources-depenses-etat/ressources/quelles-sont-ressources-non-fiscales-etat.html> for more information.

Table 1. Mining taxes in Burkina Faso, Mali and Ghana and revision of Mining Code

Taxes	Burkina Faso			
	Current (%)	After code change (%)	Mali (%)	Ghana (%)
Mining royalty rate (ad valorem)	3–5	3–5	3	5
Tax on corporate profits	17.50	27.50	35	35
Tax on income from assets	6.50	12.50		10
Tax for local development (ad valorem)	0	1	0	
Government profit-sharing stake	10	10	10–20	8

Sources: KPMG (2013), Sisso *et al.* (2016).

- creation of a fund that collects 20 per cent of royalties charged by the government for mining and 1 per cent of the monthly turnover of mining companies toward local development plans;
- an increase in the tax on income from assets from 6.5 per cent to 12.5 per cent.

As mentioned earlier, the mining sector in Burkina Faso had been economically insignificant until recently, affecting the real economic activity of the country in a limited way. Since then, the contribution of mining to the real economy has been through tax revenue, spending associated with public revenues, and job creation. The gold sector has undergone industrial modernization over the last decade, thus creating permanent direct jobs, temporary direct jobs, and indirect jobs. Most of the indirect employment involves transportation, construction, and economic activities near mining sites, and accounts for about 0.16 per cent of all employment in the economy (EITI, 2014).

From 2007 to 2016, gold mining provided nearly CFAF 1,090 billion in budget revenue to the government of Burkina Faso. During the same period, revenues from export taxes on gold rose from CFAF 3.3 billion to more than CFAF 186 billion, for a contribution to total exports that went from 1 per cent in 2007 to 21 per cent in 2012 (EITI, 2016a, 2016b, 2017; CMB, 2017). Public revenues from mining rose faster than spending during that time. According to the IMF (2014), this low level of public spending was mostly attributable to the slow execution of investments, adjustments in public wage bill, and subsidies to support the cost of energy and public enterprises.

In recent years, the gold sector has been hit hard by the international decline in gold prices, leading to a 21 per cent drop in the value-added of gold in 2013 as opposed to an 11.1 per cent increase in 2012. At the end of 2015, the gold price reached the bottom of its downtrend (about US\$1,070 per ounce) and has remained stagnant since then (about US\$1,260 per ounce in June 2017), exhibiting high volatility, as figure 1 shows.

The price effect entirely explains the decline in production, considering that volume increased from thirty tons in 2012 to thirty-eight tons in 2016 (CMB, 2017). The share of gold in total export revenues went from 63 per cent in 2013 to 51 per cent in 2015. Public revenues from mining declined by 13 per cent, which led to a major decline in income taxes as a share of total revenue and an increase in the share of royalties. Aside from this decline in public revenue and employment directly caused by the gold sector, the decline in gold prices also led to a contraction in fiscal revenue and employment in other sectors of the economy.²

²Additional details regarding the connectedness between the mining sector and the rest of the economy are presented in Sisso *et al.* (2016).

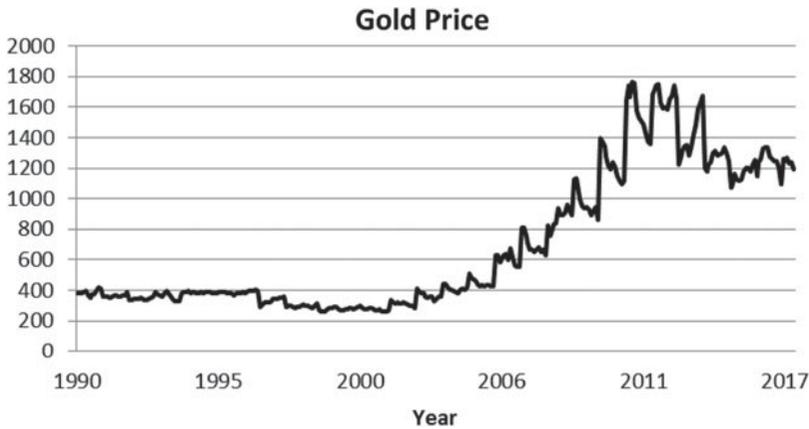


Figure 1. International gold price in US dollars per troy ounce.
Source: INSEE (2017).

Thus, the volatility of international gold price induces volatility of tax revenues, outputs, exports, etc., contributing to the conversion of what should have been a blessing (riches in gold) into a curse.

3. Literature review: price volatility, tax revenues, and resource curse

Many models have been developed to explain the inability of countries to turn natural-resource windfalls into economic growth. These notably include theories on international trade, impoverishing growth (Bhagwati, 1958), natural-resource dependence, and Dutch disease (Corden and Neary, 1982; Corden, 1984; van der Ploeg, 2011). Corden (1984) assumes that a small open economy has three sectors: the booming sector, the lagging sector (in which the market sector produces other tradable goods), and the non-market sector (here not being traded internationally), which includes services, construction, and transportation.

According to Corden (1984), the expansion of the booming sector can be summarized by two distinct effects: a *resource-allocation effect* (or *resource-movement effect*) and a *spending effect*. The spending effect assumes that a share of public revenues from mining is spent on the purchase of goods from the non-market sector. This leads to an increase in demand and in prices of non-market goods relative to tradable goods and, finally, to an appreciation of the real exchange rate. As a result, the production of non-market goods increases while the production of non-mining tradable goods declines.

Assuming full employment and a boom in the mining sector, the marginal product of labor increases in the booming sector. The effect of reallocating resources leads to a transfer of workers from the lagging sector and the non-market sector into the booming sector, which reduces production in the former two sectors. This is called the *direct de-industrialization effect*. In addition to the spending effect, the *resource-allocation effect* also creates more demand for non-market goods. The combination of these two effects leads to a transfer of workers from the lagging sector to the non-market goods sector, creating an *indirect de-industrialization effect* which complements the *direct de-industrialization effect*. Corden (1984) notes that the spending effect tends to increase non-market production, and the *resource-allocation effect* tends to reduce it. He observes

that the two effects reduce production and real remuneration to capital specific to the lagging sector. The lagging sector experiences a decline in production in all cases, while production in the non-market sector may be either higher or lower.

A number of empirical studies have attempted to test the validity of the concept of the resource curse, most of which rests on econometric methods (van der Ploeg, 2011; Badeeb *et al.*, 2017). Unlike econometric methods, CGE models account for the direct and indirect effects of a natural-resource boom on the entire economy. The few studies using CGE models tend to focus on specificities of the labor market and taxation (Ye, 1999; Levy, 2007; Lay *et al.*, 2008; Breisinger *et al.*, 2009; Wiebelt *et al.*, 2011; Robichaud *et al.*, 2014; Sangaré *et al.*, 2015; Ballesteros, 2016; Estrades *et al.*, 2016; Go *et al.*, 2016).

Sangaré *et al.* (2015), for example, analyze the impact of expansion of the uranium and petroleum sectors on the labor market in Niger. They show that an increase in the stock of capital in the uranium sector leads to an 11.7 per cent reduction in labor demand in the industrial sector. This reduction is due to the loss of competitiveness in the industrial sector, which causes a decline in demand for industrial products (−3.6 per cent), and to the reallocation of demand for labor into sectors that provide intermediate inputs to the uranium sector (construction and services in particular, in this case). The authors simulate a subsidy in the agricultural sector and in electricity and find growth in demand for labor, especially in the agricultural and industrial sectors. They show that mining and petroleum resources do not necessarily lead to the resource curse if the government implements appropriate policies in targeted sectors.

Indeed, for many African countries that have experienced booms in mining, the challenge lies in their governments' capacity to develop tax regimes that can best respond to the objectives they have established. Mobilization of fiscal revenues in these countries is limited by the predominance of the agricultural and informal sectors, the size of tax and customs exemptions and incentives, a weak capacity of the tax administration to collect revenues, and corruption (Moore, 1998, 2007). Sociopolitical shocks (civil wars), climate shocks (floods and droughts), and fluctuations in international prices of primary materials make the mobilization of tax revenues more difficult. Logically, 'boom' periods of export revenue from primary products lead to an increase in public levies through the combined effect of expansion of the fiscal space and the addition of significant non-tax revenues from the exploitation of primary products (petroleum, mining, and agricultural products). However, this logical effect can be thwarted by complex indirect effects.

Zavaleta (2003), for example, uses a static CGE model to analyze the impact of an increase in mining capital on the Bolivian economy. He finds that the Dutch disease (the resource curse) manifests through a major increase in exports from the mining sector and a significant decline in exports from traditional sectors linked to international trade. In a scenario in which capital is considered exogenous, the domestic currency appreciates and an increase in mining capital leads to a major reduction in tax revenues. The author suggests that this paradoxical result could be explained by the fact that the increase in exports in the mining sector leads to a major reduction in exports from other sectors and, thus, a decline in fiscal revenues in these sectors and in the economy as a whole.

Bornhorst *et al.* (2009), and Diarra (2012) also find a decline in mobilization of fiscal revenues in other sectors of the economy. Countries that both depend on rents received from natural resources and receive significant resources from exploitation of those resources are less likely to mobilize revenues from other sectors, considerably reducing their fiscal-mobilization efforts. Diarra (2012) advises Sub-Saharan African countries to adopt budget-smoothing policies by creating sovereign-wealth funds that invest excess revenues in shares of private companies or more generally in equity markets. Then,

in times of declining revenue, sovereign wealth-funds could take over and continue financing expenditures.

In sum, the literature shows that African countries that experience a mining boom can avoid the resource curse by implementing suitable economic and institutional policies. Revenues from natural resources should also be invested in human capital and in diversification of economic activities, particularly in rural areas. These investments should eliminate dependence on exports of mining products, absorb the diffusion of knowledge brought by foreign companies, and increase employment. Similar to other studies that have used a CGE model to evaluate the effects of natural-resource discoveries, our paper evaluates the impact of the decline in international gold prices and the effects of tax reforms on the gold sector. Note that previous applications of CGE models to the economy of Burkina Faso include responses to questions of trade liberalization (Zerbo *et al.*, 2010); public-education spending and poverty (Balma *et al.*, 2012); analysis of the effects of increasing public-education spending on monetary and caloric poverty of children (Gottschalk *et al.*, 2009; Cockburn *et al.*, 2016); and analysis of the 2007/2008 economic and financial crisis (Balma *et al.*, 2010). Thus, among CGE studies applied to Burkina Faso, none have yet addressed the question of the mining boom and the resource curse, which is the focus of our work.

4. Methodology and data

4.1 Methodology

Our CGE model is based upon the standard PEP-1.1 model of Decaluwé *et al.* (2013), calibrated using a 2012 social-accounting matrix (SAM) for Burkina Faso.

The model considers a three-level production function. At the first level, the production output of each sector is a combination of value-added and total intermediate consumption in fixed proportions. At this level, the model incorporates two aggregated inputs which are strictly complementary, following a Leontief-type production function. At the second level, the value-added of each sector is a combination of composite labor and composite capital with a constant elasticity of substitution (CES) function. The total intermediate consumption of each sector is a Leontief function. At the last level, composite labor combines two categories of labor (skilled and unskilled) according to a CES function.

Production goes either to the domestic market or to exports. A constant elasticity of transformation (CET)-type function makes it possible to account for imperfect substitutability between goods produced for different markets. This CET function captures both the heterogeneity of products sold by destination and the flexibility to switch from one market to the other. We also assume that foreign and domestic products are imperfect substitutes, following the usual Armington assumption.

The model includes four agents: households, the government, private companies, and the rest of the world. Households³ draw their income from the remuneration of production factors (labor and capital) and transfers. Households make consumption expenditures, pay direct taxes to the government, and save. The government collects taxes and makes expenditures (on consumption and investment, as well as transfers to households). Its revenues come from taxes, indirect taxes on domestic and international transactions, and payments from the rest of the world. Private companies receive a share

³Eight household types; see Sisso *et al.*, 2016.

of capital income, pay dividends to households and abroad, pay taxes on profits to the government, and save.

Because Burkina Faso is a small country, international prices of imports and exports are exogenous in this standard model. The exchange rate is the numéraire of the model. The current account balance, variation in stocks, and tax rates are exogenous. Market-clearing mechanisms apply for each market, except for the labor market.

Indeed, to be able to account for the specificities of the economy of Burkina Faso, we adapted the standard PEP-1.1 model to allow for unemployment. The labor market equilibrium can be expressed as follows:

$$LS_l = \sum_j LD_{l,j} + UN_l \times LS_l$$

where: LS_l : labor supply by work type l , $LD_{l,j}$: labor demand by work type l and sector j , UN_l : unemployment rate by labor type l .

Following Blanchflower and Oswald (1994), wages and the unemployment rate are linked through a wage curve. Note that, according to Blanchflower and Oswald (1994), studies on a number of countries show that the wage-unemployment curve is virtually identical from one country to the next and is stable over time with an elasticity generally in the range of -0.1 (Decaluwé *et al.*, 2011). Therefore, in the case of Burkina Faso, we use a value of -0.1 for the elasticity of unemployment. The wage curve is thus expressed as follows:

$$W_l = A_{wl} \times UN_l^{\sigma_l}$$

with: W_l : wage rate by category of labor; A_{wl} : scale parameter for the wage curve by labor category; σ_l : elasticity of wage curve by labor category.

4.2 Data

The SAM used was built by the World Bank in collaboration with the National Institute of Statistics and Demographics of Burkina Faso (INSD, 2015). We made a few changes to this SAM to account for the specificities of the study. As previously mentioned, labor comprises skilled and unskilled labor, whereas capital comprises mining capital, other capital, and land. Each sector uses capital and labor to produce goods and services. The accounts for activities and products (initially nineteen of each) were reduced to fifteen production sectors and fifteen products. Initially, there was only one account for private companies in the SAM, which we disaggregated into a gold-producing and a non-gold-producing company to capture their different income and spending structures.

Gross operating surplus (EBITDA) of the mining industry was used as the gold producer income which is then allocated in capital remuneration (90 per cent of EBITDA) and dividends paid to the government (10 per cent of EBITDA). More information regarding tax revenue in Burkina Faso (2012 SAM) can be found in Sisso *et al.* (2016).

Domestic public revenues (total, excluding exogenous transfers from the rest of the world) are mostly drawn from other sectors of the economy (62.4 per cent); the gold sector accounts for 11.1 per cent of government revenues. The gold sector also accounts for 62.2 per cent of taxes on production, 96 per cent of export taxes, and 33.3 per cent of direct taxes (direct taxes on gold producers and direct taxes on households working in the mining sector), however, which is important in terms of contribution from industry. In Burkina Faso, externally dependent public revenues (transfers received from abroad

Table 2. Upstream from gold production

Type of intermediate consumption	Share of total intermediate demand (%)
Products of other industrial activities	60.4
Electricity	3.0
Construction	0.2
Transport and communication services	7.0
Financial services	1.2
Other services	28.4
Total intermediate demand and mining extraction industry	100.0

Source: SAM, Sisso *et al.* (2016).

and taxes on international trade) account for about 40 per cent of revenues (2012 SAM), which makes the country vulnerable to external conditions.

The gold industry provides a small share of total employment in Burkina Faso (0.2 per cent). The only additional employment opportunities are the upstream and downstream interactions of this industry with the rest of the economy.

The upstream market refers to the market that supplies goods and services to the gold industry. In the case of Burkina Faso (2012 SAM), the intermediate demand of the gold industry is mostly for products from other industrial activities (60.4 per cent), other services (28.4 per cent), transportation and communications services (7.0 per cent), and electricity (3.0 per cent). A shock to the gold sector may have a considerable impact on employment in these sectors, and, in particular, on other industrial activities and other services (see table 2).

The downstream market here refers to the domestic demand for gold which represents only 1 per cent of gross production. Indeed, domestic demand is mostly from very small transformation industries (jewelry) with low capacity to create employment (although those industries account for 90 per cent of gold domestic demand). In terms of employment policy, the downstream market is not a major provider of employment at the local (or national) level.

5. Results

We present two simulation scenarios: a 15 per cent decline in world gold prices (Scenario S00) and a 15 per cent decline in world gold prices with tax reform (Scenario S01). The latter corresponds to the actual response of the government of Burkina Faso to observed gold-price volatility (2014 mining code).

According to the simulation results, a 15 per cent drop in international gold prices leads to a 0.74 per cent decline in real GDP. This contraction in real activity is due to a reduction in gold production (−3.4 per cent) and a 0.27 per cent decline in total exports. The decline in gold production leads to an increase in unemployment among both skilled (+17.8 per cent) and unskilled (+10.0 per cent) workers; this contributes to a 5.0 per cent reduction in household income. The negative shock produces a welfare loss for consumers because, despite the 3.0 per cent decline in the consumer price index, real consumption nevertheless falls by 2.4 per cent. Total government revenues decrease (−5.8 per cent) due to the decline in fiscal revenues (−7.6 per cent). Note that part of the government revenues (transfers from abroad) is exogenous, which explains why total

government revenues decrease less than fiscal revenues. Revenues from mining are hit especially hard (−16.0 per cent), leading to a contraction in public spending (−7.6 per cent). The decline in income of economic agents also causes a 5.4 per cent decline in total investment and a 5.8 per cent decline in demand for imported products.

Scenario S01 corresponds to the tax policy actually undertaken by the government of Burkina Faso in response to observed gold-price volatility, which was intended to counter the decline in mining-tax revenues following a 15 per cent decline in gold prices. More precisely, this scenario consists of applying a negative external shock (price decline) to the Burkina Faso economy combined with an internal shock from the increase in taxation on the mining sector (2014 mining code; see table 1).

We find a 0.72 per cent decline in real GDP due to 3.42 per cent drop in gold production and a 0.34 per cent decline in total exports. The 25 per cent decline in returns to gold capital leads to increases in unemployment among both skilled (+17.19 per cent) and unskilled (+9.98 per cent) workers, thus decreasing household income (−4.86 per cent). Again, this negative shock causes a welfare loss for consumers because, despite the 2.99 per cent decline in the consumption-price index, real consumption falls by 2.31 per cent. The contraction in public revenues from mining (−13.39 per cent) causes a 5.47 per cent drop in government revenues, which leads to a 7.22 per cent decline in public spending. The decline in income of economic agents causes a 5.67 per cent decline in total investment and a 5.78 per cent decline in imported products.

Column S01–S00 in table 3 shows the marginal impact of applying the new mining code to the economy in a context of falling gold prices. It represents the difference in macroeconomic aggregates in the scenario assuming a drop in international gold prices *versus* one that assumes a drop in gold prices with tax reform. We find that economic benefits from tax reform are nearly insignificant: no more than a 0.02 per cent increase in real GDP along with reduced investment in the economy (−0.03 per cent). It enables a limited 0.3 per cent increase in government revenues, with a 2.57 per cent increase in public revenues from mining, permitting an increase in public spending of 0.42 per cent. The 0.08 per cent decline in returns to capital in the gold sector improves the price competitiveness of other sectors, leading to an increase in labor demand in these other sectors and thus a reduction in unemployment among both unskilled (+0.03 per cent) and skilled (+0.58 per cent) workers.

To better understand the underlying mechanisms at play, we now turn to some sectoral results (see table 4). We focus on the cash-crops (export-oriented), construction, and gold sectors, keeping in mind that disaggregation of the model could provide more information (see (Sisso *et al.*, 2016)).

According to the 2012 SAM, the gold sector accounted for 0.2 per cent of employment. Therefore, the indirect effect of the gold-sector boom and bust on other sectors occurs mainly through intermediate consumption demand. Indirect job creation is generally linked upstream to production, especially through subcontracting with other industries, but there are also downstream effects. It should be noted that ‘other industrial activities’ include downstream sectors of activity (such as jewelry) and also upstream activities such as suppliers of equipment and consumables (chemical products and electricity, for example), construction activities, etc. These suppliers provide their services both to the gold sector and to other sectors in the economy. However, the links from the gold sector to the corresponding upstream and downstream sectors are very specific and thus weak.

The fall in international gold prices (S00) causes a 3.4 per cent decline in gold production, so intermediate demand and upstream demand fall, leading, *ceteris paribus*, to

Table 3. Impacts on macroeconomic variables

Variables	Price change S00	Tax reform	
		S01	S01-S00
Real GDP	-0.74	-0.72	0.02
Gold production	-3.39	-3.42	-0.03
Total investment	-5.44	-5.67	-0.23
Returns to other capital	-5.41	-5.35	0.06
Returns to gold mining capital	-24.93	-25.01	-0.08
Returns to land capital	-1.8	-1.76	0.04
Exports	-0.27	-0.34	-0.07
Imports	-5.76	-5.78	-0.02
Unemployment of unskilled labor	10.01	9.98	-0.03
Unemployment of skilled labor	17.77	17.19	-0.58
Income of other companies	-5.41	-5.35	0.06
Income of gold companies	-24.93	-25.01	-0.08
Government revenues	-5.77	-5.47	0.3
Mining tax revenues	-15.96	-13.39	2.57
Tax revenues, total	-7.19	-6.67	0.52
Public expenditures	-7.64	-7.22	0.42
Household income	-4.95	-4.86	0.09
Consumer price index	-3.03	-2.99	0.04
Real consumption	-2.37	-2.31	0.06

Source: Authors' simulations, percentage difference from the baseline, 2012 SAM.

a 3.27 per cent decline in labor demand across the economy. That leads to an approximately 20 per cent decline in direct employment (jobs with mining companies) and a 0.29 per cent increase in indirect employment. This result can be explained by the fact that the decline in international gold prices causes a fall in domestic gold prices, which benefits small-scale gold-transformation industries downstream (jewelry) and development of domestic industry, resulting in a 4.23 per cent increase in labor demand in other industrial activities.

The reduction in employment in the gold sector implies, in turn, a 2.4 per cent reduction in real wages for unskilled workers and 4.1 per cent for skilled workers. The increase in the profitability of other industrial sectors, combined with the decline in real wages, leads to a 1.26 per cent increase in labor demand in these sectors, with notable gains (4.8 per cent) in cash crops (cotton, sesame). In the services sector, however, we observe a 2.6 per cent decline in labor demand, with the largest effect in construction (-4 per cent) in response to the drop in total investment. Basically, we observe a reallocation effect of production resources from the gold sector to other sectors, including industrial sectors. The fall in gold prices thus has a *re-industrialization effect*.

Table 4. Impact on production and labor demand

	Price decline		Tax reform	
	S00		S01	
	XST	LDC	XST	LDC
Food products	-0.77	-0.66	-0.74	-0.61
Cash crops (export-oriented)	4.52	4.89	4.46	4.84
Livestock	-0.15	-2.68	-0.17	-2.66
Forestry and related services	-0.14	-2.82	-0.18	-2.81
Other extractive activities	1.37	0.16	1.03	-0.21
Gold extraction activities	-3.39	-19.90	-3.42	-20.06
Agro-industry	0.95	-0.47	0.97	-0.46
Textiles industry	7.02	5.80	6.91	5.64
Other industries	5.60	4.23	5.39	4.01
Electricity, gas, and water	0.41	-0.19	0.43	-0.20
Construction	-2.91	-4.09	-3.23	-4.44
Trade	-1.84	-3.24	-1.88	-3.31
Hotels and restaurants	-2.49	-2.77	-2.36	-2.65
Transport	1.84	0.78	1.80	0.71
Finance	7.63	6.79	7.49	6.63
Public administration	-3.35	-3.85	-3.02	-3.54
Other services	0.42	-0.69	0.36	-0.77
TOTAL	-0.39	-3.27	-0.40	-3.17

XST, Total aggregate output by industry; LDC, demand for composite labor.

Source: Authors' simulations, percentage difference from the baseline, 2012 SAM.

We also observe a decline in demand and prices of non-market goods through the spending effect, which leads to a transfer of workers from this sector (construction) to other industrial sectors. In the S01 scenario, however, increased taxes on the gold sector have no significant effect on the labor demand, compared to the S00 scenario. As expected, the volatility (drop) in gold prices has a negative effect on growth, in line with the resource curse literature findings (van der Ploeg and Poelhekke, 2009) that the tax policy fails to mitigate.

6. Conclusions and policy implications

The simulation results enable us to draw a few conclusions. As expected, the 15 per cent decline in the international export price of gold has a significant negative impact on GDP. Facing the volatility of gold price, the government of Burkina Faso chose to revise its mining code and to increase taxes on gold-mining companies. Such a policy only slightly increased government revenue, also producing a small decline in unemployment among qualified workers and to some reallocation of the economic activity, notably in favor of the cash-crops sector.

The policy implemented by the government of Burkina Faso, however, fails to mitigate the effects of gold-price volatility in any significant way. Because it is landlocked and because its financial systems are poorly developed, Burkina Faso is a good candidate for the resource curse as a consequence of the volatility of mineral prices (van der Ploeg and Poelhekke, 2009).

Future research should explore alternate ways to mitigate the effects of gold-price volatility. For example, the government could, through contracts added to current mining contracts, encourage collaboration between mining companies and domestic industries. Whether such an option would actually promote development of domestic industries, job creation, and an increase in tax revenue from mining, remains an open question. Another option worth exploring would be to assess whether using public revenues from mining to invest in the education sector and to encourage self-employment among youth would be an effective way to grow the economy in a more diversified manner.

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