Asian-driven Resource Booms in Africa: Rethinking the Impacts on Development

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ABSTRACT

Today's resource boom in Africa, driven by Asian economic growth, offers new opportunities for resource-rich African countries. Contrary to the experience of previous booms, however, most mining profits now accrue to foreign companies, leaving little room for governments to use revenues for pro-poor investments or to mitigate adverse distributional impacts. Taking Zambia as a case study, this paper shows that despite privatization, Dutch disease remains a valid concern and may hamper economic diversification, worsen income distribution, and undermine poverty reduction strategies. Mining royalties must, therefore, be increased and used to finance growth-inducing investments that encourage pro-poor economic diversification, else many African countries will remain caught in a resource trap.

Keywords: Dutch disease, resource booms, privatization, income distribution, Africa, Zambia

1. INTRODUCTION

Asian growth and the rise of China and India have led to significant changes in the structure of global trade and capital markets. Primary commodity prices have reached new highs, labor-intensive manufacturing is increasingly competitive, and Asia is a more important source of foreign direct investment. These changes in the world economy are occurring at a time when the deadline for the Millennium Development Goals is rapidly approaching and developing countries have been responding with national strategies drafted to achieve poverty-reducing growth. These economic changes are particularly important for Sub-Saharan Africa, which remains the world's poorest region, characterized by long-term divergence from economic trends in other developing regions. Many African countries rely on primary exports, yet their terms-of-trade have worsened over the last three decades (UNCTAD 2005a). By reversing the decline in commodity prices, Asia's expansion could signal new opportunities for economic growth in Africa. Indeed, resource-rich African countries have benefited from high commodity prices and accelerated economic growth from new mining investments (Goldstein et al. 2006; World Bank 2006a). What is uncertain, however, is whether the current resource boom will encourage sustainable and poverty-reducing growth in Africa.

Debate continues over the economic benefits of mineral and oil resources.[1] Traditional arguments suggest that resource booms limit structural diversification and technology accumulation, and generate rent-seeking and corruption that undermine effective spending of windfall gains (Gelb et al. 1988; Auty 1990). This is the well-known "Dutch disease" that has occurred in countries like Nigeria and Zambia, which have so far failed to translate resource abundance into equitable and sustainable growth. From this perspective, the current boom will be a curse for development as it will keep African countries locked in a resource-based development trap. An opposing view sees mining-led growth as one of the few opportunities that low-income African countries have to catch up with countries in other regions (Collier 2006; Page 2006; Goldstein et al. 2006). Historical evidence supports this counterclaim as well. Countries like Chile and Indonesia have demonstrated that mining-led growth can lead to more diversified economic growth if governments maintain macroeconomic stability and use the returns from natural resources to make appropriate investments (Temple 2003). From this more optimistic perspective, the current resource boom could help finance the investments needed to push Africa out of its development trap.

Many of the arguments surrounding resource booms and mining-led growth were informed by pre-structural adjustment conditions in Africa, when mines were state-owned and their profits (or losses) greatly influenced government revenues. However, privatization and the subsequent foreign ownership of

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[1] While Sachs and Warner (1999, 2001) find that countries with high resource-exports-to-GDP ratios experience lower growth rates, other research shows that resource abundance has a neutral or even positive effect on growth (Davis 1995; Lederman and Maloney 2003; Ding and Field 2005).

African mining could reduce some of the negative consequences of resource booms. Because mining profits are now remitted abroad, their negative exchange rate effects are offset. Conversely, difficulties in taxing foreign mining companies may prevent governments from turning natural resources into public investments that can offset the negative consequences of Dutch disease.

In this paper we consider the impact of resource booms on Africa, paying particular attention to how privatization may have altered the transmission channels determining the economic outcomes from resource booms. We first review the effects of the current boom and examine how the relationship between the mining and public sectors has been altered by privatization. We then use Zambia as a case study and develop a simple economywide model to examine the impact of the resource boom on economic structure and income distribution. We find that while privatization has significantly altered the effects of the resource boom on household incomes and government revenues, the boom still exacerbates resource competition and worsens diversification and income inequality. Thus, despite a positive growth-effect, the threat of Dutch disease remains, although its effects are less severe than they were before privatization. We also find that raising mining taxes from current low levels will provide African countries much needed revenues, but may exacerbate the negative effects of Dutch disease. African governments therefore find themselves caught in an increasingly challenging situation: to turn the current resource boom into an opportunity for accelerated economic development they must raise taxes to finance public spending, but in doing so they risk worsening its negative consequences.

2. THE CURRENT RESOURCE BOOM AND MINING-LED GROWTH IN AFRICA

Economic growth has recently accelerated in Africa. Sub-Saharan Africa grew at 2.4 percent during 1990-2002, but this rate doubled to 4.8 percent during 2002-05 (World Bank 2007). Half of this additional growth has been generated by mining and construction, whose annual growth rate increased from 1.8 percent to 8.1 percent. New mining growth has been driven by both a rise in world commodity prices and an expansion of foreign investment in the mining sector. In this section we examine both dimensions of the current resource boom and suggest that they may signal the beginning of a prolonged period of mining-led growth in Africa. We then consider how the fiscal implications of resource booms have been changed by the privatization of state-owned mines. These changes put into question whether concerns over Dutch disease and traditional policy prescriptions still apply to Africa today.

Rising Commodity Prices and Appreciating Exchange Rates

The resource boom that started in Africa in 2002 has been both rapid and pronounced. Commodity prices surged during 2002-06 due to strong global economic growth (see Figure 1). Much of the upward pressure on prices has been driven by Asia, with China alone accounting for half of the increase in world demand for aluminum, copper, and steel (IMF 2006a). This is a new peak period for metals and oil prices, both of which have doubled since 2000. Copper prices have risen particularly fast, tripling in less than five years from their lowest to their highest levels since the early 1970s. However, while metal and oil prices have risen sharply, agricultural and food prices have stagnated or only risen modestly. Most African countries still depend on primary exports and about 45 percent of Africa's population lives in mineral-based economies (Diao et al. 2007). As a result, the effects of the mineral price boom have been concentrated in Africa, where terms-of-trade improved by 30 percent during 1999-2004 compared with 8 percent for Latin America (UNCTAD 2005a). These regional differences arise not only due to higher primary commodity prices, but also due to a decline in manufacturing prices (caused primarily by rising Chinese manufacturing exports). Accordingly, resource-poor exporters of manufactured goods in East and South Asia have seen an 11 percent decline in their terms-of-trade over the same period.

Figure 1. Real global commodity prices, 1970-2006
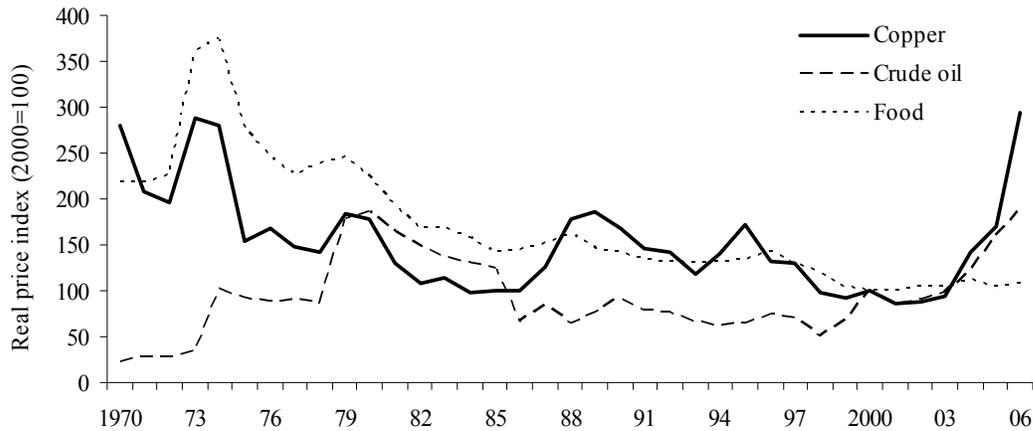
Rising mineral prices raise concerns about "Dutch disease," which refers to booming mining exports driving down non-mining exports, thus reducing export diversity and, possibly, long-run economic growth. This structural change arises because an appreciation of the real exchange rate resulting from higher prices for mining exports lowers the competitiveness of agricultural and manufacturing exports and draws resources away from non-mining export sectors towards non-traded goods and services. We can see this effect taking place after the recent resource boom. Mining exports from Sub-Saharan Africa have responded positively to improved mineral prices, more than doubling in real terms during 2000-03 (World Bank 2006a). These mining exports have in turn affected exchange rates. There is a strong correlation between recent changes in real exchange rates and the export orientation of African countries (see Figure 2). The real exchange rates of mineral and oil exporting countries appreciated during 2000-05, with Equatorial Guinea and Zambia appreciating the most. Conversely, countries with greater dependence on agricultural exports - such as Malawi, Rwanda, and Tanzania - experienced depreciations of their real exchange rates. This is consistent with the slower growth of world agricultural prices. Exporters of both mining and agricultural goods, such as Ghana and Côte d'Ivoire, have seen slight appreciations. These exchange rate movements suggest that mining exports could threaten non-mining production in mineral- and oil-based African economies. Furthermore, assuming non-mining traded goods have stronger "learning-by-doing" effects, mining growth might also result in economywide productivity losses that further reduce growth (Torvik 2001).

Figure 2. Mineral exports and real exchange rates in African countries
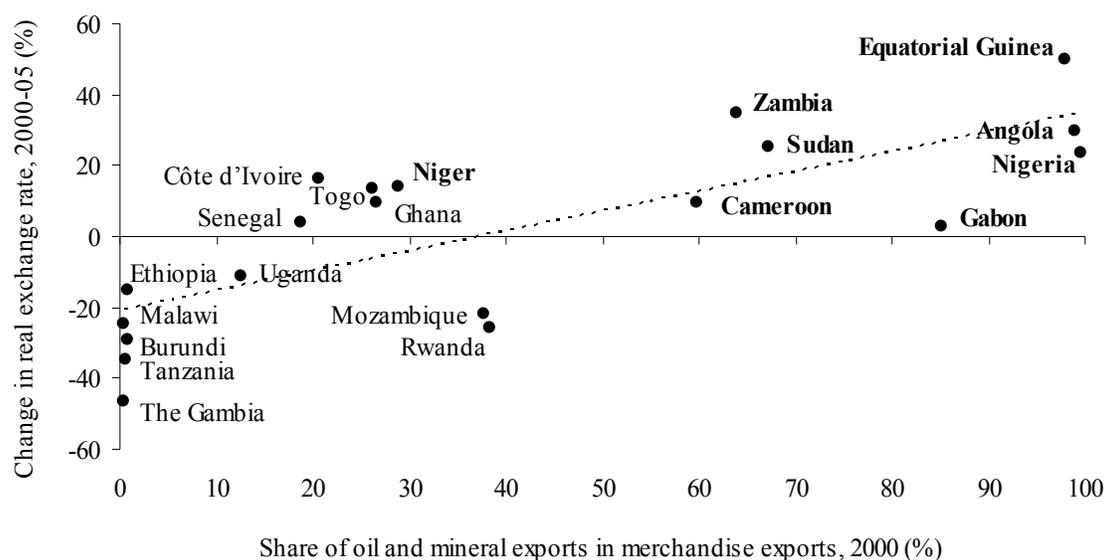
Source: Authors' calculations using World Bank (2007) and IMF (2007a).
Notes: Mineral- and oil-based countries shown in bold as classified by UNIDO (2004). Remaining low-income African countries excluded due to lack of data on real exchange rate movements.

Commodity prices are expected to fall from their current peaks. Resource booms during the early 1970s and late 1980s were followed by increased mining production and decelerations in world demand, with resulting declines in world prices (see Figure 1). Therefore, while metal and oil prices have reached new highs, supply-side adjustments, such as the catch-up of delayed investments and the easing of technical and energy constraints, should cause prices to fall (World Bank 2006b). However, historical evidence also suggests that the income elasticity for metals is high, and that demand for metals typically grows in parallel with average per capita incomes until the latter reach about $15,000-$20,000 (adjusted for purchasing power) (IMF 2006a). This is significantly higher than current per capita incomes in China and India. Thus, while price volatility will probably remain (Goldstein et al. 2006), it is reasonable to expect mining demand to increase further over the medium term. The current resource boom may therefore signal the beginning of a longer period of mining-led growth in many African countries, especially if high prices and demand continue to attract new foreign investments in the mining sector.

Expanding Foreign Investment in African Mining

Foreign direct investment (FDI) inflows to Africa have also risen rapidly since 2002. FDI doubled during 2004-05 alone, reaching the historic high of US$31 billion. This is equivalent to 15 percent of the region's total export earnings (UNCTAD 2006). The composition of FDI has also changed dramatically. Until 2000, Britain, France, Germany and the United States accounted for more than 70 percent of total

inflows. Recently, China, India, and South Africa have played a more important role, significantly contributing to the recent spike in FDI (UNCTAD 2005b). The sectoral composition of FDI has also become more concentrated in the mining sector. Foreign investment in Africa still focuses on primary sectors, but until 2000 it was balanced between agriculture and mining (see Table 1). Since 2000 almost three-quarters of FDI has been directed towards the mining sector. Mining investments grew by 22 percent during 2000-04, a rate more than twice that of the previous five years. Although oil sector investments still dominate the share of FDI, the mineral sector's share of FDI has grown more rapidly. By contrast, FDI to agriculture has decelerated during this period and the top ten FDI recipients in Africa are now mineral- and oil-based countries (UNCTAD 2005b). Thus, not only have rising world mineral prices affected African exports and exchange rates, but they have also attracted large foreign investments into the mining sector.

Table 1. Foreign direct investment (FDI) into low-income Sub-Saharan Africa

	Change in FDI inflows (%)		Share of FDI inflows (%)	
	1995-2000	2000-04	2000	2004
Low-income Sub-Saharan Africa	8.9	15.4	100.0	100.0
Agricultural sector	9.2	4.2	42.8	28.5
Oil and mineral sector	8.7	22.0	57.2	71.5
Oil	8.5	20.4	52.8	62.7
Mineral	11.1	37.1	4.4	8.8

Source: World Bank (2007) and UNCTAD (2005b).

FDI inflows include both the purchase of existing mines and "green field" investments in new mining ventures, reflecting the influence of new Asian companies as well as an expansion of current production capacities (UNCTAD 2005b). As with the rise of world mineral prices, the impact of a surge in mining investment is not clearly discernible. FDI inflows are usually associated with positive externalities, including technological spillovers, human capital formation from learning-by-doing, and crowding-in of domestic investments (Markusen and Venables 1999; Torvik 2001). However, there is consensus in the literature that the enclave structure of the mining sector limits these positive externalities (Auty 1993; Emerson 1982). Technology spillovers are undermined by the weak linkages of the mining sector to the rest of the economy, and learning-by-doing is constrained by the low labor-intensity of mining production. FDI inflows might also exacerbate the real appreciation of African exchange rates, at least in the short run. Thus, while FDI and rising world prices may encourage mining expansion, their overall impact on economic growth and poverty reduction depends on the sector's economywide growth linkages and on the externalities it generates for the non-mining sectors.

Remitted Mining Profits and Low Mining Taxes

Evidence from outside Africa shows how government revenues from mining royalties and taxes can finance the investments needed to translate mining booms into broad-based growth. Chile successfully transformed itself from a low-income copper-dependent economy into a middle-income country by using mining revenues to support structural diversification. Windfall revenues from resource booms during the 1970s were invested in agricultural export sectors and in upstream resource-based processing. This diversification strategy targeted investments in sectors with comparative advantage, and these sectors served as drivers of broader-based growth. Investments in education enabled people to participate in an increasingly diversified and skill-intensive growth process. Indonesia also used oil windfalls during the resource booms of the 1970s and 1980s to pursue a strategy of agriculture-led growth. Oil revenues financed investments in rural infrastructure, such as irrigation and roads, as well as in input subsidies for fertilizer and pesticides. Together, these investments improved the productivity of traditional crops and supported the country's Green Revolution (Gelb et al. 1988; Auty 1990; Rodrik 2003).[2]

The importance of sound governance and fiscal management in determining the success of mining-driven development is also evident from past failures. Nigeria demonstrates how inconsistent strategies in combination with Dutch disease and bad governance can lead to a resource curse. The government first used oil revenues to finance investments in non-traded sectors, such as transport and education, which undermined export diversification and entrenched oil dependence. The government then invested in heavy industries, such as steel and petrochemicals, in which Nigeria had little comparative advantage (Auty 1990). At the same time it reduced spending on agriculture and targeted it towards large-scale capital-intensive state farms (Gelb 1988). To date, poor governance and inappropriate strategies in Nigeria have undermined broad-based growth and the translation of oil revenues into positive social outcomes.[3]

The recommendations emerging from these often-cited case studies is that African governments can harness the benefits of the current resource boom if they are able to use mining revenues to invest in non-mining tradable sectors and avoid corruption and macroeconomic instability. However, these prescriptions reflect pre-privatization conditions. They assume that a resource boom will lead to Dutch

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[2] Apart from well-directed public investments, Chile and Indonesia maintained macroeconomic stability through exchange rate management (to prevent Dutch disease), capital flow controls (Chile), and protectionist trade policies (Indonesia). External factors also contributed to Indonesia's success, such as the timely occurrence of the Asian Green Revolution and a close geographic proximity to the emerging Asian tigers (Auty 1990; Gelb et al. 1988).

[3] A large body of evidence confirms the importance of governance during resource booms: (1) resource-deficient countries may use resources more efficiently (Auty 1997); (2) booms encourage rent-seeking that reduces allocative efficiency (Robinson et al. 2006); (3) governments may fail to accumulate foreign savings that can smooth price fluctuations during downswings (Auty 1991); (4) the public sector may be stretched during a boom leading to a preference for large-scale capital-intensive investments (Auty 1991); (5) windfall revenues often must be spent quickly and are thus determined by pre-shock priorities (Gelb et al. 1988); and (6) high temporary or permanent windfalls from resource booms can distract governments from investing in human capital (Gylafson 2001).

disease unless combined with countervailing public investments, and that booms generate additional revenues to finance these investments. Such conditions may not be as applicable to Africa today.

First, many state-owned mines in Africa have been sold to foreign companies. This means that much of the proceeds from mining exports will remain outside of the country in which the mining takes place. This remittance of profits reduces the demand for local currency, thus diminishing the threat of Dutch disease. This threat is further diminished by the low labor intensity of mining production and high import intensity of its intermediate and capital inputs. In the extreme case, where the full value of mining revenues remains outside the country and where there are no linkages to domestic non-mining sectors, there might be no effect on the exchange rate at all. Thus the privatization of state mines and their sale to foreign companies make mining even more of an enclave sector, and may significantly reduce the threat of Dutch disease.

Second, in order to attract foreign investment in their privatized mining sectors, African governments have often introduced investor-friendly tax systems. Consequently, mining tax rates are low in many African countries and the share of mining revenues in government income has declined, despite constant or increased production. In Guinea, for example, the contribution of mining revenues to total government income decreased from 73.7 percent in 1986 to 18.3 percent in 2004 (IMF 2006b). In Ghana, royalty rates declined from 6 to 3 percent of mining revenues during 1975-2006. Royalty rates in mineral-rich African countries today range between zero and 12 percent, with the lowest rates in Tanzania (0-5 percent) and Zambia (2 percent) (Otto et al. 2006). In addition, direct taxes on the mining sector (i.e., corporate taxes) have been reduced and other taxes, such as mineral duties, import duties, and foreign exchange taxes, have been abolished in many countries. At the same time, allowances to enable investors to recoup their capital expenditure have increased. Thus, even where mining tax systems are in place, tax collection has been limited by waived duties and tax exemptions. The current resource boom may, therefore, generate little additional revenue for African governments, thus undermining their ability to mitigate its potentially negative effects. As a consequence of low taxes and the current resource boom, many African governments are starting to reexamine their mining tax policies (Campell 2006).

The evidence presented in this section suggests that the current resource boom is indeed pronounced and, although world prices may decline, it is likely that growing Asian demand and new foreign investments in African mining will sustain high growth rates in the mining sector. There is already evidence of real exchange rate appreciation in mineral-rich African economies, justifying concerns over Dutch disease. However, experiences from outside the continent suggest that the negative impacts of resource booms can be avoided if African governments invest mining revenues appropriately. However, privatization has significantly altered the linkages between mining and public sectors. Foreign ownership of previously state-owned mines and the remittance of mining profits abroad may eliminate

any adverse appreciation of the exchange rate. Concerns over Dutch disease, therefore, may be exaggerated in post-privatization Africa. The privatization process in many African countries has also led to low mining taxes, which in turn limit the revenues that governments earn during resource booms. Thus, if the threat of Dutch disease does prove valid, African governments may not be able to finance the countervailing investments recommended by successful countries like Chile and Indonesia.

3. ASSESSING THE IMPACTS OF THE RESOURCE BOOM: A ZAMBIAN CASE STUDY

In this section we take Zambia as a case study in which to examine the impact of the current resource boom on economic structure and income distribution. We first describe the country's basic economic structure. We then develop a simple general equilibrium model, which is described briefly below and whose equations are provided in the Appendix. We use this model to (1) contrast the impact of rising world metal prices under pre- and post-privatization conditions; (2) examine the effects of new foreign investments in the mining sectors; and (3) assess the effects of the government raising mining taxes in response to the boom.

Zambia as a Case Study for Mineral-Rich African Countries

Zambia reflects the conditions and experiences of many mineral-rich African countries. First, Zambia has substantial mineral resources and its main export, copper, generates half its export earnings (see Table 2). Since 2002, copper has experienced strong price increases, rapid export growth, and high levels of FDI. It is expected that, even if copper prices were to fall, new investments would ensure continued export growth. Second, after several decades of state-ownership and economic decline, Zambia has privatized its copper mines. However, this occurred only after the government offered generous tax incentives to foreign companies, such that royalties are only 2 percent of copper revenues (IMF 2007b). Third, during the 1990s, when mining production and prices fell to their lowest levels in three decades, Zambia demonstrated its potential to diversify into non-mining sectors, especially into agricultural exports (Thurlow and Wobst 2006). However, agriculture still accounts for only 12.6 percent of export earnings, despite generating 20 percent of GDP. Fourth, two-thirds of Zambia's population lives in rural areas and depends on the agricultural sector for its income. Poverty is also widespread in urban areas. Finally, investment and private consumption are more dependent on imported manufactured goods in urban than in rural areas, although in both urban and rural areas significant shares of income are spent on food and agricultural goods.

Table 2. The structure of the Zambian economy, 2002

	Share of total (%)			Export intensity	Import penetration	Household demand	
	GDP	Exports	Imports			Rural	Urban
All sectors	100.0	100.0	100.0	13.7	16.6	100.0	100.0
Agriculture	20.0	12.6	3.5	9.7	3.9	35.8	20.3
Staples & livestock	17.6	1.4	3.1	1.2	4.0	35.8	20.3
Export crops	2.4	11.2	0.4	63.3	3.1	0.0	0.0
Mining	4.4	49.0	1.5	99.1	4.4	0.0	0.0
Manufacturing	19.3	21.2	87.5	8.8	37.8	41.3	50.9
Processed foods	10.8	4.8	7.1	5.0	9.3	30.7	37.7
Nonfood goods	8.5	16.4	80.4	18.0	51.7	10.5	13.2
Other industries	9.5	0.0	0.0	0.0	0.0	0.3	0.8
Private services	35.4	17.1	7.5	7.3	4.6	13.9	18.0
Public services	11.5	0.0	0.0	0.0	0.0	8.8	10.0

Source. Authors' calculations using the 2002 Zambia social accounting matrix (SAM).
Note: Export intensity is the share of domestic production that is exported; and import penetration is the share of domestic demand that is supplied by imports.

Modeling the Impact of Resource Booms

We develop a simple computable general equilibrium (CGE) model of Zambia to simulate the macroeconomic, structural, and distributional impacts of the resource boom. The model is calibrated to a 2002 social accounting matrix (SAM), which provides detailed information on the demand and supply components of ten economic sectors just prior to the resource boom. Agriculture is divided into staples and livestock and export crops (e.g. cotton). The industrial sector comprises food processing, light industry (e.g. textiles), heavy industry (e.g. machinery), and other industries (e.g. construction). Producers employ the four factors of production in the model, under the assumption of constant returns-to-scale and profit maximization. All sectors employ skilled and unskilled workers (with different intensities); workers are fully employed and migrate between sectors according to producer demand. Agricultural capital and land are specific to the two agricultural sectors. Nonagricultural capital is mobile across sectors, with the exception of mining capital, which is immobile, earning sector-specific profits. Factor incomes are distributed according to the endowments of households, which in turn are separated into expenditure quintiles and rural and urban areas. Households use incomes to purchase commodities so as to maximize utility. Mining revenues are taxed by the government according to a fixed royalty rate, and the remaining revenues are remitted abroad. The government generates additional revenues by levying sales taxes, import tariffs, and direct taxes. Recurrent expenditure is a fixed share of government revenues. Most goods and services are traded on international markets. We assume that Zambia's exchange rate adjusts in response to terms-of-trade shocks to maintain a fixed current account balance. Finally, private and public

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savings rates are fixed and combined with foreign inflows to determine the level of investment.[4] This static model is used to examine a number of exogenous shocks, including changes in world copper prices, foreign mining investment, and government mining tax rates. Changes in the model's variables after imposing these shocks are compared to initial or base values to determine the size and direction of impacts.

Increases in World Commodity Prices Pre- and Post-Privatization

As discussed in Section 2, the privatization of African mines may have changed the channels through which mining-driven terms-of-trade shocks affect government revenues and the rest of the economy. In this section we run two scenarios to examine the impact of rising world copper prices on the Zambian economy. In the first scenario we assume that all additional mining profits resulting from the increase in copper prices accrues to the government (Scenario 1). In the second scenario, the government maintains its low mining tax rate of 2 percent, such that almost all mining profits are remitted abroad (Scenario 2). Thus, these two scenarios broadly capture pre- and post-privatization conditions. The shock is the same in both scenarios: a 150 percent increase in world copper prices. This is similar to the price increase observed during 2003-2006 (see Figure 1).

We first consider price increases under pre-privatization conditions (Scenario 1). Here the model replicates a typical Dutch disease scenario resulting from improved terms-of-trade in an enclave export sector. The rise in world copper prices causes a substantial increase in the value of mining exports (see Table 3). This places pressure on the current account balance, which is held fixed, and causes the real exchange rate to appreciate, in this case by almost 20 percent. This appreciation reduces the cost of imports, whose share of GDP increases dramatically. Additional mining profits are captured by the government, such that mining royalties increase from 0.1 to 18.8 percent of GDP, which is around half of all government revenues. These revenues allow the government to increase public investment and recurrent expenditures. The latter is seen in the large increase in the share of the government sector in national GDP, which also rises dramatically (see Table 4). However, while the mining and public sectors benefit from additional profits and revenues, the appreciation of the real exchange rate hurts non-mining traded sectors. Agricultural exports and nonfood-related manufacturing are especially hurt by declining competitiveness and increased competition from cheaper imported goods. The production of food crops and processed foods also declines in real terms due to import competition, despite cheaper imported inputs, such as fertilizers.[5] Thus, despite the strong growth-effect of rising metal prices, there is a

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[4] A mathematical description is provided in the Appendix and the model is available on request from the authors.
[5] See Fynn and Haggblade (2006) for a study of the appreciation's effects on farm production costs and profits.

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narrowing of the economy into mining, public services, and other less-traded sectors - a typical outcome of a Dutch disease scenario.

Table 3. Changes in macroeconomic indicators under model scenarios

	Base value in 2002	Value after imposing shock			
		Pre-privatization price shock (Scenario 1)	Post-privatization price shock (Scenario 2)	Increased foreign investment (Scenario 3)	Increased mining taxes (Scenario 4)
Per capita GDP (US$)	329	396	336	357	374
World copper price (index)	1.00	2.50	2.50	2.50	2.50
Real exchange rate (index)	1.00	0.81	0.96	0.91	0.87
Consumer prices (index)	1.00	0.98	0.99	0.98	0.97
Government revenue /GDP (%)	20.0	39.9	20.7	21.3	26.2
Mining royalties	0.1	18.8	0.5	0.6	5.4
Other taxes	20.0	21.1	20.3	20.7	20.8
Investment/GDP (%)	24.4	27.1	24.8	26.9	27.4
Private savings	1.8	1.1	1.7	1.3	1.1
Foreign savings	19.7	20.2	20.1	22.5	22.5
Public savings	2.9	5.9	3.0	3.1	3.9
Exports/GDP (%)	31.3	53.0	60.0	79.4	77.5
Mining	15.4	44.7	45.5	67.2	66.8
Non-mining	16.0	8.3	14.5	12.2	10.6
Imports/GDP (%)	47.6	69.7	51.3	60.3	64.9
Food	4.9	11.6	5.7	7.1	8.5
Nonfood	42.8	58.1	45.7	53.3	56.4

Source: Results from the Zambia CGE model.

The positive terms-of-trade shock raises real incomes and private consumption (see Table 5). Per capita GDP increases substantially from US$329 to US$396, driven mostly by private consumption, which increases by 9 percent. However, this aggregate consumption measure hides changes in the distribution of incomes. Since urban workers can more readily migrate to new sectors of employment, it is urban households that benefit more from new jobs in the mining and public sectors. They also benefit from rising wages for skilled labor, which the mining and public sectors use more intensively. Thus, per capita expenditures rise for urban households, especially for those in the middle of the income distribution, because they have more skilled labor. By contrast, the decline in agriculture, especially in exports, hurts rural households because agriculture is an important income source for them. Rural households are less able to adapt to structural changes since land is their major asset and it cannot be used

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to take advantage of nonagricultural employment opportunities. As such, falling import prices drive down agricultural prices, which effectively lowers the returns to both land and lower-skilled labor. Because urban households are net consumers of food, they benefit more from cheaper imports and domestic goods. Ultimately, rising copper prices undermine structural diversification and increase income inequality, especially between rural and urban areas.

Table 4. Changes in production under model scenarios

	Base GDP share in 2002 (%)	GDP shares after imposing shock (%)			
		Pre-privatization price shock (Scenario 1)	Post-privatization price shock (Scenario 2)	Increased foreign investment (Scenario 3)	Increased mining taxes (Scenario 4)
All sectors	100.0	100.0	100.0	100.0	100.0
Agriculture	20.0	19.0	20.0	19.4	19.1
Staples & livestock	17.6	18.0	17.9	17.7	17.7
Export crops	2.4	1.0	2.1	1.7	1.4
Mining	4.4	5.1	5.1	7.6	7.6
Manufacturing	19.3	14.3	18.6	16.9	15.8
Processed foods	10.8	10.2	10.9	10.5	10.4
Nonfood goods	8.5	4.0	7.7	6.4	5.5
Other industries	9.5	11.3	9.5	9.5	10.0
Private services	35.4	31.1	35.2	35.0	33.9
Public services	11.5	19.2	11.5	11.6	13.6

Source: Results from the Zambia CGE model.

In the second scenario we again consider the impact of increasing world copper prices, although we now assume that almost all additional mining profits are remitted abroad. Accordingly, while mining royalties increase, they remain substantially below the levels achieved in the previous scenario (see Table 3). Since the additional foreign inflows generated by higher export revenues are offset by increased outflows of mining profits, the increase in copper prices no longer generates a substantial appreciation of the real exchange rate. However, the exchange rate effect is not entirely neutralized since remittances include only the returns generated on mining profits. While the mining sector is highly capital intensive, around 22 percent of the cost of production covers intermediate inputs and labor wages. The former is more import intensive and so some of these costs add to the outflows generated by the mining sector. However, all labor incomes, comprising around 6 percent of production costs, are likely to remain within the country. Thus, even if all mining profits were remitted and intermediate demand was for imports only, a small share of mining export earnings would still remain within Zambia and cause a modest appreciation of the real exchange rate.

The real appreciation again reduces the export competitiveness of agricultural exports, albeit to a lesser extent than in Scenario 1 (see Table 4). Food crops and livestock, however, are hurt more in this scenario than they are in Scenario 1, because urban incomes and demand no longer grow as rapidly (see Table 5). Per capita GDP only increases by 2 percent and household consumption by 0.4 percent, which is significantly lower than in the pre-privatization scenario. Much of this slower urban income growth arises from slower growth in the public sector, which no longer benefits from higher copper revenues. As a result, civil sector employment decreases as does the upward pressure on higher-skilled wages. Thus, despite the smaller exchange rate effect in the post-privatization scenario, there is still a significant decline in rural incomes at the lower end of the income distribution. Even after privatization, sufficient linkages remain between the mining sector and the rest of the economy to potentially undermine structural diversification and worsen income inequality.

Table 5. Changes in household consumption under model scenarios

	Per capita expenditure in 2002 (1000 kwacha)	Percentage change from base			
		Pre-privatization price shock (Scenario 1)	Post-privatization price shock (Scenario 2)	Increased foreign investment (Scenario 3)	Increased mining taxes (Scenario 4)
All households	295	9.0	0.4	2.4	4.5
Rural households	177	3.1	-0.5	0.2	1.1
First quintile	58	-6.4	-3.2	-5.0	-5.9
Second quintile	92	-3.9	-2.3	-3.4	-3.8
Third quintile	111	-0.1	-1.4	-1.6	-1.3
Fourth quintile	227	3.1	-0.5	0.2	1.1
Fifth quintile	392	7.0	0.5	2.2	3.8
Urban households	492	12.5	1.0	3.8	6.6
First quintile	141	9.4	0.2	2.3	4.5
Second quintile	206	13.8	1.5	4.6	7.7
Third quintile	348	15.0	1.9	5.4	8.6
Fourth quintile	483	14.1	1.5	4.7	7.7
Fifth quintile	1,226	11.3	0.6	3.0	5.7

Source: Results from the Zambia CGE model.

The model does not capture positive externalities arising from technology spillovers. However, this may not severely limit the applicability of the findings, because it is not clear if Africa's enclave mining sectors generate substantial spillovers. Africa's experience with state enterprises has been similar to that of Zambia, where state mining operations were plagued by inefficiency and rent-seeking. It is reasonable to expect that a return to state ownership will produce similar inefficiencies and

macroeconomic instability, which will limit positive externalities. Based on this assumption, the results suggest that even under the post-privatization conditions of privatized and foreign-owned mines, the threat of Dutch disease remains. Moreover, the current resource boom may not lead to the expansion of the urban economy, which in the past has bolstered demand for rural agricultural goods. Consequently, rural households are likely to find themselves facing negative consequences similar to those they have faced during earlier resource booms.

Increasing Foreign Mining Investments

In Scenarios 1 and 2 we only considered an increase in world copper prices. But foreign investments in both existing and new mines have increased substantially as well. While the rehabilitation of previously state-owned mines will improve the profitability of current mining, investments in new mines should generate additional jobs that may offset the negative outcomes of purely price-driven growth. In a third scenario we return to post-privatization conditions and impose on the model both the increase in world copper prices and an expansion of FDI in Zambia's mining sector. To capture the effects of new investments in the model, we assume that mining capital increases by 50 percent. This is similar to the increase in mining FDI for Zambia during 2003-2006.

Most of the new mining investment in Zambia will generate demand for imported rather than domestic goods. This implies that new FDI inflows will broadly be matched by capital outflows from imports. Thus, while increasing FDI in the model causes the share of foreign investment in GDP to rise, imported capital goods offset this capital inflow (see Table 3). FDI inflows therefore do not directly cause real exchange rate appreciation.[6] However, new capital does cause mining production and exports to increase substantially, more than it does in Scenario 2.[7] This again places pressure on the current account, causing a significant appreciation of the real exchange rate, which undermines the competitiveness of non-mining exports and encourages import competition in domestic markets.

Agriculture and manufacture are hurt by falling competitiveness, especially in the more export-intensive sectors, where demand for lower-skilled workers declines as a result (see Table 4). The high capital intensity of mining production means that it does not generate new jobs sufficient to offset those being lost in other sectors. Rising mining production does, however, generate demand for higher-skilled workers and average GDP per capita grows by 9 percent, which is substantially higher than in scenarios without additional FDI inflows. But urban households again benefit more than rural households (see

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[6] In the short-run there may be a real exchange rate appreciation if financial inflows precede imported capital goods. However, in the long-run these flows offset each other and all effects arise through changes in production and exports.

[7] Scenario 3 is equivalent to Scenario 2 but with the additional impact of increased foreign mining investment. To gauge the impact of mining FDI in isolation from price effects, we therefore compare the outcomes of Scenario 3 with those of Scenario 2 rather than with base values.

Table 5). Additional mining growth bolsters urban incomes and consumption, which grow more rapidly than in Scenario 2. Average rural incomes also rise, but this hides worsening inequality within rural areas. Rural households in the higher income quintiles benefit more from cheaper imported goods and from rising high-skilled wages, especially in the rural public sector.

The results from the model indicate that, despite encouraging economic growth and raising average incomes, higher world prices for metals undermine structural diversification and worsen income inequality. Privatization has reduced the severity of Dutch disease by limiting the exchange rate effect. However, this does not mitigate the negative consequences for lower-income rural households. Thus, resource booms in post-privatization Africa generate the same adverse effects on poor rural households, but lead to a more limited expansion of the public sector and thus smaller increases in urban incomes. Furthermore, while mining tax revenues do increase as a result of increased FDI, African governments are constrained in their ability to offset adverse distributional outcomes because they no longer capture a significant share of mining profits. It is not surprising that many African governments have begun negotiating increases in mining taxes.

Increasing Mining Taxes

There is mounting pressure on African governments to raise mining taxes. The previous scenario showed how households in Zambia will not benefit as greatly from the current resource boom as they have done in the past. This raises political pressure from an influential urban constituency that is only partly offset by cheaper imports for urban consumers. Urban constituents may advocate mining taxes as a means of financing public-sector wages and employment. In rural areas, agricultural exporters are also adversely affected by the resource boom. In Zambia, as elsewhere, agricultural exporters are often foreign companies that have taken advantage of improved post-privatization conditions. These large-scale producers can also place considerable pressure on the government, especially since poverty reduction in Zambia over the last two decades has been driven mostly by export agriculture. Rural constituents may favor mining taxes as a means of generating public investments in rural areas or subsidizing agricultural inputs. Finally, many development experts are recommending royalty and mining taxes as a means of harnessing some of the windfall gains in order to generate poverty-reducing growth (IMF 2006a). In a fourth scenario we extend Scenario 3 by including the additional impact of increasing mining royalty rates from 2 percent to 15 percent.[8] This is an ad hoc adjustment, broadly similar to mining royalties in Asia but higher than in Latin America (Otto et al. 2006).

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[8] Scenario 4 is same as Scenario 3 except that mining taxes are now increased to 10 percent. To gauge the impact of tax increases alone, we compare the results from Scenario 4 with those of Scenario 3 rather than with base values.

Raising mining taxes generates model results closer to the pre-privatization scenario. Additional mining revenues permit higher public investment and recurrent expenditures (see Table 3). Per capita GDP grows by 14 percent, which is only 6 percentage points below the growth generated under pre-privatization conditions. However, since a larger share of mining profits remains within Zambia, there is greater pressure on the real exchange rate, which appreciates further. This reduces the price of imports and the competitiveness of *both* non-mining and mining exports, which decline as a share of GDP. Again, export agriculture and manufacturing suffer under a more appreciated real exchange rate (see Table 4). There is also greater resource competition, especially for higher-skilled workers in the expanded public sector. This drives up skilled wages, thus raising urban incomes and consumption (see Table 5). Higher-income rural households benefit from higher skilled wages and cheaper imports, while low-income rural households consume less because of greater import competition for agricultural goods and falling low-skilled employment rates and wages.

The results show that increasing mining taxes raises average incomes, but may worsen income inequality. Although we assume in the model that the government uses mining taxes to finance recurrent expenditure and public investment, we do not fully capture the positive effects of this investment. While it is beyond the scope of this paper to determine the specific policies needed for Zambia to replicate the successful growth strategies of countries such as Chile or Indonesia, we do estimate the funds required to compensate rural households for the losses they incur as a result of the boom. This depends both on the level of available resources and the efficiency of their use. Here the model can provide a rough estimate of the required efficiency. First, we calculate the resources needed to compensate households whose incomes decline after the resource boom (i.e., the first three rural quintiles, see Table 5). The ratio of the value of transfers required to additional mining revenues collected is 0.047. This means that US$47 out of every US$1000 of mining royalties collected would have to be transferred to lower-income rural households to ensure Pareto neutrality. While this transfer efficiency seems relatively low, it does not prevent income inequality from rising. To ensure both Pareto and distributional neutrality, the government would require a transfer-to-royalty ratio of 0.695. This high level of efficiency demanded of the government reflects the difficulty of ensuring that the current resource boom benefits all sections of the population.

4. CONCLUSIONS

In reviewing the current resource boom we find that much of the rise in world mineral prices and foreign investments in Africa have been driven by Asian growth. This has caused real exchange rates to appreciate in mineral-rich African countries, raising concerns about Dutch disease. However, privatization has left many of Africa's previously state-owned mines in the hands of foreign companies, implying that mining profits are now more likely to be remitted abroad than added to government revenues. In this paper we have examined the impact of the resource boom on a typical resource-rich African country. We have asked whether the generous tax incentives offered to foreign mining companies have reduced the growth opportunities arising from resource booms, and conversely, whether privatization has reduced the negative consequences typically associated with resource booms in Sub-Saharan Africa.

We developed a simple CGE model of Zambia to contrast the growth and distributional impacts of rising world minerals prices before and after privatization. We find that most of the profits from rising copper prices now accrue to foreign companies. As such, per capita incomes grow by 2 percent, which is significantly below the 20 percent increase that would have been achieved prior to privatization. This is largely because urban households no longer benefit from high public-sector employment, which had previously been financed by mining tax revenues. By contrast, there is little change in expected outcomes for rural households, whose incomes are still undermined by falling agricultural export competitiveness and cheaper imported foods, and now also by lower urban demand for domestic agricultural goods.

New mining FDI raises per capita GDP, but it also reduces structural diversification and income equality, without generating substantial additional government revenues. The government has many incentives to increase mining taxes. We find, however, that although higher taxes on mining profits raises GDP significantly, it further undermines sectoral diversification and income distribution. Thus, while African governments should seek additional tax revenues from mining companies, these revenues must be directed towards investments that enhance productivity and the competitiveness of non-mineral sectors. Tax revenues can also be used to compensate poorer rural households, whose incomes are undermined by the resource boom. In the case of Zambia we estimate that 5 percent of mining royalties need to be transferred to prevent rural incomes from falling, while larger transfers are needed to mitigate rising income inequality.

The results suggest that privatization has indeed altered the context of resource booms and that it raises new challenges for African governments. While private ownership will undoubtedly bolster the previously-failing competitiveness of African mining, it will also transfer many of the benefits of resource booms into foreign hands. African governments must raise taxes to finance the investments needed to mitigate the adverse effects of the resource boom and direct their countries along a path of sustained and poverty-reducing growth.

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APPENDIX: MODEL EQUATIONS

Production function

$$QVA_a = \alpha_a^p \cdot \left(\sum_f \delta_{fa}^p \cdot QF_{fa}^{-\rho_a^p} \right)^{-\frac{1}{\rho_a^p}}$$

Factor demand

$$WF_f \cdot WD_{fa} = PVA_a \cdot QVA_a \cdot \sum_{f'} \left(\delta_a^p \cdot QF_{f'a}^{-\rho_a^p} \right)^{-1} \cdot \delta_{fa}^p \cdot QF_{fa}^{-\rho_a^p-1}$$

Value-added

$$QVA_a = QA_a \cdot \theta_a^p$$

First order condition

$$PA_{ac} = PX_c \cdot QX_c \cdot \left(\sum \delta_c^c \cdot QA_{ac}^{-\rho_c^c} \right)^{-1} \cdot \delta_c^c \cdot QA_{ac}^{-\rho_c^c-1}$$

Export supply

$$QX_c = \alpha_c^t \cdot \left(\delta_c^t \cdot QE_c^{\rho_c^t} + \left(1-\delta_c^t\right) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^q}}$$

First order condition

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PD_c} \cdot \frac{1-\delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t-1}}$$

Non-exports

$$QX_c = QD_c$$

Import demand

$$QQ_c = \alpha_c^q \cdot \left(\delta_c^q \cdot QM_c^{-\rho_c^q} + \left(1-\delta_c^q\right) \cdot QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}}$$

First order condition

$$\frac{QM_c}{QD_c} = \left(\frac{PD_c}{PM_c} \cdot \frac{\delta_c^q}{1-\delta_c^q} \right)^{\frac{1}{1+\rho_c^q}}$$

Non-imports

$$QQ_c = QD_c$$

Factor income

$$YF_f = \sum_a \left(WF_f \cdot WD_{fa} \cdot QF_{fa} \right)$$

Household Income

$$YH_h = \sum_f \left(\left(1-tf_f\right) \cdot YF_f \cdot \theta_{hf}^h \right)$$

Household expenditure

$$PQ_c \cdot QH_{ch} = \beta_{ch}^h \cdot \left(1-ty_h-msh_h\right) \cdot YH_h$$

Government income

$$YG = \sum_h ty_h \cdot YH_h + \sum_f tf_f \cdot YF_f + \sum_c tq_c \cdot PQ_c \cdot QQ_c + \sum_c tm_c \cdot pwm_c \cdot QM_c \cdot EXR$$

Government expenditure

$$YG \cdot \left(1-msg\right) = GADJ \cdot \sum_c PQ_c \cdot qg_c + \sum_h gh \cdot CPI$$

Factors

$$\sum_a QF_{fa} = QFS_f$$

Commodities

$$QQ_c = \sum_a QA_a \cdot \theta_{ca}^i + \sum_h QH_{ch} + qg_c \cdot GADJ + QI_c$$

Current account

$$\sum_c pwe_c \cdot QE_c + FSAV = \sum_c pwm_c \cdot QM_c + \left(\sum_f rm_f \cdot YF_f / EXR\right)$$

Savings-investment

$$PQ_c \cdot QI_c = \beta_c^i \cdot \left(\sum_h msh_h \cdot YH_h + YG \cdot msg + FSAV \cdot EXR \right)$$

Price index

$$\sum_c PQ_c \cdot \theta_c^w = cpi$$

gh	government transfer to household	rm_f	remitted income rate
msg	marginal propensity to save for government	tf_f	factor tax rate
msh_h	marginal propensity to save for households	tm_c	import tariff rate
pwe_c	export price (foreign currency)	tq_c	rate of sales tax
pwm_c	import price (foreign currency)	ty_h	personal income tax
$\overline{qg}_c$	base-year quantity of government demand	δ^p_{fa}	CES value-added function share parameter for factor f in activity a
α^p_a	efficiency parameter in production function	θ^p_a	value added share of gross output
α^q_c	Armington function shift parameter	θ_{ac}	yield of output c per unit of activity a
α^t_c	CET function shift parameter	θ^h_{hf}	household factor income share
β^i_c	investment demand share	ρ^p_a	CES production function exponent
β^h_{ch}	household consumption share	ρ^q_c	Armington function exponent
δ^p_a	CES activity function share parameter	ρ^t_c	CET function exponent
δ^q_c	Armington function share parameter	δ^c_c	share parameter for output aggregation function
δ^t_c	CET function share parameter	$\overline{QFS}_f$	quantity supplied of factor
$\overline{CPI}$	consumer price index	$\overline{WD}_{fa}$	wage distortion factor for factor f in activity a
$\overline{FSAV}$	foreign savings (FCU)	QH_{ch}	quantity consumed of commodity c by household h
$\overline{GADJ}$	government consumption adjustment factor	QI_c	quantity of investment demand for commodity
EXR	exchange rate (LCU per unit of FCU)	QM_c	quantity of imports of commodity
PA_a	activity price (unit gross revenue)	QQ_c	quantity of goods supplied to domestic market (composite supply)
PD_c	demand price for commodities	QVA_a	quantity of (aggregate) value-added
PE_c	export price (domestic currency)	QX_c	aggregated quantity of domestic output of commodity
PM_c	import price (domestic currency)	QA_a	quantity (level) of activity
PQ_c	composite commodity price	QD_c	quantity sold domestically of domestic output
PVA_a	value-added price (factor income per unit of activity)	WF_f	average price of factor
PX_c	aggregate producer price for commodity	YF_f	income of factor f
QE_c	quantity of exports	YG	government revenue
QF_{fa}	quantity demanded of factor f from activity a	YH_h	household income
PA_{ac}	Marginal cost of commodity c from activity a		

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