Mineral Policy in the Era of Sustainable Development: historical context and future content

Rudarska politika v času trajnostnega razvoja: zgodovinski kontekst in vsebine prihodnosti

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Abstract: The goal of public policies is to connect desired ends with practical means toward their achievement. How the desired ends are determined, and whose goals and objectives they incorporate, depends upon the culture and political system of the country in question. With few exceptions, policies change over time to reflect changed perspectives and understanding of the world around us. This is true regardless of the policy area in question. Thus, how societies view and manage their mineral resources has evolved in response to public attitudes, societal needs, economic circumstances, cultural perspectives, political orientations, technological advancements, and geological knowledge.

In this paper we examine how the scope of concern has changed for mineral policy. We then review the overarching issues that have in recent years been considered essential components of mineral policies. We point out how neoclassical microeconomics has influenced recent policy design. We then use a market flow diagram to illustrate how policies can be focused at specific market issues. We next discuss mineral resources in the context of sustainable development. We identify issues that become relevant when the frame of reference is enlarged beyond ensuring supply and capturing economic rent. We show that policy based solely on neoclassical economics may not be able to effectively incorporate these issues.

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Izvleček: Cilj politik je povezati želena stanja s praktičnimi uporabnimi sredstvi z namenom doseganja teh stanj. Kako so določena želena stanja, kakšni so cilji, kako so vključeni v politiko, je odvisno od političnega sistema in stanja v državi. Z manjšimi izjemami se politike spreminjajo glede na spremenjene cilje in poglede na svet. Slednje drži za vse vrste politik. Pogled družbe na mineralne surovine in način, kako z njimi ravna, se spreminjata glede na javnost, potrebe družbe, gospodarske okoliščine, značilnosti nacije, splošne politične usmeritve, stanje tehnološkega razvoja in poznavanje geoloških razmer.

Raziskali smo, kako se je menjalo področje prevladujočega interesa rudarske politike. Pregledali smo splošna vprašanja, ki so v preteklih letih tvorila temeljne elemente rudarskih politik, pri čemer smo posebej poudarili vpliv neoklasične mikroekonomije na oblikovanje sodobnih rudarskih politik. Na diagramu prikazujemo, kako se rudarske politike osredinjajo na specifična vprašanja trga. Poleg tega obravnavamo mineralne surovine v kontekstu načel trajnostnega razvoja, pri čemer identificiramo relevantna vprašanja, kot je okvir politike, širši od zagotavljanja oskrbe z mineralnimi surovinami in zajetja ekonomske rente. S tem dokazujemo, da rudarska politika, temelječa samo na neoklasični ekonomiki, ne vključuje vseh odprtih vprašanj.

Key words: mineral policy, sustainable development, neoclassical economics, ecological economics

Ključne besede: rudarska politika, trajnostni razvoj, neoklasična ekonomika, ekološka ekonomika

Introduction

The purpose of public policy is to direct or control actions by government bodies or the public so as to achieve desired ends or objectives. Policies can range from the very specific, i.e., a detailed course of action or program of activities, to the general, i.e., an overall plan embracing identified goals, or even to the conceptual, i.e., a general expression of societal purpose.

Which goals are pursued depends upon the values and interests of the people involved in policy creation. Originally, rulers made policies. However, power may devolve over time from absolute rulers to elites to (more or less) democratic governments to the public. And when a country moves along this continuum, the range of issues worthy of consideration in policy broadens to incorporate the needs and interests of the people rather than only those of the ruling classes.

The authors described this gradual evolution in a prior paper (Shields & Šolar, 2006). Recent history was divided into eras, each of which saw major changes in thinking about the nature of the relationship between the government, the economy, workers, the environment and society at large. This expansion of the scope of concern is closely linked to general societal development. The concept of a progression is demonstrated by the changing thinking about mineral supply over the past 100+ years (Figure 1) (Shields & Šolar, 2006):

- Pre-industrial era – concern about access to deposits;
- Industrial evolution – concern about capitalists, industry, and economic markets;
- Late industrial era – concern about workers;
- Post industrial era - concern about environment;
- End of the millennium – concern about social impacts and preferences; and
- Twenty first century – concern about intra- and intergenerational equity.

The focus of the first two eras was ensuring the availability of mineral resources. The third era dealt with the rights and protection of workers. The fourth era can be seen as an extension of the third in that it involves protection of the environment. The rise of environmental consciousness was contemporaneous with the rise of economic liberalism in the latter half of the 1900's. People began to understand more clearly that human societies exist within and are ultimately depen-

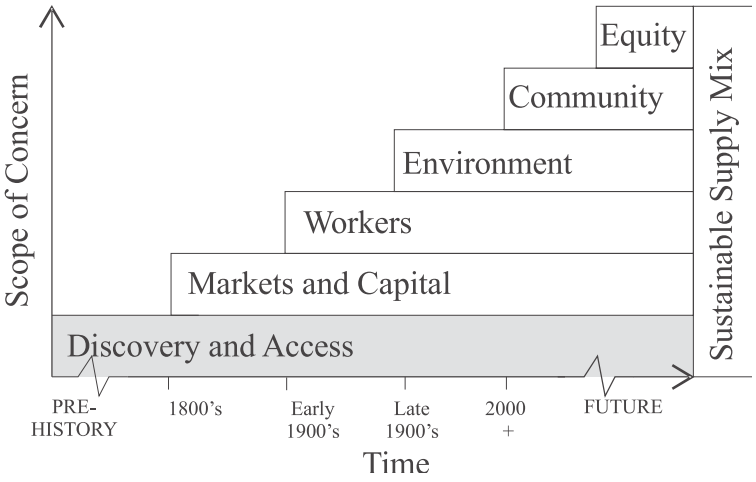

Figure 1. Expansion of Issues of Concern (Shields & Šolar, 2006)

dent upon the services provided by the earth's physical, chemical and biological systems, just as production is dependent upon labor. Inevitably, human actions change environmental systems. The current spatial extent of anthropogenic impacts, combined with their increasing intensity, has endangered and degraded the structure and functioning of some environmental systems.

During the latter part of the 20th century concern increased about social problems as well, for example widespread poverty, lack of access to fresh water, and the needs and rights of indigenous. The broader public became more aware of the fact that the environmental, economic, and social issues societies face display attributes of high uncertainty, urgency, complexity, and connectivity. The sustainable development (SD) paradigm was embraced as a potentially effective way to frame and analyze such problems. First, it is based on a comprehensive and inclusive, i.e., post-modern, view of systems as open, dynamic, and integrated. The interconnectedness of social, economic and environmental systems is explicitly recognized. Second, the overarching goals of sustainability, i.e., economic prosperity, environmental health and intra- and intergenerational equity are widely accepted. The importance of economic development is recognized, but is balanced with an understanding that natural systems must to be protected and the needs of current and future generations fulfilled (Shields et al., 2002; Elliott, 2005).

As will be discussed later in this paper, the principles of sustainability extend to mineral production and management. Thus, the right-hand column of Figure 1 places the original concern about access to mineral resources into a comprehensive sustainability context, a sustainable supply mix (SSM) as it were. Minerals can be supplied from different mines in different regions and countries, using different methods, each with their own set of social, environmental, and economic impacts and benefits. Products containing minerals can be reused and recycled, but again doing so has economic and environmental implications. Achieving a SSM necessitates that these tradeoffs be explicitly recognized and used in decision making. Each of these variables must be weighted so as to reflect societal objectives and the needs, preferences and values of multiple stakeholders. SSM is achieved by selecting that mix of sources that taken together maximize benefits and minimize costs of mineral supply for present and future generations, i.e., that are intra- and inter-generationally equitable. If there is to be a shift to a SSM, mineral policies will need to be reconsidered and in some cases revised or extended.

Mineral policy

The fact that new ideas are discussed, e.g. that concerns about the environment, communities, and future generations are being raised, does not automatically or immediately translate into new or changed policy. Rather, policies change gradually. The procedure by which desired ends are translated in laws, rules and regulations that direct or guide action is called the policy process. In its most simplified form, the cycle comprises 6 stages: 1) identification of objectives and interests, 2) definition of policy, 3) codification of policy in laws and acts, 4) establishment of a regulatory framework, 5) monitoring, and 6) review and adaptation (Šolar & Shields, 2000).

Classical policy models typically assume that policy is created in an orderly, sequential fashion. An issue is defined, alternative solutions are proposed, analyzed, tested, and refined, and eventually a solution is codified in law and then implemented by the government. We acknowledge that this is not a strictly accurate description of the world around us and that policy making is actually a complex and messy business. As Bismark famously noted, one should observe neither the making of sausage nor of legislation. But the cycle does illustrate the reason why there is a time lag between public discourse and revised public policy, which is that each stage of the process requires information, discussion and agreement. The lags are exacerbated in circumstances where the issues at hand are complex and multidisciplinary, and even more so where discourse is limited or suppressed, or where those in power do not see policy revision as in their interest.

Resource policy in general, and mineral policy specifically, is complex for reasons beyond the fact that the scope of concern has expanded over the past 100 years. It is complex because it concerns the allocation of scarce resources, the distribution and full extent for which can never be known with certainty. It necessitates the coordination of both governmental and market processes to be effective. And it is further complicated by the fact that each mineral commodity has its own economic, military, social, environmental, technical, and other considerations.

Nonetheless, there is broad consensus that national mineral policies should cover sovereignty, economics, legislative framework, and regulatory agencies (Otto, 1997). They should clearly define the range of acceptable mineral activity and types of minerals that can be exploited. The goal of policies should be to create an enabling economic environment that aligns the country's investments with its underlying comparative advantage, so as to improve the use of scarce capital and human resources.

This economic environment includes legal, institutional and fiscal reforms, in particular setting tax regimes that allow the nation to capture economic rent generated by mineral extraction. National minerals policies also need to provide the regulatory certainty necessary to foster investments in mineral development, including the allocation of rights to subsurface resources (Carpenter, 2005). In addition, mineral policies should endeavor to ensure that mineral supply will be adequate to support the economy and the defense of the nation in question, now and in the future.

The Ascendance of Neoclassical Economics

The preceding view of the role of national mineral policies is informed by a neoclassical economic perspective. Four key propositions of neoclassical economic theory are (Otto & Cordes, 2002):

- Rational pursuit of self-interest by individuals and firms in competitive markets leads to equilibrium outcomes that efficiently allocate scarce resources and maximize economic output.
- Economic growth is a natural and harmonious process made possible by operation of free and competitive markets.
- Pace of growth is greatly enhanced by unrestricted international trade and factor flows (labor, natural resources, and financial and physical capital) consistent with prevailing measures of comparative advantage.
- Governmental interference with market processes reduces or impedes growth and leads to increased social, political and economic unbalance;.

Implicitly, the role of government is to establish the social, political and legal conditions necessary for markets to operate effectively and efficiently, i.e., facilitating production of minerals with a minimization of waste. If a pure neoclassical perspective is taken, government's role does not extend beyond this charge. In economic theory, however, well-functioning, competitive markets have numerous characteristics, the following of which are particularly relevant for minerals:

- Many buyers and sellers, none of whom have capacity to affect market price;
- Neither buyers nor sellers are able to collude or form organizations that can affect market price;
- No positive or negative externalities; and
- Low cost entry and exit from the market.

Few if any markets, mineral or otherwise, can satisfy all these requirements, and individuals and firms do not have the ideal rationality of the economic

agents populating neoclassical models. As a result, what could be termed 'purist' neoclassical economics has been expanded to incorporate the concept of market failure, which occurs when one or more of the aforementioned conditions (or those not listed) is not met. Under such real-world conditions, government's role can legitimately be expanded to include combating persistent unemployment, inflation, external account imbalances (Otto & Cordes, 2002), as well as other issues such as environmental oversight and encouraging efficient consumption. One effect of the recent economic crisis has been to highlight the potential for catastrophic disruption of poorly- or un-regulated markets, and a recognition of the need for policies that acknowledge the interconnectedness of socio-economic and bio-physical systems.

Mineral policy and economics in the 1950's, 1960's and 1970's did not reflect a neoclassical perspective. Rather they were marked by governmental interventions in areas such as administrative procedures, taxation, land and resource use restrictions, nationalization, joint ventures, state owned companies, etc. Some governments tried to maximize their incomes through higher taxes on mineral extraction, or by limiting the repatriation of profits earned by foreign mining firms (MMSD, 2002). These measures were in some cases followed by other even more restricting measures (export / import control, national staff employment, mandatory joint ventures with national companies, or even outright appropriation) (Otto & Cordes, 2002).

By the 1980's, it was clear that such policies were not leading to desired outcomes. Bureaucratic, inefficient, or corrupt governments, with unrealistic expectations and plans for commodity power, nationalization, or economic development agreements were seen by many as solely a burden to the mineral industry. They clearly disrupted market functioning and made it difficult for willing buyers and sellers to complete transactions efficiently. For these reasons there was a collapse of confidence in the beneficial effects of active governmental intervention and participation in mineral economic activities and economic liberalization became the prevailing policy in mining sector. Legal, institutional and fiscal reforms took place and in the reform time, neoclassical economic theory prevailed. The way forward was privatization of state companies for revenue and efficiency reasons, and the attraction of foreign investors. Legislation was changed, liberalized, and made more sensitive to investors and markets. During the 1990's over 100 countries restructured their mining legislation.

An Economic View of Market Flows

It is widely recognized that well-

functioning, competitive, and efficient mineral markets are in the interests of both mineral producing and consuming nations. Market disruptions or market failures can lead to loss of profit for producers and shortages for consumers. Figure 2 illustrates potential reactions to a market disruption that has caused resource scarcity. We will first describe the flow through the market and then consider where within the flow policies might facilitate the efficient functioning of the market and correct market failures. We will also comment on the policy opportunities during periods when resource supply exceeds demand, leading to surpluses, as has recently been the case.

We begin with a market in equilibrium, which then faces a market, government, or production induced supply disruption. The latter, for example, could stem from a) natural settings (depletion), b) lack of proven reserves caused by insufficient exploration, c) environmental factors (natural disasters), or d) social factors (civil unrest). The inevitable consequence of scarcity in a market economy is increased price. Industry and producers, markets and consumers, and governments all respond to both the scarcity itself and the resultant price change. The most common industry and producer responses are: 1) lowering the cut-off grade, 2) increasing exploration, 3) reopening old and developing new mines that were previously sub-economic or infeasible, 4) diversifying sources of supply, and 5) enhancing delivery, transportation, and distribution systems. Market and consumer responses include: 1) substitution (in consumption or in manufacturing), 2) dematerialization (by increasing material efficiency or conservation), and 3) increasing usage of secondary materials by recycling, reusing, remanufacturing.

Industry and producer responses lead to upward pressure on supply, whereas market and consumer responses lead to downward pressure on demand, which will lead to another market equilibrium. The new equilibrium is in most cases not the same as the previous one, but rather fits the new circumstances that emerged after the market disruption.

From a pure neoclassical perspective, the market will re-stabilize without government intervention, albeit with dislocations and possibly severe consequences for firms, workers, and the economy as a whole.

An alternative view is that effective governmental policies can be used to enhance underlying supply- and demand-side pressures so as to more quickly re-establish an equilibrium and minimize dislocations, Governmental initiatives, incentives, and policies impact market equilibria directly or indirectly. In the case of scarcity, they

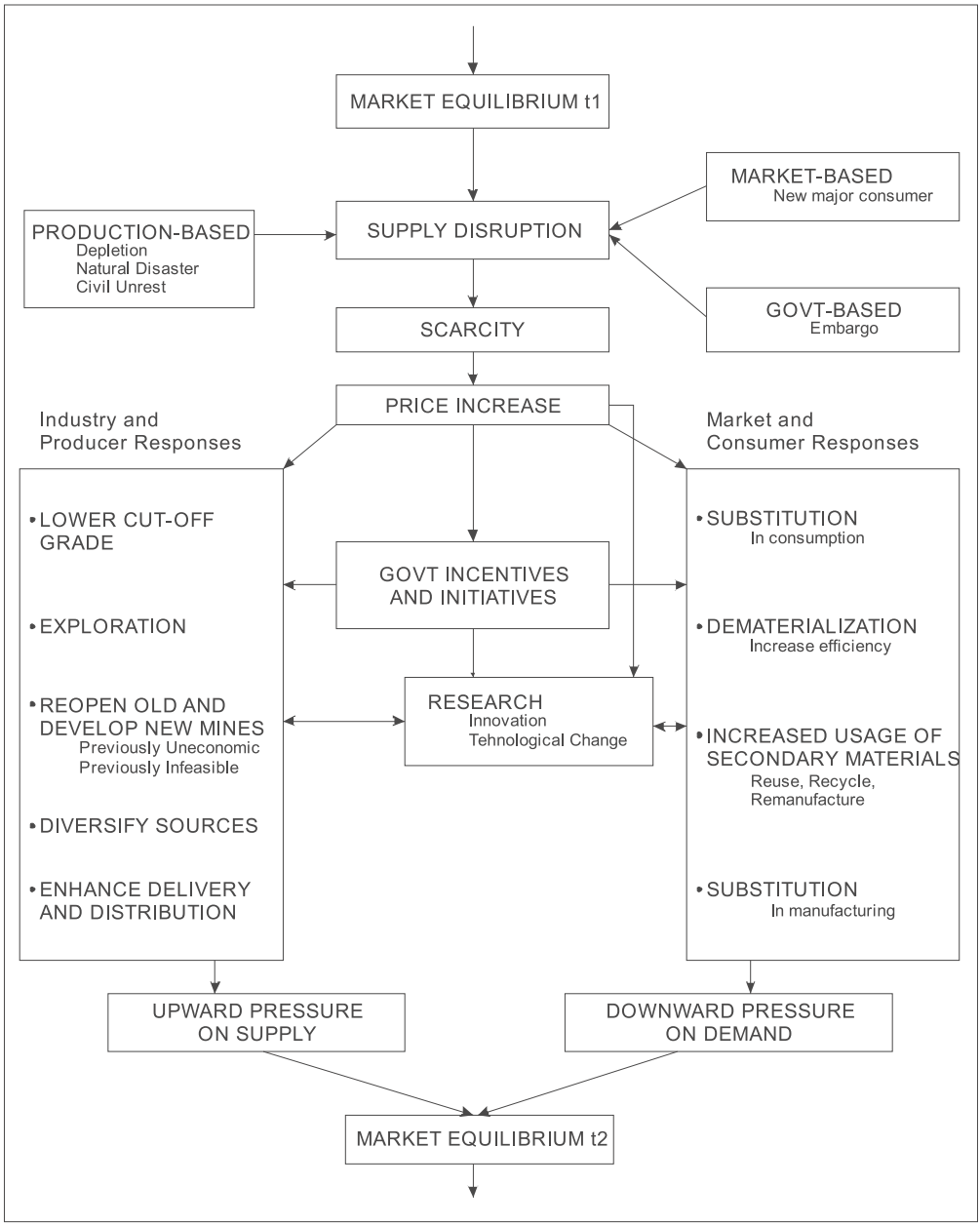

Figure 2. Mineral Market Flow

can be used to enhance the economic viability of the minerals sector through changes in taxation; increase secondary supply by promoting reuse, recycling and remanufacturing support research into substitution among resources; and to increase primary supply by encouraging exploration for and development of new deposits, facilitating trade, and funding studies of enhanced exploration and advanced extraction methods. On the demand side, government can affect consumption choices and levels through taxes or incentives, or the promotion of dematerialization.

In the case of surpluses, affected firms could be offered tax deferments, laid-off workers offered education grants or unemployment benefits, and consumers offered tax incentives to purchase resource intensive durable goods such as appliances or cars. Governments could also invest in infrastructure projects that require mineral resource inputs, which could place a floor under declining demand. For example, recent stabilization and increases in copper prices are seen by the authors as a response to national investment policies. While such policies reflect a more comprehensive neoclassical perspective, they do not in and of themselves reflect a sustainable development perspective. In the next section we discuss how sustainability principles apply to minerals and then address two core aspects of neoclassical economics that are problematic vis à vis sustainability.

Sustainability and minerals

It is inappropriate to speak of mineral resources as being sustainable in the same way as are ecosystems or biological resources. Furthermore, mining does negatively impact the environment, either temporarily or permanently. Together, these facts have led many people to express the simplistic view that mining is either inconsistent with sustainability (once extracted the resource is 'gone'), anathema (primarily a source of pollutants and environmental degradation), or of secondary importance (merely a source of virgin materials for which recycled materials or renewable resources can and should be substituted) (Cowell et al., 1999; Shields et al., 2006). But in reality, sustainable development involves managing resources in a way that is conducive to long term wealth creation and the maintenance of capital (natural, social, human, economic and physical). This perspective extends naturally to mineral resources, which are themselves a form of endowed, natural capital and are an important source of wealth creation. As a result, the discussion about minerals in sustainability now speaks of replacing depleted mineral capital with other forms of capital. The need

for environmental protection, fair and just distribution of risks and benefits, and assurance that the contribution of a mine will be net positive over the life of the project, from exploration through post closure, are also considered to be core aspects of minerals sustainability.

Given the importance of neoclassical economic theories in mineral policy, it is essential to understand how those theories deal with sustainability. A traditional economic perspective leads policy makers to focus on efficiency and cost minimizing. More specifically, the neoclassical approach to sustainable development is to treat resources and other forms of capital as substitutes and to assume that technological innovation will ensure that the needs of future generations are provided for. In other words, natural resources are viewed in the same way as we would view any other capital resource – one in which the markets can operate to generate wealth and aid societal economic advancement. By extension, markets are seen as the most appropriate tool for dealing with what is in fact an ethical question: what kind of world do we want to live in and leave for future generations (Boulding, 1966).

Conversely, ecological economists see some natural capital resources as goods that are not easily monetized and which are valued beyond what the marketplace dictates (Williams & McNeill, 2005). According to this paradigm, natural and created capitals are complements, not substitutes (Costanza & Daly, 1992). Recent literature has identified the shortcomings of traditional neoclassical theories of resource economics, including monetary valuation, substitution of natural by economic capital, traditional cost-benefit analysis and normative policy theory (see Rammel & Van den Bergh, 2005, for one review of this literature). In the subsections below we address two economic concepts that distinguish the neoclassical approach to extractive resource exploitation from the ecological economic approach: intergenerational equity and capital substitutability.

Intergenerational Equity

While providing for the future is of concern to both the neoclassical economists and the ecological economists, neoclassical economists prefer an approach in which efficient markets in the present stimulate the economic growth necessary to bring about the technological progress and innovation required to enrich generations in the future. Policies are evaluated in terms of the present value (PV) of their benefits and costs, i.e., their dynamic efficiency. PV analysis starts from the idea that people would rather have money now than in the future, either because purchasing power is expected to be lower in the future due to inflation, or because present money could be invested to gener-

ate income for the future. The present and future values of a sum of money are made comparable by discounting to present levels the future value. The 'discount rate', or rate of time preference, reflects a person's (or firm's or a society's) preference for money now versus money in the future.

Benefits minus costs = Σ_i (net revenue) $/(1 + r)^i$

Where: i is the number of years into the future
r is the discount rate.

Any discount rate greater than zero places lower value (importance) on future costs and benefits than those accruing in the present time period. The longer the time horizon, the less value is placed on far future revenues and the less important environmental and social costs are deemed to be. Hence a larger discount rate indicates a preference for the present generation over future generations. Larger discount rates also infer shorter time horizons – the time for which economic benefits will be gained. A zero discount rate indicates a preference that future generations be treated the same as the present generation. As a generalization, neoclassical economists believe a discount rate above zero is appropriate because investments now will make future generations better off and thus better able to deal with future costs, as will technological advancements, which are funded with current revenue streams. Ecological economists believe that a higher discount rate produces an inequity between the generations and is therefore inherently unfair.

One of the challenges of mineral policy relate to the private versus social. The former reflects the preferences of the individual or the firm, while the latter necessarily takes a longer term societal view with the goal of bettering society over time. From a neoclassical perspective, the optimal mineral extraction rate is best determined by maximizing the net present value (the PV of revenues minus costs) of the deposit over the expected life of the mine. The discount rate used should reflect what the firm could have earned with their money in the next best alternative investment available to them (Hotelling, 1931). Mineral policy should create a situation in which firms are able to optimize extraction based on the private rate of time preference, because doing so will benefit society by providing minerals and also creating wealth.

Although there will undoubtedly be fewer natural resources available to future generations (exhaustible resources will be depleted to some degree), there will also be better technology producing larger amounts of other capital (Stiglitz, 1979; Solow, 1986; and Hartwick, 1977). Utilizing this approach, a

neoclassical economist would say that it is acceptable to exhaust a mine in order to benefit society today as long as the rents created from the mining are invested in the creation of new man-made capital that greater economic benefits than the mine itself produces (Harris, 2003).

The core difficulty with the approach is the reality of market failure. Firms do not incorporate intangible losses (costs) into their financial calculations. Environmental impacts are addressed as expenditures to follow regulations about emissions, to reduce water use and GHG (greenhouse gas) emissions, reclamation etc, but not loss of habitat or displacement of species. Community impacts are included as expenditures to local governments, provision of facilities such as medical clinics. But impacts that cannot be monetized cannot be addressed in a PV calculation. As a result ecological economists reject the neoclassical approach as biased toward business interests, and lacking in fairness to future generations because it uses a discount rate. (The topic of optimal extraction and discount rates for minerals continues to be debated; see for example Eisenhauer, 2005; Krautkramer, 2005.) This fundamental disagreement between neoclassical economists and ecological economists leads us to the issue of capital substitutability.

Capital Substitutability

In 1932, J. R. Hicks introduced substitutability into the resource economic discussion. His concept, along with the previously mentioned work, became the basis for the neoclassical approach to resource substitutability. Under this paradigm, as the price of a resource rises, the demand for the resource decreases, and substitutes (some man-made, some natural) become economically feasible. As such, non-renewable resources will never be completely exhausted; they will simply be replaced by other goods as the resource price becomes prohibitive. This neoclassical position on substitution is known as weak substitutability.

An implication of weak sustainability as expressed by neoclassical economics is that consumption need not be diminished even as the stocks of natural capital decline, as long as the profits generated from the resources are invested in technologies which further the growth of economies. In short, it is the total amount of capital available that matters, regardless of whether it is man-made capital or natural capital. In fact, some neoclassical economists have expressed the belief that natural capital (resources) may not be necessary at all. Such a thought was presented by Solow (1994), who argued that "If it is very easy to substitute factors for natural resources, there is in

principle no 'problem.' The world can, in effect get along without natural resources, so exhaustion is just an event, not a catastrophe." Another, related view is that the fixed-stock paradigm of resources is fundamentally flawed and should be replaced by an opportunity-cost paradigm (Tilton & Lagos). This perspective incorporates the view that technological change can ameliorate depletion, but goes further to suggest that the real issue is what societies are willing to pay to get minerals.

The alternative view is strong sustainability, which is much more restrictive with respect to the ability and feasibility of substituting man-made capital for natural capital. Under strong sustainability, certain types of capital are seen as complements rather than the replacements for each other, and as such the exhaustion of any resource presupposes limits on society in general. In the same manner as it is no longer the ability to catch fish that limits the ability to feed the populace, but rather the availability of fish that serves as the limit, the ability to produce more energy and mineral resources is not limited by the extraction technologies, but rather by the resources themselves (Gordon et al, 2007; Williams & McNeill, 2005; Daly, 1994). This position does not imply that nonrenewable resources should be left in the ground and not be developed, but rather that there needs to be adhered to a set of minimum conditions which leaves the future with necessary resources. Costanza & Daly (1992) suggest such minimum conditions for the development of both renewable and nonrenewable resources. For renewables, the suggested approach is to limit the consumption to sustainable yield levels, while non-renewable extraction profits (resource scarcity rent) should be invested in the development of renewable natural capital. It has also been suggested by other authors that in some circumstances or locations mining is not acceptable, even if profits can be reinvested, if other irreplaceable natural or social capital will be lost.

Sustainability and policy

The requirements for progress towards sustainability are (Gibson et al., 2005): 1) socio-ecological integrity, 2) livelihood sufficiency and opportunity, 3) intra-generational equity, 4) inter-generational equity, 5) resource maintenance and efficiency, 6) socio-ecological civility and democratic governance, 7) precaution and adaptation, and 8) immediate and long term integration. All of these topics are relevant to the minerals sector, and each can be addressed through policy. However, in most countries current mineral policies, which for the most part are based in pure neoclassical economics and narrowly focused, either do not deal with these issues or address them

partially or tangentially. An important characteristic of these policies is their stand-alone nature; they lack direct connection with or reference to other closely related policies such as those for environmental protection. .

Existing mineral policies reflect the issues and interests of the prior eras when they were put in place. The public policies of the 19th and 20th centuries embodied societal interest in settlement, industrial development, and economic expansion. Core policy issues related to the resource endowment, its size and longevity, its management, and the distribution of economic rent among workers, equity holders, the state and others (Tilton, 2000). Even in circumstances where sustainability is considered, proposed policy options tend to focus on topics such as intergenerational rent distribution and ensuring the appropriate economic climate for innovation (*ibid)* or setting aside 'reserved' mineral deposits for future development (Otto & Cordes, 2002).

The purpose of sustainability policy is to codify the principles and goals of sustainability in a manner consistent with the social structure and desires of the nation in question with the objective ensuring a sustainable future. One key goal would be social betterment, and another is intergeneration equity. In addition, sustainability-based policies need to respond to complex, interconnected, and broad scale issues. To ask whether a policy or economic alternative is 'sustainable' only makes sense within the context of the economy and environment (Woodward & Bishop, 1995).

With respect to minerals, sustainable policies need to: 1) facilitate the transformation of natural mineral capital into built physical, economic, environmental or social capital of equal or greater value; 2) ensure that environmental and social impacts of mining are minimized and their costs incorporated into production functions; and 3) require transparency and information sharing; 4) reconsider the allocation of rights and the availability of resources across generations; 5) address benefit/risk tradeoffs from the perspective of multiple stakeholders, and create contingency plans that will ameliorate the effects of mineral market booms and busts (Shields & Šolar, 2004). It is also essential that a sustainable mineral policy be correlated and consistent with other governmental policies (Shields et al., 2002). A sustainable mineral policy utilizes the strengths of neoclassical economics with respect to reaching a market equilibrium, but goes beyond that theoretical construct to incorporate the issues that are foundational to sustainability.

Conclusions

The foregoing discussion suggests that a pure neoclassical approach to sustainability has serious limitations. Assumptions about substitution are unrealistic and concern for future generations is truncated by positive interest rates. Further, unquestioning faith in the efficacy of markets and free trade present their own problems, as the recent recession has clearly demonstrated. Market failure is a recognized phenomenon; not all externalities are captured or priced. As a result, mineral prices do not reflect the full cost of commodity production. And trade, while potentially beneficial to a society as a whole, may actually harm certain groups within that society. This type of outcome is not consistent with sustainability principles. Finally, markets are essentially amoral, whereas sustainability is an ethical construct. Markets are not concerned with and cannot be depended upon to reach what societies consider fair or equitable resource allocations within or between generations.

Current mining policies address land ownership, access, taxation, trade and employment, etc., but not capital transformation, social impact reduction, or fairness. Other issues relevant to sustainability, such as environmental protection and worker safety, may be handled in separate legislation, but are seldom part of the policy set of mineral producing countries. The issues current mineral policies address are important and cannot be ignored; however, the scope of mineral policy will need to be broadened to incorporate such topics as the social costs of development and production, equity, and transparency. On the other hand governmental initiatives are beneficial to sustainability outcomes.

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