

**Vulnerability of Artisanal and
Small-Scale Mining to
Commodity Price Fluctuation**

**PAPER 2: Risk and vulnerability:
evidence from the artisanal and
small-scale mining sector**

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Summary

This paper concentrates on the vulnerability context in which miners live. As highlighted in paper one, ASM is overwhelmingly governed by subsistence mining practices which typically aim to maximise household welfare and minimise household risks. The nature of risks and the protective mechanisms available for them play an important role in the livelihood strategies' decision-making process of miners. In fact, examples show that it is the minimisation of risk rather than the maximisation of utility that determines the livelihood strategies and the mining methods used.

We suggest that the failure to identify and recognise the ASM sector according to context specific characteristics can lead to an increase in the risks that stem from unfriendly legal and policy frameworks. Because this study requires a global view of the sector, this paper broadly discusses the types of risk that affect the sector globally and some of the protective mechanisms used by miners. This is intended to provide a better understanding of the drivers of the ASM sector that will conclude in policy implications regarding policies aimed towards stabilising the incomes of those involved.

We establish a link between poverty and vulnerability in the context of ASM and adopt a definition of vulnerability that focuses on negative consumption variability as a consequence of negative shocks. The paper reviews the most common forms of social risk protection mechanisms used by the poor and analyses some of the most significant sources of shock that affect the sector including changes in yield, health, weather, and government policies, and also economic and market risks such as a changes in prices, interest rates and exchange rates. When the risk is idiosyncratic (for example, accidents, low yield or the loss of waged employment), the effect on consumption smoothing can be prevented or mitigated by a series of protective mechanisms including income-based strategies, informal insurance and self insurance.

However, the bottom line is that risks come from many different sources and are highly correlated and the heterogeneity of risks therefore requires a similarly heterogeneous response. We assess the policy implications for the design of holistic policies directed to reduce vulnerability within the sector.

Although not conclusive, our analysis leads us to believe that commodity price risk might not be the most important source of risk for the ASM sector. Certainly, unexpected low yield levels can determine a loss even with favourable prices. Therefore, when considering price stabilisation mechanisms, the full range of risks must be taken into account. From the perspective of a highly vulnerable activity, price vulnerability must be further studied to determine not only its effects, but the role of price stabilisation mechanisms as protective measures against all other risks.

Formalisation of the industry may be viewed as one way to assist miners in breaking out of subsistence mining and the poverty trap. However, we find that in the case of formalisation initiatives, the elimination of bureaucratic barriers alone are not enough to spring the sector out of poverty. Formalisation comes with obligations and unless all other risks and their effects are dealt with, these obligations will increase the cost of staying formal thus creating incentives to return to informality. Initiatives that seek to engage with the informal sector must therefore, take all other risks into account and consider them as crucial to their strategy. In other words, a strong and reliable safety net must be in place first; this can then be tightened to create a springboard.

The paper concludes that policies should focus on consumption rather than income smoothing in order to reduce the vulnerability of the poor and provide incentives for less riskier and more profitable behaviour.

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1 Introduction

Over 13 million people depend directly on the artisanal and small-scale mining sector to survive. The ILO estimates that this figure surpasses 100 million when those indirectly related to it are considered. Artisanal and small-scale miners are subject to a series of risks that jeopardise their lives and the sustainability of their income generating capacity. These risks are related to the same factors that make the activity attractive and, in few cases, rewarding. According to the MMDS report on Artisanal and Small-scale Mining (ASM) in Southern Africa (2001), in Tanzania, 'the nature and extent of the growth' of the sector 'is influenced by [the] social, political and economic structure and [the] geological setting of the country' (p.65). Poverty, the absence of formal employment or income sources, the lack of political participation and the existence of mineral deposits and the strong social capital networks related to the ASM sector combine to make this activity a highly attractive option among the urban and rural poor.

Little is understood, however, about this activity that attracts and accounts for the lives and deaths of so many people in the world; including many of the most vulnerable. In this paper we concentrate on an aspect of the ASM sector that can be identified in the Sustainable Livelihoods framework as the vulnerability context, and we discuss the risks that the miners and those involved in related activities face.

Why risks? We have two reasons for addressing risks in this paper. The first is a pragmatic one. The overall objective of this study is to determine the effects that macroeconomic risks have on the ASM sector. However, in order to properly assess it we need to put it into some kind of perspective: is it the most important risk? How does it relate to other risks? Therefore, we present this initial exercise (certainly not conclusive) to map the risks that affect the ASM sector.

The second reason is that ASM is overwhelmingly governed by subsistence mining practices. Subsistence miners, like farmers, have two main objectives: maximising household welfare and minimising household risks. The nature of risks and the protective mechanisms available to them play an important role in the livelihood strategies' decision making process of miners. In fact, examples show that it is the minimisation of risk rather than the maximisation of utility what determines the livelihood strategies and the mining methods used.

Many assumptions are made about the risks that miners face and the protective strategies they choose. Also, many assumptions are made about the reasons why they choose particular mining methods and livelihood strategies. These assumptions stem from the (understandable) desire to model the sector within a common framework; unfortunately, however, this framework is based too heavily on the formal and large-scale mining sector. A quick review of the literature, however, suggests that few assumptions can be justified. Maybe only that the ASM sector is largely made of informal miners, who engage in subsistence mining activities, that are, themselves, often seasonal and part of more complex diversified livelihoods, but that are the backbone for the subsistence of a highly vulnerable population in the developing world.

Generalisations about methods used, size of mining plots and investment capacity are difficult to make and policies based on such generalisations may even increase the vulnerability of the sector. In this paper we suggest that the failure to identify and recognise the ASM sector according to context specific characteristics can lead to an increase in the risks that stem from unfriendly legal and policy frameworks. A review of the literature does, however, suggest another assumption which might be justified: the risks that ASM miners face are, although different in magnitude, similar across the

developing world. Because this study requires a global view of the sector, we will not deal with the description and analysis of specific risks and their effects on the miners and the sector; rather we will broadly discuss the types of risk that affect the sector globally, some of the protective mechanisms used by miners and their effects on their level of vulnerability.

This will provide a better understanding of the drivers of the ASM sector and will help visualise the nature of the policies which might help smooth the consumption levels of those involved. The review of the sector and the associated risks suggests that ASM mining is a livelihood strategy affected by many related risks. Unfortunately these relationships are often complex. The reduction of health risks due to mercury exposure through the introduction of retorts can, for example, increase risk of violence and theft: thieves learn of gold mining activity through the noise of the retorts. Hence an important policy implication is that any initiative to reduce the vulnerability needs to address all the risks and needs of the sector; addressing one alone might increase vulnerability.

This paper is structured in four parts. The next section will provide a brief outline of the sector which we have reclassified according to the observable modes of production. In the second section we present the literature surrounding poverty and vulnerability. We establish a link between the two and adopt a definition of vulnerability as negative consumption variability as a consequence of negative shocks. This section also reviews the most common forms of social risk protection mechanisms used by the poor. In the following section we provide an analytical review of some of the most significant sources of risk that affect the sector. Finally, we put forward some policy implications for the design of holistic policies directed to reduce vulnerability within the sector.

2 A brief outline of the sector

In this paper we consider a new classification of the artisanal and small-scale mining sector. We set aside definitions that use size and level of mechanisation and focus on one that is based on those who participate in the activity. The ASM sector can then be classified in terms of three forms of production: subsistence, petty commodity and small-scale capitalism. In this brief section we present some of the basic characteristics of each sub-sector (for a detailed description see the companion paper).

Subsistence mining is defined as mining by consumer/producer household units (as individuals or organised groups) that mine with the objective of maximising utility and minimising risk. There is no division between capital and labour in subsistence mining activities or among household and mining resources. Access to formal markets, rights and services is limited and they lack bargaining power because of the necessity of satisfying their basic needs. As a consequence, they are unable to accumulate capital and remain vulnerable to shocks and market developments against which they have little formal protection.

On the other side of the spectrum lie the small-scale capitalist miners. These operations are organised and formal and behave as firms, maximising profit subject to production costs. They have access to markets, services and rights and enjoy a more bargaining power in market exchanges, which enables them to protect themselves against risk. As a consequence they are able to accumulate capital and invest in the mining cycle.

There is, however a middle ground where the distinction between the two classes of mining is less clear. A proportion of seemingly subsistence miners do accumulate capital and small-scale mining firms are made up of small groups or individual miners behaving more as peasants than capitalists. This middle ground, in which access to markets, services and rights is still limited but at least possible, and more complex labour relations

take place (beyond the household unit), can be described in terms of 'petty commodity' production.

This new classification shifts the focus away from external characteristics of the sector and centres on the people involved in it. It describes the way they employ their resources and respond to changes in their living environment. Hence, the question of risk and vulnerability becomes relevant: what is it that affects artisanal and small-scale miners?

3 Risk and poverty

3.1 The poverty trap

Vulnerability has a significant impact on poverty (Morduch, 1994; 2002). In India, for instance, Morduch shows that the effect of positive unexpected changes in weather and prices has a significant and greater effect on reducing the probability of entering poverty than an increase in the number of earners in the household. Hence reducing unexpected and undesired shocks can help reduce the incidence of stochastic or transitory poverty. In this section we will present a review of the literature linking poverty and risk. We begin with a view of poverty as defined by behaviour of the poor towards risk and their own perceptions of vulnerability. We then discuss the concept of vulnerability and some of the strategies that the poor use to protect themselves from risk. When relating this approach to the situation observed in the artisanal and small-scale mining sector, it is possible to identify many exceptions and possible inconsistencies, which seems evidence of a highly heterogeneous sector, which is difficult to model.

With respect to risk, it is possible to identify two types of poverty (Banerjee, 2000). One type of poverty is defined as desperation and the other as poverty as vulnerability. In the first group the poor have so little to lose that they are willing to take risks. Because they have so little, however, they are unable to access credit and so smooth consumption or engage in investment. Hence they remain poor. The vulnerable poor, on the other hand, are unwilling to take any risks or invest because they consider themselves too vulnerable and are risk averse. As a consequence they remain poor, too. Both are then faced by a poverty trap.

Our analysis of miners suggests that they can be seen to be risk-takers. Miners are aware of the high risks related to the activity and the livelihood (Heemskerk 2001; Heemskerk 2003). Nonetheless, they engage in them in exchange for higher returns. Hence the view of poverty as desperation suits them. From the description of the sector above, ASM miners are not well endowed. They do not have the productive assets or the access to the markets, services and rights that would allow them to be successful in alternative, less risky, activities. They have few household assets by any definition of poverty, and one could expect them to remain scarce. This is because they have to be highly mobile, cannot access to high return, low risk activities and do not have the capacity to accumulate assets during prolonged periods of relative stability due to their high vulnerability to many risks. Unable to access fair credit lines (formal or informal) to invest in productive assets, they remain at a subsistence level.

When it comes to change, however, subsistence miners appear to behave in a way more consistent with poverty than with vulnerability. They are reluctant to introduce new technologies or methods and are well aware of all the risks to which they are exposed. Even with higher wages or incomes than other sectors, miners invest a great deal of effort and resources in coping with risks and are therefore unwilling to take on new ones. As a consequence, they remain at a subsistence level.

In both cases, poor households are faced with a poverty trap. Most important, though, is that even if they aim to protect themselves from risk, it is very likely that they will remain trapped. Jonathan Murdoch's work on poverty and vulnerability (2002; 1994) considers two alternatives when it is not possible to access formal insurance arrangements: specialisation in safe activities and depletion of productive assets. In the first, the poor allocate a share of their resources to absolutely safe activities; foregoing any expected profits from alternative ones. Faced with risky but profitable opportunities, the poor will ignore them if they do not have access to consumption credit – even if production credit is available. Hence even if shocks are temporal, this behaviour is persistent and the poor show an unwillingness to take larger risks. This is consistent with poverty as vulnerability.

The second strategy is the depletion of productive assets to protect current consumption levels. If a shock is idiosyncratic and asset markets are active, this could be a good strategy to cope with risk¹. When these shocks are correlated, however, all households would aim to sell their assets simultaneously drastically reducing their exchange entitlements and increasing their vulnerability and poverty. (And even in the case of idiosyncratic shock, by depleting their productive assets, households threaten their future income generating capacity.) Idiosyncratic shocks are not rare, but evidence shows that few are purely idiosyncratic or correlated (Dercon 2002). Nonetheless, this strategy is widely observed and explains, for instance, the long process of famine that becomes visible when the entitlements of large populations are depleted (De Waal 1997; Crow 2000; Devereaux 2000; Dercon 2002). This alternative is more consistent with the view of poverty as desperation.

Again, both suggest measuring vulnerability in terms of consumption variability and that the goal of the poor is to smooth consumption over time. And in both cases, vulnerability plays a significant role in deepening and extending their poverty. In conclusion, poverty is clearly affected by vulnerability. On the one hand, the behaviour of the poor is dependent on their own perception of their vulnerability; while on the other, their actions to protect themselves are constrained by their limited access to markets and negative shocks that stem from their vulnerable situation. These strategies also show that a key objective of the poor is to reduce consumption variability.

3.2 Vulnerability as consumption variability

Therefore, we argue that vulnerability is an important factor affecting the decisions of the poor in the case of miners, and that vulnerability can be measured in terms of variations in consumption. In this subsection, we will explore this last assumption. The literature on vulnerability offers many approaches to study and measure it. Kamanou and Morduch (2002) review such approaches including vulnerability in terms of consumption variability, change in poverty status, ability to cope with shocks and asset holdings (while their study is concerned with the development of a methodology to measure vulnerability and hence they assess each approach's methodological plausibility, we are concerned with the understanding of vulnerability and its relation to poverty and livelihood strategies).

3.3 Vulnerability as variations of consumption

Empirical evidence from households in Cote d'Ivoire shows that the standard deviations of changes in consumption are lower than for income. This indicates, according to

¹ Idiosyncratic risk refers to those that affect individual households or sectors. For instance, illnesses in one household, the loss of wage labour, etc. Correlated, common or covariate risk, on the other hand, refers to those that affect many or all households and sectors. For instance, drought, HIV/AIDS, war, etc.

Kamanou and Morduch, that households are more inclined towards smoothing consumption levels that income. More important still is that consumption smoothing is stronger among poorer households than richer ones; hence this is a significant desired outcome among the poor. A methodological limitation of this approach is that vulnerability is not simply about changes but about negative changes in consumption.

Dercon and Krishman (2000) measure vulnerability in terms of the risk of falling into poverty (a negative change in consumption). They find that the vulnerable population in rural Ethiopia exceeds the one measured by classic poverty lines by about 40-70%. This means that a significant proportion of rural Ethiopians could, as the result of a negative shock, almost immediately become poor. Other studies, such as by Jalan and Ravallion (1999) and Morduch (1994), show that both the poor and the non-poor can be described in structural and stochastic terms. The structurally non-poor, for example, belong to the population that remains above the poverty line through good fortune and the effects of a good income period. These would be more vulnerable than the structurally non-poor. And a similar view can be used to describe the poor that are more likely to fall deeper into poverty. Vulnerability is not, however, static. Individuals are vulnerable not only because of the state they are in with respect to an arbitrary (and questionable) poverty line but from their ability to respond or react to shocks.

Dercon (2002), Morduch (2000) and Amin et al (1999) among others, widely discuss the informal insurance and coping mechanisms of the poor. These imply that the occurrence of a shock does not necessarily result in a fall in consumption. The ability to cope with such an event is important. Amin et al, for Bangladesh, consider household vulnerability in terms of the extent to which income shocks translate into consumption shocks. They discover that vulnerability is a function of the pattern of possible shocks (in terms of losses and needs), the strength of coping mechanisms and structural and behavioural consequences of a decline in consumption (do they become persistent shortfalls and lead to poverty traps?). The approach describes two extremes: One in which households have strong coping mechanisms and face high risk and others with few coping mechanisms but face low risk. The policy implications of each are significantly different. In the former, it is better to attempt to reduce income vulnerability while in the latter it is more desirable to strengthen coping mechanisms. However, it is not clear which one is more vulnerable. This is important in the case of mining where miners and their households face high risks with few and weak coping mechanisms.

An alternative way of measuring vulnerability is in terms of their asset holdings. This is supported by the fact that asset accumulation is a very common coping strategy and households work hard in acquiring and accumulating certain assets. Also because, risks affect individuals by means of the impact they have on their assets (we consider the set of assets used in the sustainable livelihoods literature (Ellis, 2000; Carney, 2002; Dorward, 2003; Mendizabal, 2003; Scoones, 1998; Whiteside, 2002)). This approach, discussed by Dercon (2002) and Kamanou and Morduch (2002), proposes that households accumulate assets in good periods to smooth their consumption in bad periods. Dercon suggests that asset accumulation is a form of self insurance which, according to Deaton (1991), does not reach significant levels due, mostly, to impatience. The theory and analysis of risks below would support an alternative view that low levels of asset or capital accumulation are the result of participating in low return activities and the great number of risk sources and shocks that the poor (in our case, miners) have to face. Ideally, the more assets an individual or household can accumulate, the less vulnerable it will be. This only holds for idiosyncratic shocks, however, and seems less true for correlated or common shocks such as climatic changes or broad macro-economic shocks, which affect the entire sector.

An important policy implication is that it might be more effective to provide insurance and credit for consumption than for production. If the poor are given the security of a minimum level permanent consumption, they might be inclined to take more risks in

more profitable activities; thus, possibly, escaping the poverty trap. This could be done through formal insurance mechanisms, consumption credits, control or policies towards improving asset markets, and providing basic goods and services. The literature also suggests that policy should engage with the mechanisms that transfer income shocks into consumption shocks; and aim to provide stronger preventive, mitigation and coping strategies (Vasquez, 2001).

In conclusion, we suggest that households are more vulnerable when they are faced by a higher risk of negative shocks against which they have little or no protection and that will have significant effects on their current and future consumption levels. Protection from risk can come from various sources and behaviours. The review of vulnerability approaches suggests three main strategies based on income, self insurance and informal insurance.

3.4 Measures to protect against risk

Income based strategies aim to smooth income as a means to reduce consumption variability. The approach to vulnerability taken by Amin et al is consistent with this view. Three main strategies can be identified in this category: participating in safe activities, diversification of income sources and labour supply adjustments (Dercon, 2002). The first has been described above (from Morduch): households allocate a significant share of their resources into one safe activity, even if it is not so profitable, to guarantee a fairly constant source and level of income.

The second describes an entirely different behaviour: households allocate their resources in different income sources to spread risk among them and smooth income. This strategy is widely observed in developing countries. The literature on rural non-farm employment (Reardon, 2001; Escobal, 2001), for instance, reports that rural households obtain about 50% (and in some cases more) of their income from non-agricultural activities. Diversification is not, however, always a successful income smoothing strategy. Dercon (2002) argues that, in fact, diversification is an expensive strategy for the poor since it requires more and different resources (household members or individuals have to develop different skills, use different tools, and even migrate). Collier and Gunning (1999) add that because the poor are not able to accumulate enough resources, their diversified income source portfolio is made up of low return activities. The consequence is a persistent and increasing poverty.

Finally, other strategies include the use of 'reserve labour' within the household. Kochar (1995) notes that labour adjustments such as the introduction of children into the labour force or into household productive activities are common strategies among the poor. The effects of these adjustments, however, can have undesirable consequences which persist long after the shock has dissipated. In mining, for instance, participation of women and children in mining activities can result in low human capital accumulation (children may become ill and are taken out of school) and reduces future labour productivity.

Income based strategies are very common in the ASM sector. Mining is commonly a seasonal activity and mining villages often involve highly diversified households. On the other hand, mining is their main income source as it provides high returns and demands a significant degree of specialisation.

When households are unable to diversify their income or find safe income sources, they can opt for self-insurance strategies. In the case of mining, where risks are high, households can aim to accumulate assets during good periods (as a result of favourable yields, demand or prices) to smooth their consumption during bad periods by depleting the accumulated assets. Asset holding as a means of protection, however, is conditional to access to functioning asset markets (Dercon, 2002). If the poor cannot access these

markets and sell their assets, their vulnerability increases dramatically. Furthermore, in poor households, the largest effects of risk come from the covariance between asset values and income; income is generated from land, livestock, tools, etc. which are, common assets among the poor and would therefore be subject to correlated risk. Also, as the literature on famine has thoroughly described, negative changes in terms of trade often coincide with a surge in consumer prices relative to asset prices. In Bangladesh in 1974 and in Ethiopia in 1985, the income of farmers fell as a result of unfavourable terms of trade and the value of their assets collapsed in relation to consumer prices. As a result, they could not exchange their assets for food. Hence, market imperfection, such as these described by Amartya Sen (Crow, 2000) triggered starvation in these countries; while a wider set of political and social imbalances and strategies caused the famines (De Waal, 1997;Devereaux, 2000;Crow, 2000)

An important policy implication, which must be considered throughout this paper, is that policies should aim towards influencing asset markets rather than income sources only. These could seek to integrate these markets with the wider economy and provide more attractive savings instruments to reduce covariance between assets and income.

Dercon and others discuss informal insurance measures which involve, for example, the use of intra- and inter-household safety nets; often based on social capital. This, however, draws attention to the sustainability of these arrangements, particularly in the case of covariate risks and when risk sharing is not perfect (Fafchamps, 2002). In the presence of imperfect risk sharing (i.e. when some members of a group are subject to more risk than others) those exposed to lower levels of risk would be tempted to exit the informal arrangement.

In our review of the risks affecting the ASM sector below, we will identify these forms of protection and provide examples for each case. In this section we have provided a framework for the study of the sources of vulnerability. We have determined that it has an effect on poverty (through the creation of poverty traps), that it can be described in terms of consumption variability (as the result of shock in income sources, assets and social capital) and that the poor adopted different protective strategies (income based, self insurance and informal insurance). In the following section we explore some of the risks that miners face and attempt to link the sector with the literature (that focuses mostly on peasants).

4 What are the key risks that artisanal and small-scale miners face?

In this section we provide a review of some of the risks faced by miners. These risks are the sources of vulnerability that affect the livelihoods of those within the ASM sector and are crucial for the understanding of the behaviour of miners and the sector as a whole.

According to Heemskerk (2001, 2003), based on an anthropological study of artisanal mining communities in Suriname and the French Guyana, artisanal miners are mainly subject to economic and health risks. She also suggests that these risks affect those involved in mining in different ways and with different intensity, depending on the activities and roles they play.

Other risks exist. Some, as in the case of accidents and most health risks are preventable through fairly simple, but often inaccessible, protective mechanisms. Others, however, are entirely exogenous to the miners. The yield of the mineral mined, for instance, can decide whether the operation is profitable or not (Hruschka, 2002). The risk of mining a

low yield site is high considering that the miners often use base their decisions on observing past mining activity and use very primitive tools to explore prospective mining areas. The weather is also beyond the control. Sudden changes in the weather can have significant negative effects on their ability to mine. Early rains might flood the shafts and excavations or make it impossible to access river beds. Similarly, for those involved in agriculture, the weather can affect their fields and crops, requiring them to devote their energies to agriculture instead of mining. 'Paranormal' risks, or those risks associated with disturbing local spirits or the balance of nature, which might seem absurd to outside observers, sometimes have considerable power over the decision-making process of artisanal and small-scale miners.

Less exogenous but still beyond the control of the most vulnerable and excluded, policy and legal risks should be considered. Policy risks are associated with sudden and constant changes in the policy environment in which the ASM operates. These are often identified as inconsistent and contradictory policy interventions by central and local governments that are influenced by other more politically powerful groups (e.g. large mining corporations, venture capitalists, environmental groups, etc.). Legal risks are related to the informal status of mining operations but particularly to the lack of tenure or use titles for the land they mine on and on which their livelihood depend.

Finally, because the livelihoods of artisanal and small-scale miners are often diversified and depend on more than one economic and social activity, it is important to consider the risks that miners' households face in other sectors. Risk associated with agriculture, trade, the tourism industry, public sector employment, etc. can have an effect on the livelihoods and decision making process of miners.

4.1 Risk associated with community structure

Risks vary in intensity according to the structure and organisation of mining communities and the position and roles of individuals and groups with them. Both in Mozambique and in Peru, two types of mining communities are reported: the mining village and the mining camp. Often, the village is an existing mining settlement where alternative livelihood opportunities are available for all members of the mining household. Camps, on the other hand, are established in or near the mining site with the sole purpose of mining. At camps, the risks detailed above are more intense and the probabilities of ill health, accidents, violence, food insecurity, social marginalisation, etc. are higher.

Village settlements also represent long term livelihood strategies. Felix Hruschka explains that in Peru, male miners follow the news of finds on their own (Hruschka, 2003). Only when they consider that the site is worth mining in the long term do their families join them. Camps in Suriname, on the other hand, are home to miners that work for mine operators who in turn provide them with housing, food, tools and everything they need to mine. In these camps, men live alone while their families (if they have them) remain in their farmland or in the city, involved in other activities (Heemskerck, 2001; 2003).

Exposure to risk also changes according to the role played within the communities. At mining camps, operators and miners are subject to different levels and types of risk. Operators in Suriname are more likely to be victims of violent crime, since they are better off economically. Operators that own or rent capital goods and pay fixed wages to cooks and machinery operatives will suffer when yields or production are low. While miners with no fixed costs might be able to adjust their expenditures, pit workers will be more at risk of accidents and contamination from mine dust or chemicals used in the process than operators. And women in mine camps are more vulnerable to sexual violence.

Within the household, vulnerability is different. In Tanzania, women are affected by specific factors that influence their vulnerability to risk. The first is economic hardship due to the fact that although they provide about 50% of the labour, they do not receive 50% of the rewards. They are also excluded from certain informal mining services which confines them to a subsistence level mining. In second place, women are affected by a deficit of information capital in comparison to men. A traditionally male activity, mining techniques and know-how are reserved to men. This gap is intensified by the higher illiteracy levels among women. Finally, family commitments determine women's capabilities to participate, earn an income and achieve a livelihood. Often social structures reduce their mobility confining them to their household, the village or a specific activity within or outside the mining sector. These restrictions and their exclusion from crucial assets and participation increase their vulnerability to external shocks by reducing the range of possible livelihood strategies to deal with them (Dreschler, 2001). This is consistent with other studies in Zimbabwe and Ethiopia (Dercon, 2003) which show that the impact of shocks is not uniform within households. Dercon and Hoddinott discover that younger pre-schoolers and adult women are more adversely affected than older pre-schoolers and adult men, respectively; and that within adult women the household head's daughters are the most affected.

This clearly describes imperfect risk sharing. Fafchamps (2002) argues that in the presence of imperfect commitments towards risk and inequality within the group, patronage might develop as an effective arrangement to ensure mutual insurance. In this situation, the poor sacrifice higher return in exchange for some sort of protection from the rich. In the analysis of labour relations in Ghana, Suriname and Peru, patronage appears to be a common arrangement. Patronage, within and outside the household can be understood as a protective measure.

4.2 Yield

Artisanal and small-scale miners have little or no control over the yield of the mineral they extract. Since they do not have the capacity to invest in exploration of the site and because they are driven by need and face high expulsion risks, yield levels only become certain after processing the ore; thus defining their income and profit levels. A study of the costs of artisanal miners in Peru (Hruschka 2003) shows that this variable is the only one that the miners cannot control and that has the power to determine whether they gain or lose.

Low gold recovery levels increase the effects of yield risk. In South Africa, gold recovery is about 50-60% of the potential carats. In Mozambique, recovery is even lower at 20-35% (Dreschler 2001). These low levels force miners to use mercury amalgamation with great risk to their own health. The miner loses a large proportion of the mineral in the extractive process; as it filters through its tools and hands. This loss increases when the mineral is sold to buyers or is processed at mills. Mill owners in Peru often keep the sediment as part of payment, which contains at least 30% more mineral than the miner was unable to rescue (Hruschka 2003).

Therefore, identifying a profitable mining site is crucial for the miner's livelihood; a low yield site will probably not yield enough mineral to cover the costs of extracting it. This explains the fierce resistance to leave the land and its often violent defence from larger mines or other artisanal miners. There is a common belief that artisanal miners, because they lack modern technology and formal geological training, cannot make rational decisions about where to mine. In fact, sometimes the opposite is true. Large scale mines in Peru have relied, historically, on artisanal miners to guide their exploration initiatives. In Zambia this capacity is based on a rich and deep knowledge of the local geology and mining history, which is translated, for example, into the use of local names to describe rock formations. Nonetheless, artisanal exploration is risky; and miners are

usually uncertain of the yield and size of the mineral reserve they are about to mine. Their urgency to satisfy their households' basic needs determines that they mine anything likely to be worth mining.

4.2.1 Protective mechanisms

A common strategy to guarantee higher yields is to mine in abandoned mines (World Bank and IFC 2002). When large or medium-scale mines abandon a mine site, they often leave enough mineral for artisanal and small-scale miners to mine. With their more basic tools and methods they are able to reach areas which large machines cannot, and so make a profit out of small-scale production. Mining in these sites, however, carries certain risks mostly related to the absence of the safety equipment needed for the risks present at large scale mines; e.g. deep open shafts, air pollution, dust, etc.

The use of mercury to retrieve gold from sediment is another mechanism to mitigate the impact of low yield. Similarly, they employ child labour to reach gemstones in deep and narrow mines and increase labour intensity. Another consequence of low yields is that they have to spend more time mining and less processing and selling the mineral. This means that miners are often willing to take discounted prices if buyers and mill owners will pay in cash.

4.2.2 Effect on vulnerability

A yield shock (i.e. finding out that the yield of the mineral is too low) can easily translate into a drop in household income. And the uncertainty surrounding exploration methods suggests that this is a common occurrence. The magnitude of the change for each household, and its impact on consumption levels, however, would depend on the role it plays in the sector (e.g. patrons with fixed costs would be affected more than wage labour) and its ability to cope with the shock. For instance, a low yield ore would bring down the income of independent miners but, because the process is often carried out during a single day, he could easily adapt his method or labour intensity to correct future incomes and maintain a desired consumption level. In this case income would be variable but consumption could remain smooth. On the other hand, a bonded miner who is allowed a certain number of days a month to mine for himself as a form of payment (e.g. in Peru) would not have time to put in practice coping mechanisms to revert the income effects of low yield. In this case, income would change monthly based on the yield and consumption would vary accordingly.

An important policy implication is that although coping strategies may be successful for some, they can be inaccessible for others, depending on the labour arrangements and roles they play in the sector. Therefore, it would be worth trying to introduce preventive and mitigating strategies. It would be worth, even, including exploration services and information regarding yield as an incentive and benefit gained from formalisation.

4.3 Health

According to the ILO, the five major health risks that artisanal and small-scale miners face are associated with are:

1. Exposure to dust;
2. Contamination from mercury and other chemicals;
3. Noise and vibration;
4. Poor ventilation; and
5. Overexertion

The MMDS report for Southern Africa adds the effects on the environment (contamination of waterways, destruction of flora and fauna, deforestation and the emission of fumes) as health risks for those involved in mining and others that might be affected by these externalities.

Indeed, health risks can have far-reaching consequences. Pollution from mine dust or other chemicals, as well as contamination of water, lack of sanitation and nutritional problems can cause long term effects to miners and other members of their household. Similarly, accidents can be the cause of illness and death. When these strike the household, its resources are re-directed towards coping with these effects. Because of their exclusion from public or formal private sector social protection mechanisms to prevent and mitigate those effects, they have to find alternative informal mechanisms to care for the ill and bury the dead (see paranormal risks). Unfortunately, since households are productive-consumption units, these mechanisms involve a loss of valuable productive resources; e.g. they sell their productive assets, send children to work, or reduce expenditure in food.

Violent crimes are also common in mining communities. Mine operators and women are particularly vulnerable to them. The former are targeted by thieves who expect them to be carrying large sums of cash to pay wages; and women are more prone to be sexually molested. In the context of subsistence production, violent acts, and ill health in general, can be very damaging for the household welfare. Even small thefts such as stealing a bucket can have considerable effects; this could be the only water container the household owns or an invaluable tool for mining activities. With little to no savings, replacing it would cause a significant setback.

Children are also very vulnerable in mining sites. In Tanzania, in the Merelani Tanzanite mines in the Arusha region alone, about 3,000 'snake children' work in the deep narrow tunnels (Dreschler, 2001). Here households face a trade-off. The relative absence of schools and alternative livelihood activities mean that, if not working, children would be net consumers. In subsistence conditions this would produce a high economic stress within the household unit and to avoid this they are incorporated to the productive labour force. Marieke Heemskerk's anthropological research of miners in Suriname provides another possible explanation for the participation of children and women in mining activities, even when they are more vulnerable to risks. She concluded that artisanal miners are aware of the risks that mining entails and, in fact, take precautions against them. One of those protective strategies is to avoid working for extended periods of time or for very long work days (Heemskerk, 2003). Therefore, the involvement of other household members allows mining households to increase their mining intensity while protecting each individual member from overexertion.

The proliferation of HIV/AIDS and other STDs in mining communities is another considerable health risk. In Africa, HIV/AIDS is spreading fast among miners in the large and small-scale mining sector (Elias, Draft). This risk increases at mining camps when men are estranged from their families in a seasonal basis and engage in unprotected sexual activities. Also, the lack of proper medical services and equipment such as needles and pre-screened blood banks to deal with accidents and emergencies can also be blamed for the prevalence of HIV/AIDS. Most worrying is also the fact that mining sites act like hubs for disease. When mining is taken as a short-term income generating opportunity by men and women involved in other activities, such as agriculture, trade, public services, etc., the negative health effects are exported to other economic and social sectors. If ASM continues to attract these seasonal miners (the Zimbabwean ASM sector is expected to grow at least three times according to Dreschler, 2001) the risks of transmission of these diseases will increase; unless considerable efforts are directed towards taking advantage of the conditions offered by the structures of mining sites for the implementation of focalised prevention and treatment interventions.

Health risks in the ASM sector are closely related to the methods used. And these are associated with the need to obtain cash incomes quickly, with little or no investment. They include, for example, the use of hazardous chemicals such as mercury, mining in deep pits and unventilated underground shafts, digging into rocks at risk of collapsing, working long days, etc. (Dreschler, 2001). Some of these methods could be considered backward and irrational but are often the result of rational behaviour. In Suriname, maroon gold miners in the Amazon refuse to use retorts (that would prevent the risk of mercury intoxication) to retrieve gold because the noise they make alerts thieves or competitors thus increasing their own risk (Heemskerk 2003). Similarly, in Mozambique, although women retrieve almost as much as men from re-panning the sediment left after the first retrieval effort, the use of mercury guarantees a faster process (Dreschler, 2001), and, as a result, health and safety considerations are cast aside.

Working in abandoned mines to secure higher yields can also have significant negative effects on their health. In Zimbabwe and Zambia research suggests that unprotected excavations, shafts and the lack of protective clothing constitute a risk for men and animals in the mine sites. The use of animals and mechanised equipment, at risk from death and damage as a result of falling into abandoned and open shafts, for instance, can have considerable economic consequences on the miners.

4.3.1 Protective mechanisms

To prevent and mitigate the effects of ill health miners resort to various protective measures. The most significant is the use of informal insurance such as social and family networks as safety nets. However, when mining is seasonal and miners have to leave their communities of origin, these networks break down with considerable effects on them and those who stay behind. Mining villages, unlike mining camps, maintain these networks and use them to respond to risk. As mentioned before, to avoid overexertion, miners can incorporate their children and other members, they resort to family and friends to care for the ill and make use of local knowledge and traditional medicines to treat disease.

Local knowledge is associated with local beliefs and traditions. In mining sites, protective measures against ill-health and accidents often imply performing ceremonies and rites to seek protection or permission from spirits or ancestors; failure to do so, it is believed, causes accidents and illness.

On the other hand, some miners adapt new technologies that reduce their exposure to dust and chemicals. Although the literature on environmental and personal health of miners emphasises the need to introduce such measures, more needs to be done regarding the provision of basic water and sanitation services for the miners. Since mining communities are not agricultural economies population densities are higher than in other rural centres. As in urban centres, public health is threatened by the inability of households to dispose of human waste and the organisms it draws. This, unfortunately, cannot be provided by the community itself nor by individual small-scale cooperatives, firms or mine operators. The State must intervene to extend the provision of these services to mining communities.

Self insurance is also present in the form of asset accumulation. To avoid illness, miners resort to various strategies, including reducing work load and taking breaks from the mines. However, these strategies, as in the event of illness, require the use or depletion of accumulated assets to smooth consumption. Without them, the household might not be able to survive the frequent periods of low productivity due to accidents and illness. Assets are also threatened by the risk of theft.

4.3.2 Effect on vulnerability

The effect of health shocks on income is unavoidable since the miner relies almost entirely on his own labour to earn a living (tools and machinery in this sector, by definition, is artisanal). Hence the household's vulnerability will depend on its ability to prevent and cope with negative health events.

Health shocks are preventable but often in expense of returns. Miners, nonetheless, are willing to go to great lengths to protect themselves from them. For instance, they rearrange labour patterns or adopt new technologies to avoid contact with chemicals and dust. Their main forms of protection are, however, coping strategies in the form of informal and self insurance. The accumulation of assets during healthy periods to be used during unhealthy ones is most significant. In fact, this accumulation can be used to avoid ill-health by providing miners with resting periods. However, the frequency of illness and accidents, added to the threat of crime, make asset accumulation difficult. A policy implication of this is that safer services should be provided and formal insurance, to complement informal arrangements could be introduced to reduce the burden of small accidents or illness from hard earned assets.

Informal insurance strategies, on the other hand, depend on social networks. These, unfortunately are constrained when there is migration or when shocks are highly correlated risks as a result of specialisation within mining communities, contagious diseases, exposure to the environment and general mining related accidents.

4.4 Environmental risks

According to D'Souza, (2003) environmental shocks play a significant role in the ASM sector. It is an important source of risk and opportunity for miners. For instance, natural disasters can render areas inaccessible to mining, cut off trade routes and trigger environmental and public health emergencies. The weather can also bring about losses in other sectors on which miners might depend on for income during the wet season or as an important component of the household income. Natural disasters can destroy access routes to markets; thus increasing transport costs and time-frames (based on conversations with artisanal miners in Peru, they hope to mine in the morning and be paid in the afternoon; hence any difficulty to reach the market or buyer is greatly feared).

Mining in Malawi is almost an entirely seasonal activity and it is explained by the weather conditions in mining sites, the methods required and the weather conditions for alternative livelihood activities, such as agriculture and fishing. In Ghana, for instance, rain does not allow miners to access gemstone sites as they become flooded (Dreschler, 2001) and in the Amazon jungle, rain makes it impossible to access mining sites, and regions, altogether (Kuramoto, 2003; Hruschka, 2003).

Weather is also the source of disease and infestation. In Suriname, mining sites in the Amazonia, are plagued by malaria (Heemskerk, 2003). Although the consequences are related to health risks, the weather or, more precisely, the environment, can be the source of disease. And the effects of an uncontrolled environment prone to flooding, infestation and disease are triggered by the use of untreated water and the lack of sanitary services (as explained above).

4.4.1 Protective mechanisms

There is little miners can do to control the weather. They can, however, take measures to prevent and mitigate its effects. A perfect example of protective mechanisms is the seasonality characteristic of the activity. To avoid significant loss of life and resources or negative effects on health, miners must adapt their activities to the nature of the weather. Their mobility (in Peru, a considerable proportion of gold miners in the highlands are nomadic miners) allows them to respond to sudden changes; in mine sites, miners often do not own the tools and therefore do not risk losing any capital or investment.

Income based strategies such as livelihood diversification to take advantage of weather changes and seasons are another side of this protective strategy. By participating in other activities (during the mining season or outside it) mining households are able to cross-subsidy from one or more activities to others when the latter fail. If the weather has negative effect on the household's mining income during a given period, income from petty trade or on farm labour might cover the costs incurred or lost in mining. However, as we have discussed above, diversification comes with a cost to miners who are often forced to enter low return activities. Also, since weather is a common risk, even diversified livelihoods could be dramatically affected; particularly if it has an effect on the household's assets.

4.4.2 Effect on vulnerability

The literature agrees that correlated risks are impossible to control unless formal insurance is available. Hence, artisanal and small-scale miners are very vulnerable to weather shocks and changes in consumption are highly likely. To reduce vulnerability policies should aim towards providing formal insurance which would not be subject to the effects of weather shocks.

Particularly for the poor and those under patronage arrangements, insurance of this sort protects them from extending these unfavourable conditions. It also allows them to make investments, even if perceived to be risky, due to the security of consumption insurance. For those who are unable to access protection, consumption credits or transfers should be readily available after a negative shock.

4.5 Legal and policy risks

One of the main incentives for entering the formal sector is the guarantee of access to a secure mining site. This reduces the risk of being evicted from private or public land or cheated out of a newly explored site (e.g. by formal small-scale mines that go after already exploited sites to save the cost of exploration). In fact, as Juana Kuramoto suggested during an interview in Peru, this is such a motivator that miners are willing to associate and become formal but only up to the point when they gain access to the land; once this is achieved they halt the formalisation process. Also, formalisation and association of individual informal miners does not necessarily imply a change in behaviour from subsistence mining to small-scale capitalism. In Peru, many miner associations have become formal enterprises to benefit from a new legislation that facilitates the process of land titling to small private firms, but these groups are divided in smaller units of about three or five miners that mine at a subsistence level. Even in the cases where utilities are distributed among the members of the enterprise or co-operative, this is done according to labour contributions and not to capital.

An important element of informality is that it is related to violence. The lack of ownership or use rights increases their vulnerability against invasions or expropriations. This often causes violent confrontations against large mining companies, indigenous communities

and national or private security forces. Examples of these confrontations are present in Peru involving indigenous communities, artisanal miners and large scale mines and their security services (Hruschka, 2003) and in South Africa between small-scale miners association and splinter groups that illegally expand the associations' land rights (Dreschler, 2001). They stem, among other things, from a lack of information about alternative cooperative strategies and a mistrust of the 'others'.

In Zambia, land disputes are also triggered by the negative externalities that mining operations impose on farmland, private property and the environment (Dreschler, 2001). These could be traced to the inability to enforce highly complex and comprehensive mining codes and the failure to recognise the existence of a large unregulated sector within the official policy framework.

Violence is also present in the cases where artisanal mining is related to conflicts and drug trafficking. In Central and South America, gold is used to launder money (although there is very little evidence of this - MMSD, 2002). In Africa, for instance, 'blood diamonds' in Angola financed the civil war.

Another source of legal risk is the failure to properly identify and classify the ASM sector. Countries use different parameters and values to describe its activities. Often these parameters miss the true composition and characteristics of the sector; which are more dependent on the characteristics of the mining household and its vulnerability context than on the technical characteristics of the economic activity itself. Country examples show that there is no clear-cut division between artisanal and small-scale mining. In fact, there is not a clear definition of either one which is readily accepted world wide. For example, while in the Philippines the ASM sector is defined according to investment size ranging from zero to US\$200,000 (Bugnosen, 2001), in Tanzania, artisanal mining is defined as informal, disorganised and nomadic (Dreschler, 2001), and in Peru, informal artisanal miners in the Amazon are medium-scale in size with operations of around US\$500,000 (Kuramoto, 2003). The following table shows some of the different characteristics used to define the ASM sector:

Table 1: Definitions of artisanal and small-scale mining in selected countries

Country	Main characteristic of definition of small-scale mining as determined by the governing authority in each country
Brazil *	Level of mechanisation, mode of occurrence
Burkina Faso	Level of mechanisation
Chile	Legal structure, production levels
Cote d'Ivoire	Level of mechanisation
Ethiopia*	Annual production, level of mechanisation
Ghana	Capital investment, number of participants
Guinea	Type of minerals
Mexico	Production levels and value
Philippines	Level of mechanisation, capital investment
Suriname	Mode of occurrence, level of mechanisation
Senegal	Depth of work, crude production levels
South Africa	Capital investment
Tanzania	Capital investment, labour and technology requirements
United Nations	Annual production capacity
Zambia	Size of concession
Zimbabwe	Size of concession, capital investment

* Countries with different definition for artisanal mining

ECA (2002) Compendium on Best Practices in Small-scale Mining in Africa, Mineral Resources Forum, UNCTAD: Addis Ababa, p.6,

Without a clear definition that can be accepted internationally, it is difficult for development agencies and international civil society to promote the rights of those in the sector. Each definition is insufficient to identify artisanal or small-scale miners and, because they fall outside the formal parameters, informality is high in Southern Africa (80-90%), according to the MMSD Southern Africa Report (Dreschler, 2001). In Zambia, for instance, the mining community has been divided into large and small-scale mining operations according to its investment capacity and measured in terms of the size of the concession. This definition is then used to determine the mining rights of miners and is the foundation for the mining legislation in the country (Dreschler, 2001). However, this classification is not enough to account for the characteristics of the most vulnerable miners who have no investment capacity and mine outside the legal framework. (This is a similar problem to the use of an arbitrary poverty line at US\$1 to measure poverty. Based on it, the classification of 'poor' and 'non-poor' fails to recognise a significant number of people above it that fail to satisfy basic human capabilities.)

Without legal recognition, subsistence miners are vulnerable to expropriations, violent expulsions, corruption and other abuses. Ironically, from the Zambian authorities perspective, there are more illegal miners than legal ones in the country; an estimate suggests that out of every 30-40 registered gemstone mining operators, there are 200 to several thousands illegal mining operations. Surprisingly, it is the latter that remain invisible to the legal framework.

Legal risk is also associated with economic risk. In urban studies, it has been demonstrated that people without property rights to the land on which they live, often remain in or stay close to their homes and miss out employment opportunities (Field, 2003). Similarly, miners and family members are forced to live within or close to the mining site to guard it from invasions or expropriations. This reduces their livelihood diversification strategies and increases the risk of income volatility.

Policy risk is closely linked to legal risk as it stems from the same cause but covers a much broader scope. For instance, while considering land disputes between small and large scale miners in Ghana, Hilson (2001) finds that despite the Ghanaian Government's disposition to work with the artisanal and small-scale mining (rather than against it as had been the case in the past) sector, it gives priority to attracting foreign investment in its minerals and mining sector. As a result it sometimes awards land to large-scale mining companies displacing small-scale miners who rely upon that land for subsistence. This seemingly ambiguous policy in the mining sector can have a damaging effect on the expectations and trust of the artisanal and small-scale miners, and is rooted in the failure to recognise the sector as a legitimate livelihood strategy for a large and vulnerable population. If miners do not expect that the government policies will be consistent over the long term, then they are unlikely to take them into account in their behaviour.

Examples from Africa and South America show that interventions and policies are not sustainable. In Peru, the ASM sector has not yet given the formal recognition it deserves and is still treated as a transitional productive sector. The GAMA initiative, funded by the Swiss Cooperation (COSUDE), although successful, was undermined by officials from the Ministry of Energy and Mines, apparently bowing to pressures from the large scale mining sector. In South Africa, the MMSD report found that 'the lack of any clear policy or guidelines for the small-scale mining sector is notable' (Dreschler, 2001).

4.5.1 Protective measures

Protective measures against legal and policy risk concentrate on informal insurance based on social and political capital. However, mobility, migration and the effects of other risks have negative consequences on the strengths of these networks. More examples on how social and political networks have operated in Africa are needed.

4.5.2 Effect on vulnerability

An interesting effect of legal and policy risk is that it can have a significant influence on the rate of asset accumulation by mining households, as well as their diversification strategies. If a household expects changes in policies to affect their land and mining rights, they might be tempted not to accumulate assets that they will be unable to take with them if they are forced out of the site. On the other hand, there might be an incentive to accumulate immobile assets as a way of deterring public or private agents from attempting evictions. The latter strategy is observed in the behaviour of squatters and slum dwellers in developing countries. Their choice will be closely related to their own perception about the strength of their social and political capital.

In the absence of rights and justice, households would be reluctant to leave their land unprotected for long periods of time as they could be subject to theft or eviction. Hence they would set up near the mining site or keep some members close to the home at all times (Field, 2003). This drastically reduces the income and employment sources of the household thus increasing consumption vulnerability.

4.6 Risks in other sectors

Other sectors also face risks related to weather, health, production, economic variables, etc. (e.g. agriculture, manufacture, services). Since ASM miners diversify their livelihoods, they also depend on the incomes from these sectors; and sometimes these sectors might even cross-subsidise each other. Rural non-farm employment literature can help describe the linkages between sectors. Reardon et al (2001) and Escobal (2001) argue that although agriculture is still the principal motor of development and growth in the countryside, it is not the only one. Increasingly, the share of farm income in the household is becoming less important. As households diversify their sources of income, one of these is mining. Mining is, however, an activity with enormous environmental effects; unregulated and uncontrolled it cannot exist side-by-side with agricultural land. Hence mining communities where agriculture is present would be often only involved in subsistence agriculture; to cover the household's needs.

On the other hand, those involved in agriculture as an income generating activity need to travel to mining areas and therefore can only do so during the dry season. As agriculture loses its importance as income generator and mining gains it, households become more specialised in mining and mining related activities. In Zimbabwe, for instance, a country with a strong agricultural tradition and where three quarters of the population is rural, miners are spending at least 60-70% of their time mining (Dreschler, 2001). The sustainable livelihoods approach provides an explanation for this. As households find that agriculture provides them with fewer chances to reach their livelihood outcomes they turn to other strategies. Mining is an activity with higher income returns but which demands significant adjustments within the household. These adjustments involve the 'trade-in' of agriculture assets for mining assets and the adoption of drastic livelihood strategies, such as migrating, selling off agricultural land, etc. These changes make it increasingly difficult for the households to go back to agriculture because their incomes in mining, although higher, are only enough to maintain a subsistence livelihood. Even when the risks associated with mining are high and considered to be so by the miners, the cost of leaving mining and facing an even higher uncertainty regarding their household welfare is even higher (Heemskerk, 2003). This is similarly applied to cocalero farmers in Bolivia, Colombia and Peru who have chosen this as a livelihood strategy (Sanabria, 1993).

Externalities produced by the ASM sector can also be the source of risks for other sectors. For instance, as men and other family members migrate to mining areas from

agricultural communities, farms lose productivity and land can rapidly deplete. The prevalence of HIV/AIDS in mining sites and its spreading through migratory patterns can also affect the production of goods and services in other sectors. Similarly, environmental degradation, in particular the contamination of water sources, can have long lasting and distant effects.

4.6.1 Protective measures and the effect on vulnerability

It is important to note that an income based strategy undertaken by households for protection in the mining sector can, in fact, increase their vulnerability. The existence of this risk illustrates the costs of diversification.

An important policy implication is that policies aimed at the ASM sector could be targeted at other sectors such as agriculture and livestock which require more sedentary livelihoods and that could provide an entry point for consumption smoothing insurance, credit and other services.

4.7 Economic risks

The evidence we have obtained and analysed so far suggests that the effects of macroeconomic variables, particularly commodity prices would be limited. Put in perspective of all the other risks that the sector faces, it could be that this is not the most important source of risk –it is clear that it is not the only one.

The description of the risks above shows that all can bring about income and consumption variability. We understand vulnerability in terms of the effect that the income variability has on consumption variability, and we define economic risk as that originating in changes in economic variables such as commodity prices, exchange rates and interest rates.

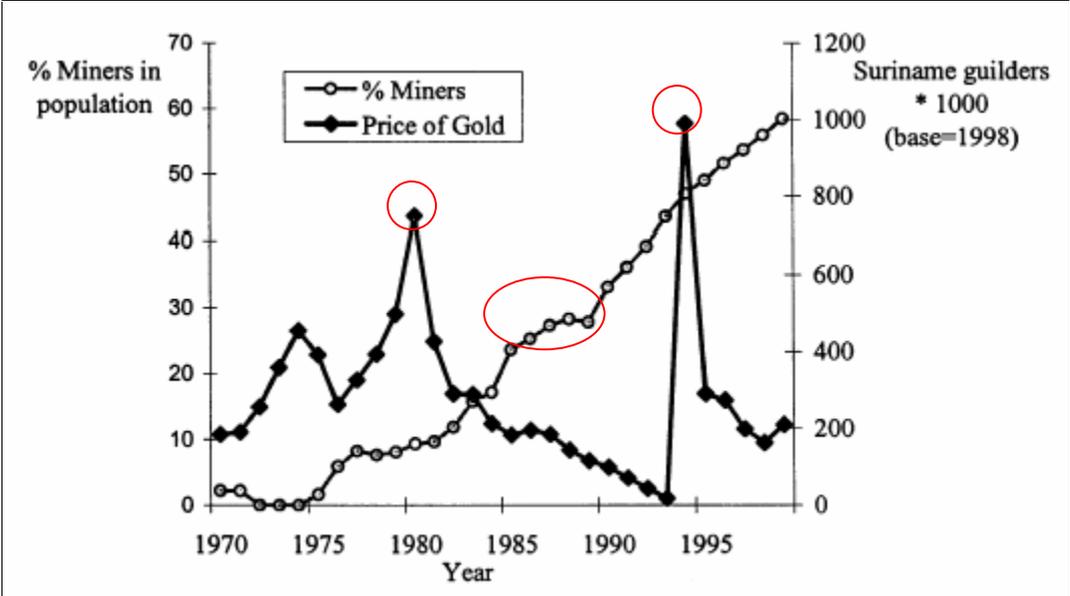
Economic risks can be mitigated or exacerbated by other risks. Yield levels, the weather and health risks can play significant roles in the household's ability to generate income. Illness can incapacitate the productive members or consume an excess of resources available in the household. Changes in the economic situation of the country or region can increase relative prices of basic goods and services needed by the household and increase their vulnerability. For instance, Dercon (2002) argues that unfavourable changes in the terms of exchange in agriculture often coincide with an increase in relative prices. Thus economic risks also affect those households and individuals that might be involved in mining activities in a seasonal or sporadic nature. For instance, in Puno, Peru, seasonal artisanal miners during the summer months are students from local universities that, in need of an extra income to cover their tuition fees and living expenses, engage in mining as a short term source of cash income.

So far we have considered income variability as a function of shocks that affect the production process. On the demand side it is possible to highlight the effects of commodity prices and exchange rate. The significant levels of patronage and the effects of other risks affecting miners would suggest that short-term fluctuations in commodity prices would only have a marginal effect on them. Similarly, because they have no access to capital markets (and would only be affected if their current informal sources of working capital were to transfer any increase in interest costs onto the miners) variations in interest rates would tend to have only a small impact. And since they trade in local markets and usually use locally produced inputs they should not be significantly affected by exchange rate changes. On the other hand, a considerable reduction of interest rates might extend the market of financial services and venture capital providing them with

more funding alternatives. Similarly, an exchange rate increase would increase local minerals competitiveness in the international markets increasing demand by buyers. It should be noted, however, that where ASM mining occurs within some border and conflict areas (e.g. Congo and Angola) and drug economies (e.g. Colombia), exchange rate fluctuations would have little effect since the currency in use would be the U.S. dollar.

It seems that short-term fluctuations in prices and other economic variables would probably not give the sector enough time to adjust. For instance, while buyers are willing to buy a few grams from each miner everyday, they cannot sell a few grams to wholesalers and must first stock up. Also, some mining operations are carried out in isolated areas and mine operators need to gather enough mineral or ore to make up for transport costs from the mine to the market. Then, commodity price fluctuations would have to be considerable and long-term to have an effect on the decision making process of miners. And even in the case of significant changes, one should not necessarily expect conventional responses. According to the peasant economy approach by Chayanov, in the case of a significant fall, it is possible to predict that production would increase rather than decrease. Subsistence miners do not have savings capability therefore, if the price falls, they will have to increase their output to make up for the loss. Heemskerk (2001) in an empirical analysis of the effect of international gold prices on small-scale gold mining in Suriname discovered that the price and the percentage of miners in the population bear no relation, even during significant and long-term falls.

Graph No.1: Changes in the price of gold and percentage of miners in population in Suriname: 1970-2000



Source: Heemskerk (2001)

In the graph above it is interesting to note that while prices fell during the 1980s and a good part of the 1990s, the percentage of miners in the population increased. We note the considerable short-term rise of the price of gold in 1995 that had no obvious effect on the magnitude of mining participation in the country. This does not mean, however, that the rise, or fall, in the price did not have an effect on the livelihoods of the miners. Between 1985 and 1990, however, it is possible to notice a decrease in the rate of increase of miners in the population. This can be traced to the continuous fall in prices since 1980.

The long term effect of price trends, on the other hand, is consistent with what was observed in the mining community of La Rinconada, in Peru. As a consequence of a fall in gold prices between 1994 until the late 1990s, the population of this community fell from about 30,000 in the 1980s to 13,500 people (Hruschka 2003). A possible explanation for

this difference is that miners from La Rinconada might have left the overcrowded mining site for other opportunities in new ones, thus not necessarily reducing the number of miners. Finally, during the 1990s subsidies to the country side were removed as a result of a Structural Adjustment Programme and some of these miners, often involved in agricultural activities during the wet season, would have migrated to the cities in search for other livelihood strategies.

4.7.1 Protective measures

Protection from economic risks often takes the form of income based strategies. Miners seek to diversify their income sources as a means of reducing the overall market risk of the household. We have already noted that these strategies produce their own set of risks. Other initiatives include access to working capital credit from public or private providers. These, however, do not tackle the issue of consumption smoothing directly and do not effectively reduce vulnerability. It could, in fact, be argued that strategies to promote production may increase the vulnerability of subsistence miners by increasing their obligations; particularly if other risks are not addressed.

Self and informal insurance strategies are also available to deal with market fluctuations. Asset accumulation, however, is subject to the existence of and access to active asset markets, and poor miners are often excluded from these markets. Informal insurance mechanisms, on the other hand can provide access to these and commodity markets through social and value chain networks.

As a means of smoothing consumption, however, miners resort to other more complex arrangements. For instance, they sell their mineral at discounted prices to buyers and mill owners in return for cash; they adopt more formal co-operative or 'firm-like' production structures to sell their mineral at more favourable prices; or reduce costs by bypassing safety and legal standards. All these are intended to secure a less variable income which, and all other risks equal, would guarantee a smooth consumption level.

4.8 Paranormal risks

The livelihoods of artisanal and small-scale miners are governed by many overlapping structures; local governments, national regulations, markets, traditional and cultural structures, etc. A very important element of these structures is the role that religious or other cultural beliefs play. Fear of spirits, curses and taboos define some of strategies undertaken by miners to mine and market their product, including the safety precautions they take and the organisation of labour within the household and the community.

For instance in Malawi and Mozambique women are not allowed into the mine out of fear that they will offend the spirits. Hence they are relegated to work in the processing of the ore and its commercialisation (Dreschler, 2001). In Suriname, according to Heemskerk, artisanal miners make offerings and are careful not to offend the 'spirits' or their ancestors as protective measures against accidents in the mine site. Although miners are aware of the risks they are subject to (Heemskerk 2003) and know how to protect themselves against them, strong cultural traditions lead them to explain them in these terms. And these result in rituals and ceremonies that fail to address the actual physical risks they face.

4.8.1 Effect on vulnerability

The effect that paranormal risks have on consumption variations is arguable. It might however, have an effect in perceptions of vulnerability that, as we have seen above, have a significant impact on the behaviour of the poor. Miners who consider themselves to be vulnerable to spirits or bad luck might not be willing to take risks and remain in low return activities (poverty as vulnerability). The main effect on vulnerability, however, may come from the use of assets in these rites and ceremonies and the limitations imposed on other physical and human resources. These can have a significant impact on their income generation capacity and their consumption variability; particularly in the presence of the real risks these forms of protection are supposed to prevent.

5 Policy implications

The previous section has offered a review of some of the most significant risks that miners face. We have attempted to present some of their protective measures and the extent to which these risks affect their vulnerability, understood as negative variability in consumption. In this final section we put forward some policy implications that draw from the analysis above with the objective of promoting a holistic response to the demand and needs of the ASM sector.

The bottom line is that risks come from many different sources and are highly correlated. These are sometimes related to each other but not necessarily directly; the reduction of some might bring about an increase in others. The heterogeneity of risks therefore requires a similarly heterogeneous response. Trying to reduce risk in one area alone might increase vulnerability as a whole. Therefore, policy must aim to assist miners in ways that address more than one risk alone. For instance, providing health services will clearly help miners but might not be enough if justice and legal services do not follow them.

Although not conclusive, our analysis leads us to believe that commodity price risk might not be the most important source of risk for the ASM sector. From the perspective of a highly vulnerable activity, price vulnerability must be further studied to determine not only its effects but the role of price stabilisation mechanisms as protective measures against all other risks.

When considering price stabilisation mechanisms, the full range of risks must be taken into account. Unexpected low yield levels can determine a loss even with favourable prices. Similarly, illness can reduce labour productivity dramatically. A negative aspect of price stabilisation could be developing a false sense of security. Stable prices can provide the miners with sustainable permanent incomes, but if other risks are not controlled, this stability can be highly threatened. It could, if not properly addressed lead to a reduction in household income diversification and increase the vulnerability of mining households or individuals to the risks associated with mining.

Also, protective measures against these risks are weak and miners often have to cope with or mitigate the effects of risk rather than prevent them. For instance, if miners were able to protect their mining sites from flooding, then they could mine during the wet season. And if health services were available in mining communities, health risks could be crucially reduced. Similarly, if miners had access to political capital and legal and business services, adverse changes in policies and the legal framework could be contested and avoided.

By relying on coping strategies, mining households are forced to use their productive resources. This depletes their initial asset endowment increasing their vulnerability and reducing the livelihood strategies options they have to overcome this. Within prevailing unstable environments (violence, illness, income uncertainty, etc.) subsistence mining

becomes the norm. This vicious cycle could provide a marginal and partial explanation for why subsistence miners, albeit with higher average incomes, cannot easily accumulate capital and defeat poverty.

Legal and policy risks are related to formalisation initiatives (e.g. Peru and Ghana). The elimination of formalisation barriers and the facilitation of the process then, are not enough to propel the sector out of poverty. Formalisation comes with obligations and unless all other risks and their effects are dealt with, these obligations will increase the cost of staying formal thus creating incentives to return to informality. Initiatives that seek to engage with the informal sector must therefore, take all other risks into account and consider them as crucial to their strategy. In other words, a strong and reliable safety net must be in place first; this can then be tightened to create a springboard.

Income based strategies are, in themselves, risky. Income diversification requires more and different forms of capital. Without it, the poor may increase their vulnerability unless they are allowed to tap into more profitable activities. Income smoothing policies should try to provide access to these markets or the assets needed to participate in more capital intensive activities.

Asset accumulation is a potentially successful self insurance strategy. Unfortunately, asset accumulation has two important disadvantages. First, the level of risk and vulnerability of miners suggests that good periods in which they can accumulate assets do not last long. Second, negative shocks that affect their income tend to affect the value of their assets too. This can have a devastating effect on the protective value of these assets during the aftermath of common shocks. It might be more effective to aim to control or regulate asset markets to ensure that they remain active even during common bad periods; and provide additional and safer assets such as insurance and savings.

An important implication of understanding vulnerability in terms of consumption variability and recognising that the poor, and in this case miners, aim to smooth their consumption levels across time is that policies should focus on this rather than income smoothing. Micro credit programmes should provide consumption credits and technology transfer should include insurance to cover certain basic consumption needs for the household. These additional services would reduce the vulnerability of the poor and provide incentives for riskier and more profitable behaviour.

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