Deliverable D7.07

Sustainability and effects of policies: the case of coal

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Outline

- The survey (D7.07) on policy options to internalize externalities concerns coal as there is a large and growing role played by coal especially in emerging and less developed countries

- Important externalities associated with it: environmental and social

- The question arises: is this emerging pattern sustainable?

Outline of presentation

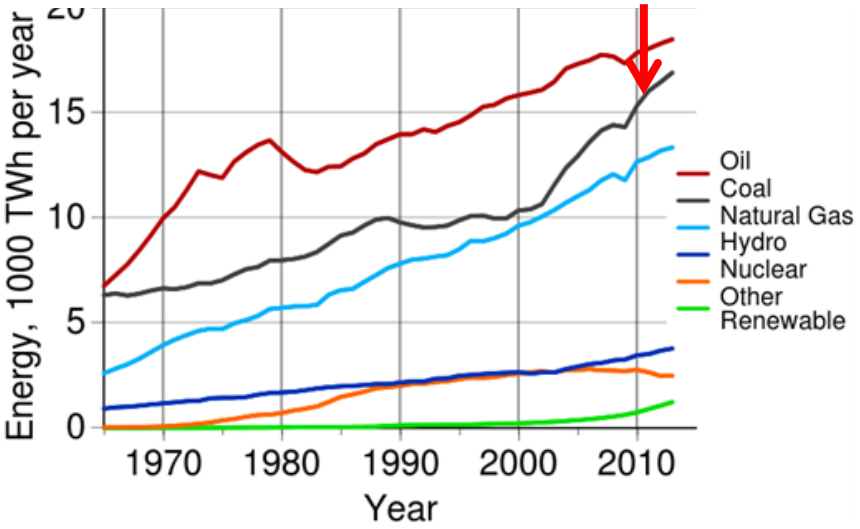
- Background on coal industry
- Efficiency, externality and policy options
- Review of the literature
  - Empirical study framework
  - Results for social externalities
  - Results for environmental externalities
- An evaluation in terms of sustainability of the policy options actually implemented in different countries is the main result

- Conclusions

Background

Coal is frequently associated with the old ages and seems a neglected fossil fuel but…

The coal consumption is constantly increasing and many countries have significant quantity of coal (BP 2013)



US EIA expects that the world coal consumption will increase by 56% in the period 2007- 2035

It is well-known that coal consumption has several side effects – main source of CO2 –
ExternE estimates that external cost of coal plants is 1.5 millions of Euro

CO2 is intensively tackled with innovative technologies and policy initiatives
Is enough for minimizing the coal side effects?

Externalities in coal mining

Underground mines

- Horizontal access or vertical sharf
- Tunnels

Responsible for methane emission (coal mine methane) and mortality and morbidity

Surface mines

- area, contour, mountain top removal
- Minor labour costs

Responsible for several environmental impacts (forest loss, landscape damages, water loss or contamination) mortality and morbidity

Policies (market vs no-market based) can internalize these effects – inefficiency –and achieve an efficient allocation

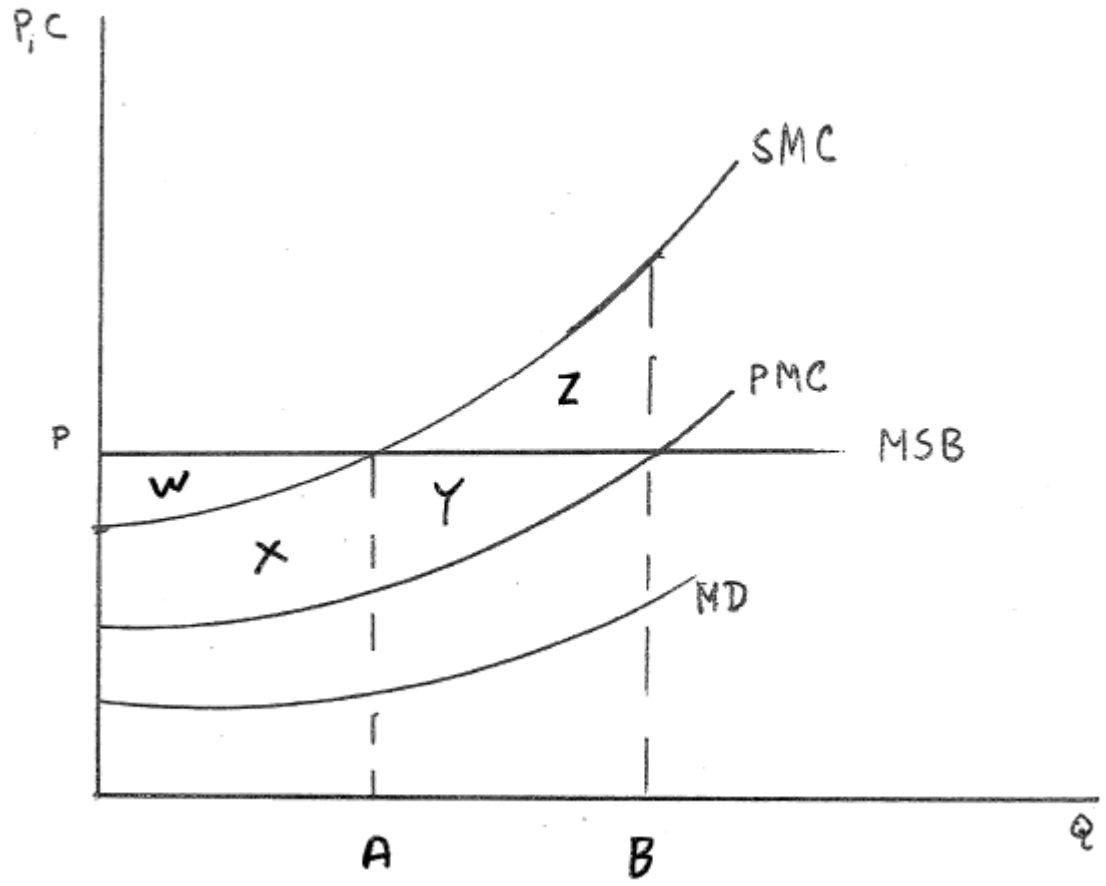
Why are they still no implemented? They are COSTLY

Life cycle Analysis of coal (Epstein et al 2011): the cradle

Mining	Social externalities	Environmental externalities
Underground	Mortality and morbidity in coal communities	Methane emissions
	Health risks due to abandoned mines	Abandoned mines
Surface	Mortality and morbidity in coal communities mines	Biodiversity lost
	Health risks due to water and air contamination	Rivers, stream, ponds water contamination
	Coal miners labour risks	Air contamination
		Methane emission
		Acid rain
	Health risks due to abandoned mines	Landscape effects due to abandoned mines

Surface mines in the world

Externalities and efficiency



If the farm has the right to clean water:

At 0A firm's surplus is W+X whereas the damage inflicted to the farm is X: so *an agreement* is possible to get to the efficient solution

This however requires an assumption about the marginal utility of income
Analogously if the firm has the right to produce (Y+Z>Y)

The effects of policies

- All the policy implemented to correct an externality have intrisecally redistributive effects
- Efficiency condition cannot select a particular productive allocation along the production possibility curve: to do so we need a social welfare function that embodies a specific hypothesis on income distribution unless we assume homogeneity in preferences
- Hence it is possible that policy makers choose a policy option taking into consideration this aspect

Review of coal mining policy options

Working hypothesis:

1. if an externality presents higher impact (quantification of impacts) more policy options will be available
2. Policy options reviewed for their effects
3. Several differences are expected across countries - emerging economies

Advanced Web search:

- 126 single search in Google and Google scholar following these rules:
- Written in English;
- Physical or monetary measures;
- Keywords driven search
- Web page domain search

Advanced web search

String of key words search:

Key word string	*Policy options	@ Externalities	Web dominie
Quantitative assessment of effects of (*) to damages from coal surface mines/underground mines/ abandoned mines to (@);	Pigouvian taxation, charges, subsidies, tradable permits, voluntary actions, command and control policies, regulation, environmental bonds, insurance workers	biodiversity loss; methane emissions; emissions fires; water contamination; particulate emissions; sludge slurry ponds; mortality morbidity health coal communities miners	.org; .gov; .ue; .gov.uk; .gov.au; . .cn; .ch

- More than 300,000 documents found
- For every single combination the first 10 relevant studies were considered
- More than 50 studies were extracted and detailed analyzed

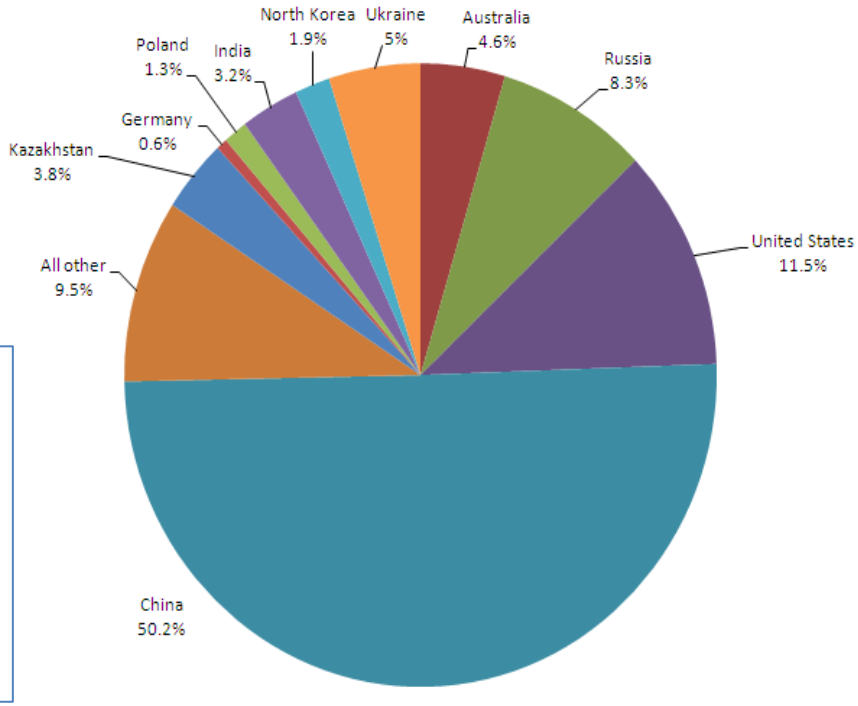
Results: quantitative impacts of coal mining

		Quantitative measures
Social	Mortality and morbidity in coal communities	6,500 to 16,500 deaths annually (UNDP 2000)
	Coal miners labour risks	30% more risk of hypertension, 64% more risk of chronic obstructive pulmonary disease, 70% more risk of kidney disease
Environmental	Methane emissions	8-12% of global methane emissions
	Abandoned mines	5-9% of national methane emissions
	Biodiversity lost	45%-90% biodiversity loss in surface mines
	Rivers, stream, ponds water contamination	6% of rivers loss in surface mines
	Air contamination	na
	Acid rain	na
	Landscape effects due to abandoned mines	20% loss od forest in surface mines

Results: Methane emissions

- Methane (CH4) is a dangerous greenhouse gas with a much higher radiative efficiency than CO2.
- Underground mines contribute for 90% of the coal methane emissions
- Governments initially regulate methane concentration for healthy reason:
  - Ventilation
  - Degassification
- The coal mine methane (CMM) is the gas released with coal
- CMM as an alternative fossil fuel
- Externality vs fossil fuel
- The leader in CMM are China, US

  Russia e Australia



Unresolved legal issues concerning the **property rights** of CMM have traditionally been one of the most significant barriers to recovery projects.

Results: methane results in a nutshell

Country	% CMM used	Methane regulations for healthy reason	Policy actions for CMM	Policies Effects
China	10	90s	regulation and subsidies	Technology improvements for CMM draining

Results: methane in the US

- Methane was first an issue for health and safety reason:
  - 1910 Bureau of Mines
  - 1941 Power of control to the bureau
  - 1969 Federal Coal Act strength production and define penalties
  - 1977 Surface Mining Control and Reclamation Act consolidate all federal laws
- Only in 1994: Methane is recognized for its environmental effects
- CMM can be freely managed by coal lessee if emitted;
  royalties applied if it is commercially used
- 1994 Coalbed Methane Outreach Programme – companies committed to capture and use methane
- 2004 the Global Methane Initiative promoted research and innovations for tackling methane around the World

- The 1977 law aim at reducing disparity between states, improve competitiveness and minimize equity problems
- In 15 year 81% of methane capture equal to 150-350 millions revenues (EPA 2011)

Results: methane in China

- Methane was first an issue for health and safety reason:
  - In the 90s many small mines (mostly illegal) were closed
  - 1996 Mineral resource law was revised to monitor coal supply
- CMM is an associate mineral
- 2005 'Five years plan 2006-2010' program aims at recovering and use CMM
- 2006 'Opinions on speeding op CMM' – principles for CMM extraction
- 2007 'Notice on CMM price management', the gas price can be freely negotiated, if it is used for local heating then the price is equal to the heating power, CMM energy plans have priority by grid operators
- 2010 Executive Opinions on subsidising CMM, financial subsidies for company able to use CMM for locals

- The 2005 programme improves CMM draining quota but not use (Cheng et al 2010)
- 2006 regulation applied by many coal companies
- Chinese government is committed to reduce CMM and is using market and non market instruments
- No proper policies assessment is ready yet

Results: mortality and morbidity risks

- Mining is one of the most dangerous job
- Over 100,000 deaths since last centuries and many more died of a 'slow death'
- On average 7,000-17,000 deaths annually
- Underground and surface mining present different rate of risk

	Underground			Surface			
	explosions	**strata fall**	**both**	**explosions**	**strata fall**	**both**	**All fatalities**
China	2145	188	2333	17	35	52	3532
US	49	26	75	0	4	4	177
Russia	na	na	na	na	na	na	1340
Australia	0	0	0	0	0	0	8

- Coal mines communities risks:
  - Lung cancer, respiratory, kidney and lung diseases
  - Heart attack, stroke and asthma
  - High blood pressure
  - Hearing problems
  - Respiratory symptoms especially in children
  - Low birth weight and other problems

Results: mortality and morbidity in US

- The 1977 Federal Mine Safety & Health Act national harmonization of states' legislation on mines which had created inequity in competitiveness, safety and miners' health.
- Coal regulations in the US had distributional effects on energy and metal industries
- The cost of regulations in the US is roughly a 40%
- US surface mines are less regulated and results show that coal communities bear the external effects.
- This is a an effective warning to emerging countries not to adopt policies that have proved to be ineffective

Results: mortality and morbidity in Australia

- Several regulations issued and managed by each state
- In 90s a shift from compliance to self-management of health and safety was initiated

- In 2000 a national legislation aimed at harmonizing the health and safety in coal mines
- In 2002 the National Mine Safety Framework specify principles for coal industry promoting self regulation, unionization of workers and other voluntary options
- The regulations have satisfactory effects and number of fatalities is very low
- No study formally values the distributional effect of the policies

Limitations of web search

- Web search was systematic and comprehensive, but it is possible that some articles were missed.
- The tendency toward publication bias (where studies with statistically significant findings are more likely to be published) we may have overestimated some effects
- The google research algorithm provides different results if the research is repeated: this limits the possibility to re-test the findings.

Overall conclusions

- Coal mining produces several externalities not fully internalized in the production process
- Coal price is still very low and demand very high
- Methane is still the most relevant externality for mine but several projects aim at using methane as alternative fossil fuel
  - US is promoting voluntary agreement for methane use – *minor distributional effects problems*
  - Australia forces energy producers to use CMM
  - China promotes methane use with financial incentives (guarantee prices or subsidies)
- Methane has unclear property rights, a limit for companies and governments especially for its current use as energy source
- Mortality and morbidity rate is decreasing but…
  - China and Russia start recently to regulate and controls are still few
  - Australia is very successful using self-regulating, self management strategies
  - US regulations is not very stringent and fatalities are still occuring

Conclusions on policy instruments

- The sustainable use of coal cannot be easily achieved

- Command and control and voluntary agreements are the main instruments used in the coal industry. Several reasons:
  - the implementation of market based policies can be complex, costly and may require sophisticate institutional settings
  - for social externalites they seek to avoid that the weak part of the population bears the costs of externalities
- Policies are continuously evolving especially in emerging economies (China, Russia)
- The methane emission can be improved using well defined property rights

- The ex-post assessments of policy are extremely rare

THANK YOU