Environmental and Employment impact of resource use in India: A case study of copper

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Abstract

India's recent economic boom has led to a significant growth in the infrastructure sector. Copper metal, that finds large application in various infrastructure related sector like telecommunication, electrical and construction, has too experienced growth. This has led to a rise in the demand for the primary resource copper ore and concentrates in India. Apart from some major players in the copper production sector, there also exist around 1000 small scale units involved in conversion to ingots from scrap metal. The growing demand for copper ore has significant impact on the total emission and employment generation of the sectors that are directly and indirectly dependent on the resource. To capture some of those interlinkages, cross sectoral impact on environment and employment has been estimated through the SAM (Social Accounting Matrix), using input output table. The emission coefficients show that highest emission is expected to be observed in manufacturing basic iron, steel, precious and non ferrous metal. Also, impact on employment is observed for energy products followed by manufacturing of basic iron, steel, non ferrous and agricultural sector. The findings call for a larger integration of the institutions to implement measures tackling the emission related issues of the copper industry and its associated effect on other sectors of an economy. However, this would require an intervention from all the central and state agencies. Laying policy principles for technological innovations for emission reductions, efficient recycling and utilization of wastes, proper management of energy resources in the copper and copper scrap sector holds a key towards

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addressing environmental emission. Also, concerted efforts towards policy implementation will help in attaining sustainable extraction and use of copper resource in India.

Key words: Demand and supply of non-renewable resources (Q31), Input output model (C67), Pollution (Q53), Labour employment (J21), Government policy (Q38)

Introduction:

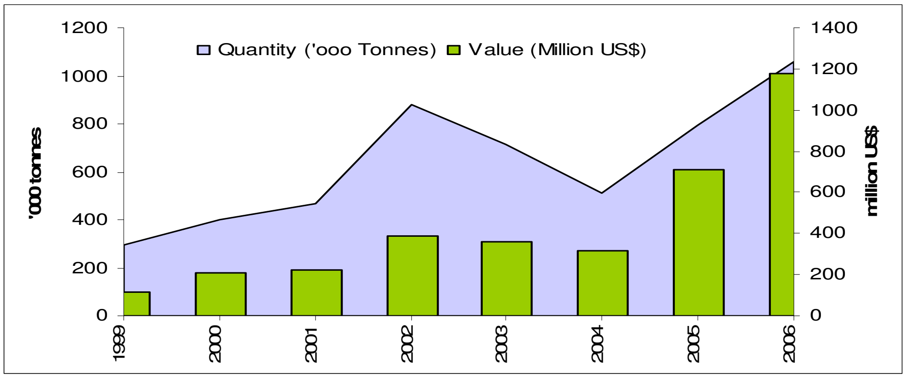
Expansion of secondary and tertiary sectors led to high growth of Indian economy in recent years. Such growth has been accompanied by growth of infrastructure and service sector. Copper is largely used (directly or indirectly) in such sectors (like construction). India is dependent on import of high grade copper ores from countries like Chile, Zambia, Indonesia and Australia due to limited domestic availability. With this background, an enhanced growth of sectors using copper would create pressure on domestic resources and can increase the reliance of India on import of copper ore.

Growth of telecom, electrical and construction are the major sectors contributing to rapid growth of copper usage (see copper outlook, Karvy, 2006). To cope up with this huge demand for copper, India has to depend on imported sources of copper ore and concentrate because of two reasons. Firstly, Indian copper ore is not of very good quality[5] (lower copper concentration) and secondly, domestic copper ore availability (in India, copper reserves are mainly concentrated in Jharkhand, Rajasthan and Chhattisgarh) is not sufficient enough to meet this demand. Currently about three fourth of Indian copper requirement is met by imported copper and remaining one fourth is met by domestic copper.[6] Indian import of copper ore and concentrate has decreased within 2002-04 and increased thereafter both in quantity and value terms (figure 1). Major source of India for copper ore import are Chile, Indonesia, Zambia, Australia and Canada.[7] The copper imports have also grown over the years in the following way –

[5] Indian copper ore has a copper content of 1.2-1.3% compared to world average of 2-3%.

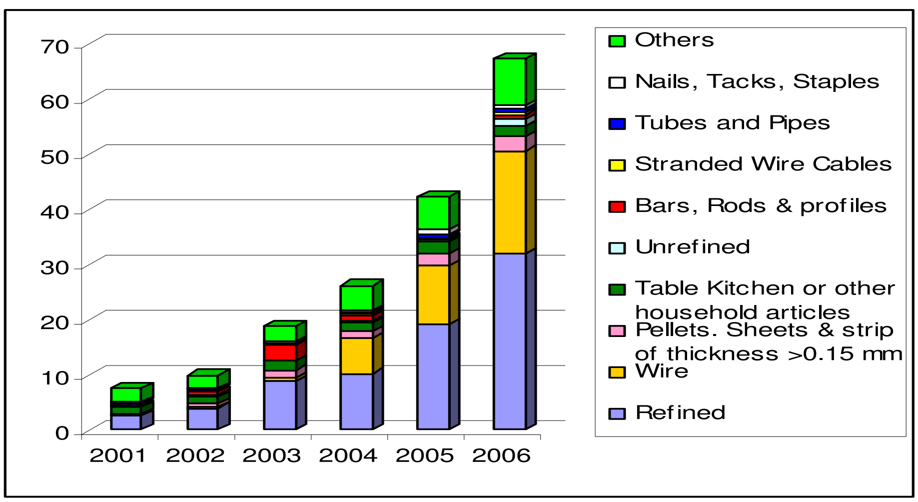
[6] www.mecl.gov.in/Reports/RamchandraPahar.pdf last accessed on 22 July, 2009

[7] http://www.crnindia.com/commodity/copper.html last accessed on 22 July, 2009



Source – ICRA, Indian copper industry, October 2006

This growth in imports have been matched by an increase in the copper consumption intensity in different countries of the world. Even if India is importing copper ore and concentrate, simultaneously it also exports refined copper and copper products. Among the copper related export, refined copper and copper products have major contribution. Total copper export of India has increased from Rs. 7.492 billion in 2002 to Rs. 67.328 billion in 2006. Major export destinations of copper items for India were China (17.5% of total value), Saudi Arabia (17.1%), UAE (12.4%) and Singapore (6.2%)[8].



Source – ICRA, Indian copper industry, October 2006

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8 http://www.intracen.org/appli1/TradeCom/TP_EP_CI_P.aspx?IN=74&RP=699&YR=2006&IL=74%20%20Copper%20and%20articles%20thereof&TY=E, last accessed on 6th April, 2009

Indian government increased custom duty on copper ore and concentrate from 2.0% to 2.1% between 2006-07 and 2008-09. During the same period, excise duty on copper ore and concentrate has decreased from 16.3% to 14.4% (with an intermediate increase to 16.5% in 2007-08).Custom duty on refined copper has increased to 5.2% from 5.1% within 2006-07 and 2008-09. Excise duty for refined copper is same as that of copper ore and concentrate[9]. The major Indian players in copper industry are Hindustan Copper Limited (HCL) (public sector enterprise), Hindalco and Sterlite (private enterprise). Among them, HCL is involved in mining, smelting and refining but other two are engaged in copper smelting and refining. Recently they are also exploring opportunities in mining abroad to get access to high quality mineral ores. For example, Hindalco has acquired two copper mines and Sterlite has acquired one copper mine in Australia. Apart from these companies, there exists about 1000[10] SSIs involved in copper industry which are mainly engaged in conversion of ingots from scrap. The industry had produced 519 thousand metric tonnes of ingots in 2006-07 with a consumption of 413 thousand metric tonnes (including recycled scrap)[11]. Most small scale units operate through energy intensive processes and an increase in the production of output could lead to an increase in emissions. On the other hand, employment in Indian mining and quarrying sector has increased from 10.05 lakh to 12.37 lakh[12] (public and private organised sector) in between 2000-07. The annual average growth rate of employment is 0.026% in that period. Apart from that, there are many unorganised small scale units in mining sector which are mainly labour intensive. Their production, employment and emission are interlinked. To capture such a linkage, a social accounting matrix (SAM) has been constructed and an emission coefficient matrix for all the sectors of Indian economy has been made. The multipliers from SAM will show how the output for each of the sectors would increase for unit increase in the demand for copper from various sectors of the Indian economy. To create SAM, an input output matrix for Indian economy has been constructed. The details of an input output matrix and SAM is given below –

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9 www.**crisil**.com/india-budget-analysis/industry/**nonferrous**_0809.pdf

10 www.metalworld.co.in/feature1-0208.pdf, last accessed on March 2010

11 Indian copper industry, ICRA, 2006

12 Economic Survey 2009-10

Input Output and Social Accounting Matrix:

An input output table for the Indian economy has been constructed. Input output table has been constructed with a focus on the resource copper. This means that copper producing and consuming sectors were considered in detail. Input output table consists of primary, secondary and tertiary sectors of an economy. Primary sectors account for activities like agriculture, animal husbandry, mining, fishing, and quarrying. Secondary sectors account for manufacturing activities. Tertiary sectors account for service sector related activities. All together, 238 sectors have been taken which have been further aggregated to 24 sectors of the economy.

The data for the input output table has been estimated by modifying the planning commission input output table and incorporating amendments in the input data based on the 2007- 08 National Industries Classification (NIC) database. From NIC database, 56 sectors capturing copper ore and equipments were aggregated and built into the input and output table. The modified input output table shows the flow of income between copper producing and copper using intermediary and final sectors. Once the input output table has been prepared, a social accounting matrix has been developed by incorporating the income flows across production sectors and other economic agents like households (including rural, urban), factors of production (labour, capital), government and trade flow with Rest of World (through export, imports). In addition to 24 sectors of input output table, 17 agents of the Indian economy have been considered in the SAM. SAM is constructed under the principle that for every income there is a simultaneous outlay in the economy.

SAM is a square matrix which shows cross agent transactions in an economy. So, SAM could be represented as $R = \{r_{jk}\}$. The matrix R is arranged in a way so that each group of transaction in the Indian Economy has a corresponding row and column in the matrix. This means that receipt of the transactor j is entered into the row j of the SAM. Following this, the expenditure of k is entered in column k. Thus flow of money takes place from k to j, r_{jk} accounts for the total value of receipts of j which flow from k during the accounting period considered. Similarly r_{kj} means flow of money from j to k during the accounting period (The accounting period considered here is 2007 – 08).

One interesting caveat to this is that the matrix should be a square matrix[13] where corresponding row and column total for each transaction should be equal. This is because in each transaction, for every receipt there must be some matching expenditures that are equal to the total income (for that transaction) in aggregate. So for every sector the total receipts should match the total expenditure.

A simple structure of SAM (related to copper for this study) in brief is shown in the table below. The row represents the receipts while column accounts for expenditure for a particular transaction.

	Production account	Factors of production	House hold	Private corporate	Public non-departmental	government	Indirect tax	Capital account	Rest of the World
Production account	Input Output Table (A11)		Private consumption (A13)			Government consumption (A16)		Investment (A18)	Export (A19)
Factors of production (Land, Labour and Capital)	Value added (VA) (A21)								Net factor income (A29)
House hold (5 rural and 4 urban class)		VA Income (A32)				Govt. transfers, interests on debt (A36)			Net current transfer (A39)
Private corporate		Operating profit (A42)				Interest on debt (A46)			
Public non-departmental		Operating surplus (A52)							
government		Income from entrepreneurship (A62)	Income and Wealth taxes (A63)	Corporate taxes (A64)					
Indirect tax	Indirect taxes on purchase (A71)		Consumption taxes (A73)			Indirect taxes on purchase (A76)		Indirect taxes on purchase (A78)	
Capital account		Depreciation (A82)	Household savings (A83)	Corporate savings (84)	Public non departmental savings (A85)	Govt. savings (A86)			Foreign savings (A89)
Rest of the World	Imports (A91)					Govt transfer to RoW (A96)			

[13] Number of rows is same as number of columns.

Production account receipts originate from intermediate and final demand comprising of household and government expenditures, investment and net exports. Cost of production includes gross value added and value of indirect taxes. Incomes of the factors of production are transmitted to the owners of factors of production. Household receives income from government transfers as well as from interest on public debts, income transfers from rest of the world. Households incur expenditure on consuming goods and services and also pay income taxes. The rest is saved by the household. Income of private corporate sector arises out of interest on holding public debt and value added. The private corporate sector pays the corporate tax and the remaining amount is the saving. Income of the public non departmental enterprise is the operating surplus or the saving. Government receipts consist of income from entrepreneurship, direct and indirect taxes. Outlay of government comprises of final expenditure on goods and services, transfers, interest payments to households, private corporate sector, transfers to the rest of the world. Capital account receipts come from net savings of different institutions and depreciation.

SAM as a standalone matrix is not a model. Once there is a specification of the closure rule in SAM it becomes a model. With a multiplier model, income and employment effects for various sectors can be found out. The multiplier would show how the output, income and employment changes in the sectors of Indian economy owing to changes in demand. The next section highlights the framework of the SAM multiplier, emission coefficient matrix and the corresponding results as obtained in our model.

Multiplier and Results:

Emission Coefficient Matrix:

The emission coefficient matrix has been prepared from substances account. A substances account depicts information on emissions, wastes in physical units. Such an account has a row, column and each of the matrix space shows the flow on use and supply of various emissions, wastes in physical units. Here flow of emissions of chemicals, wastes etc. has been considered. The emission consists of different kinds of pollutants which are – a) carbon dioxide, b) methane (CH_4), c) suspended particulate matter (SPM), d) oxides of sulphur (SOx), e) carbon monoxide (CO) and f) oxides of nitrogen (NOx). Such emissions (in tones) have been divided by the total value of the output (Rs. lakhs) to arrive at the direct pollution emission coefficient matrix.

These emissions have been considered to be coming from imports, consumption activities and domestic production. Emission emerges from domestic production and consumption. These emission coefficients are being multiplied by the SAM multipliers that shows by how much the emission across the sectors would increase due to rise in the demand for the sectoral outputs of the Indian economy.

SAM multipliers are estimated through the following steps. The first step in our calculation is the estimation of the expenditure coefficient matrix. This has been done by dividing each element in T_{ij} (as given in the diagram above) by the corresponding sum of the column/row vector Y_j. From this, using the identity $Y = AY + X$ we have got the multiplier $(I - A)^{-1}$.

$(I - A)^{-1} = M$ is the multiplier matrix in our model. Such a multiplier matrix comprises multipliers of factors, institutions, activities and capital account. The multiplier matrix shows how an increase in any element of Xi (for instance changes in demand for any goods in any sector) would increase the corresponding element of Yi (the corresponding supply of the goods whose demand increases) and how it would impact other elements (like employment associated with the production of goods whose demand increases and also how this would impact other sectors where the good is used as an intermediate). So the multiplier matrix would have *own effect multipliers* and *cross effect multipliers*. A change in any element of X (direct and indirect demand for the goods) would impact Y (the supply of the good whose direct and indirect demand changes) as any rise in demand impacts the respective sectors (having a direct demand for the good) as well as it impacts the other related sectors (where the good is used as an intermediary input).

Also an increase in company incomes would raise the government income through larger tax collection from profits. These impacts could be termed as transfer effects of income.

For instance an increase in a production activity raises the demand for factors of production raising the income level of the factors of production. A rise in factor incomes would raise income in the accounts of the institutions. An increase in the income of the factor would result in an increase in their spending which would further raise the demand and thereby would raise the economic activity and production. So an increase in income could have cross multiplier effects. Multiplier effect could be used to estimate the impact on employment by using the labour output ratios. The first step is to calculate the labour output ratio. Once the labour output ratio is calculated the multipliers could be multiplied with the labour output ratio to find out the change in the labour demand and supply. Similarly, multiplying the emission coefficients with the SAM multiplier results, we could get the change in emission from a particular sector due to change in demand for that or another sector.

Integrating the multiplier matrix and the emission coefficients we can calculate how for an increase in each unit of demand, emissions for the sector would increase.
With this background of the SAM, the next section would highlight the multiplier results for the Indian economy showing monetary flows across the sectors.

Results:

Multiplier Results:

Sectors	Agriculture	Energy Products	Iron and Manganese Ore
Agriculture	A1	A2	A3
Energy Products	B1	B2	B3
Iron and Manganese Ore	C1	C2	C3

The table above shows that a percentage change in the demand for energy product sector would require an increase of A2 in the agriculture sector. If the entry would have been –

A2 then it would have meant that a percentage change in the demand for energy sector would have led to a reduction of A2 of production in the agriculture sector. Similarly, B1 means that a percentage increase in demand for agriculture sector would lead to an increase of B1 level in the energy products sector. If the entry would have been – B1 then it would have meant a percentage reduction of B1 level of production in energy product sector due to a percentage increase of demand for agriculture sector.,The multiplier matrix highlights how the requirement of a sector changes for a change in the demand of the product in the sector under consideration.

A cross comparative picture of the sectoral emissions, employment is highlighted in the next sections below –

Emission coefficient:

For an increase in demand in any sector, the production level will increase in that sectors and other related sectors. The increase in production will be accompanied by increase in emission. The emission coefficient table is shown in appendix. Each cell in the table shows that, how much total emission will change in a particular sector, when demand for output in a sector, where the former used as input will increase by one percent. For example, for an increase in per unit demand of agricultural products, total emission increases in agricultural sector by 0.40444 units. Similarly, for a per unit increase of demand for copper equipment sector (CUE), total emission increases in agricultural sector by 0.000000689 unit. But total emission increase in copper equipment sector is 7.8330 units, while total emission increase in copper ore production sectors is 0.000162 unit. The sectors which are major contributor to emission compared to other sectors are Manufacture of basic iron, steel, ferrous metal (16.91% for one percent increase in demand for output of that sector), Copper equipments (7.83% for one percent increase in demand for output of that sector), Aluminium (7.83% for one percent increase in demand for output of that sector), Non-ferrous basic metals (7.83% for one percent increase in demand for output of that sector).

Employment coefficients:

Apart from emission, for any change in demand driven output, the employment potential will also change in that sector. Since wage varies across skill and sectors, change in demand of a particular sector will change the labour distribution in all other sectors at least in long run. On the other hand, if a sector adopts a particular technology to control emission that might change the sectoral employment based on the capital /labour intensiveness of the technology. The following table shows the employment elasticities of Indian economy for different sectors. The figure shows that how for one unit change in the demand for an output in a particular sector, demand for labour (which is a proxy for employment) changes accordingly.

Code - commodity	AGR	EGP	IMO	BXT	CUO	CUE	MNM	MMP	CCM	NFB	HTH	TAI
Labour	0.000186	0.000315	0.000000	0.000000	0.000000	0.000000	0.000002	0.000010	0.000107	0.000002	0.000001	0.000017
Code - commodity	JJW	ASC	ELA	RWM	FBV	TLP	PCP	ALU	MIS	DMA	MTE	SER
Labour	0.000006	0.000001	0.000017	0.000001	0.000020	0.000008	0.000178	0.000000	0.000241	0.000087	0.000015	0.000011

Note: The Full name of the sectors are given in appendix

Note: Labour stands for labour demand in a particular sector

This table shows that for a unit increase in demand for agricultural sector, labour demand increases by 0.000186 units in that sector. Similarly, labour demand will increase by 0.00002 units in food and beverage sector, for a unit increase in demand .in that sector. The major employment potential are in Energy Products (0.000315), Manufacture. of basic iron, steel, ferrous metal (0.000241), Agriculture (0.000186) and Petrochemical Products (0.000178) compared to other sectors.

In order to address the sectoral emissions and the effect of an increase in the sectoral demands on output and employment, it would be important to design and create interlinking policies. The nature of the focus of such interlinking policies is laid out in the next section –

Interlinking policies:

Currently, the policies that exist in the mineral resource sector are - MMDR Act (1957), MCR (1960), MCDR (1988). There is a scope of larger integration of the institutions to implement measures tackling the issues of emissions in the copper industry as a whole. This would require an integrated and coordinated action of all the central and state agencies. Laying down of the policy principles of technological innovations for reduction of emissions, efficient recycling and utilisation of the wastes, proper management of the energy resources in the copper and copper scrap sector holds a key towards addressing environmental emission domain of the copper industry. This has to be followed by effective modes of actions. Parallely, labour policies have to be aligned and well defined to link up with the issues of employment that could arise in the copper sector as shown by the multipliers in the above sections. As the multiplier shows the nature of increase in the demand for labour owing to an increase in the demand for output in the selected sectors of the economy, it becomes imperative to design policies taking care of how the increased demand for labour could be absorbed. The policies have to mention how an effective labour employment potential can be created in these sectors owing to the rise in demand as reflected by our multipliers. As a support structure to implement such policies, fiscal measures in terms of mobilization, efficient allocation and channelling of money for larger exploration of minerals have to be streamlined. Fiscal measures would mean redesigning of royalty structures, budgetary measures, grants, concessions as instruments to pool money for technological innovation and for addressing the effects of an increase in production of copper. Well defined policies have to deal with issues of recycling potential, possible and stockpiling of copper reserves, future investment in efficient technologies for recycling and for creation of greater exploration of copper from options like sea bed mining. All these measures have to be linked to the possible effects of increase in sectoral demands for copper and copper products on emissions, employment and output across the sectors of the Indian Economy. This necessitates the need for creation of a holistic interlinking policy plan and its subsequent implementation for realization of attaining the pathway of sustainable development in key mineral resource producing sectors like copper in India. The need for such a policy plan has been aimed to be raised through the SAM oriented emission multipliers that has been presented in this paper.

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Appendix:

Code used for different sectors:

Sector	Code	Sector	Code
Agriculture	AGR	Jems & Jewellery	JJW
Energy Products	EGP	Aircraft & spacecraft	ASC
Iron and Manganese Ore	IMO	Electricity appliances	ELA
Bauxite	BXT	Recycling of waste metals and non-metals	RWM
Copper Ore	CUO	Food & Beverage	FBV
Copper Equipments	CUE	Textile, leather and wood product Printing and service activities related to printing	TLP
Metallic & non metallic minerals	MNM	Petrochemical Products	PCP
Miscellaneous metal products	MMP	Aluminium	ALU
Chemical, cement & non-metallic product & metals	CCM	Manufacture. Of basic iron, steel, ferrous metal	MIS
Non-ferrous basic metals	NFB	Electrical appliances & domestic machinery appliances	DMA
Hand tools, hardware	HTH	Transport	MTE
Tractors, machine & misc. equipment	TAI	Services	SER

Table: Total emission coefficients

Part 1:

Code	AGR	EGP	IMO	BXT	CUO	CUE	MNM	MMP	CCM	NFB	HTH	TAI
AGR	0.40444	0.000039	0.000000	0.000000	0.000000014	0.000000689	0.000003	0.000010	0.000150	0.000028	0.000000	0.000002
EGP	0.00000	2.725626	0.000000	0.000000	0.000000001	0.000000059	0.000008	0.000157	0.008390	0.000913	0.000002	0.000023
IMO	0.00000	0.000000	0.560317	0.000000	0.000000000	0.000000001	0.000000	0.000014	0.000990	0.000007	0.000000	0.000001
BXT	0.00000	0.000000	0.000000	0.560317	0.000000000	0.000000001	0.000000	0.000015	0.000092	0.000100	0.000000	0.000001
CUO	0.00000	0.000000	0.000000	0.000000	0.560317943	0.000162823	0.000000	0.000021	0.000029	0.000101	0.000000	0.000001
CUE	0.00000	0.000000	0.000000	0.000000	0.000000000	7.833027099	0.000000	0.000047	0.000001	0.000000	0.000016	0.000014
MNM	0.00000	0.000027	0.000000	0.000000	0.000000005	0.000000264	0.560319	0.000037	0.002046	0.000321	0.000002	0.000016
MMP	0.00000	0.000124	0.000000	0.000001	0.000000043	0.000000717	0.000005	1.501817	0.001917	0.000213	0.000010	0.000241
CCM	0.00000	0.000459	0.000003	0.000000	0.000000102	0.000000715	0.000016	0.000389	11.291048	0.000328	0.000049	0.000768
NFB	0.00000	0.000025	0.000000	0.000000	0.000000004	0.000003681	0.000002	0.000384	0.008224	7.834375	0.000033	0.000467
HTH	0.00000	0.000044	0.000000	0.000000	0.000000000	0.000048928	0.000000	0.000007	0.000094	0.000015	0.543134	0.000153
TAI	0.00010	0.000131	0.000001	0.000000	0.000000032	0.000212504	0.000006	0.000114	0.001080	0.000172	0.000018	0.544464

Part 2:

Code	AGR	EGP	IMO	BXT	CUO	CUE	MNM	MMP	CCM	NFB	HTH	TAI
JJW	0.00000	0.000062	0.000000	0.000000	0.000000011	0.000000599	0.000005	0.000018	0.000314	0.000065	0.000000	0.000013
ASC	0.00000	0.000010	0.000000	0.000000	0.000000002	0.000000105	0.000001	0.000002	0.000628	0.000004	0.000000	0.000000
ELA	0.00000	0.000007	0.000000	0.000000	0.000000003	0.000000100	0.000000	0.000002	0.000552	0.000004	0.000000	0.000005
RWM	0.00000	0.000011	0.000000	0.000000	0.000000002	0.000004160	0.000001	0.000004	0.033320	0.000005	0.000000	0.000003
FBV	0.00000	0.000015	0.000000	0.000000	0.000000004	0.000000175	0.000001	0.000006	0.000545	0.000008	0.000000	0.000001
TLP	0.00000	0.000077	0.000000	0.000000	0.000000023	0.000000472	0.000004	0.000096	0.048614	0.000022	0.000011	0.000102
PCP	0.00006	0.000179	0.000005	0.000003	0.000000221	0.000000605	0.000007	0.000139	0.005517	0.000026	0.000010	0.000074
ALU	0.00000	0.000000	0.000000	0.000000	0.000000000	0.000000003	0.000000	0.000001	0.000002	0.000000	0.000000	0.000000
MIS	0.00000	0.000065	0.000000	0.000000	0.000000016	0.000000982	0.000005	0.000763	0.000702	0.000033	0.000080	0.000500
DMA	0.00000	0.000023	0.000000	0.000000	0.000000005	0.000000282	0.000002	0.000007	0.000129	0.000011	0.000000	0.000002
MTE	0.00000	0.000123	0.000000	0.000000	0.000000018	0.000000532	0.000004	0.000015	0.000289	0.000032	0.000003	0.000038
SER	0.00000	0.001024	0.000014	0.000010	0.000000903	0.000000309	0.000027	0.000594	0.012335	0.001465	0.000049	0.000456

Part 3:

Code	JJW	ASC	ELA	RWM	FBV	TLP	PCP	ALU	MIS	DMA	MTE	SER
AGR	0.000012	0.000004	0.000002	0.000003	0.000075	0.000040	0.000045	0.000000	0.000318	0.000004	0.000010	0.000425
EGP	0.000006	-0.000001	0.000000	0.000001	0.000002	0.000002	0.000067	0.000000	0.000185	0.000009	0.000004	0.000006
IMO	0.000000	0.000002	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000040	0.000001	0.000002	0.000000
BXT	0.000001	0.000000	0.000000	0.000002	0.000000	0.000000	0.000000	0.000129	0.000000	0.000000	0.000000	0.000000
CUO	0.000002	0.000000	0.000000	0.000006	0.000000	0.000000	0.000000	0.000033	0.000000	0.000000	0.000000	0.000000
CUE	0.000000	0.000029	0.000041	0.000048	0.000000	0.000003	0.000000	0.000000	0.000003	0.000000	0.000006	0.000000
MNM	0.000197	0.000002	0.000000	0.000002	0.000000	0.000006	0.000016	0.000002	0.000077	0.000003	0.000006	0.000001
MMP	0.000013	0.000004	0.000001	0.000007	0.000001	0.000017	0.000038	0.000000	0.000216	0.000006	0.000067	0.000019

CCM	0.000010	0.000003	0.000001	0.000002	0.000002	0.000011	0.000068	0.000000	0.000196	0.000011	0.000647	0.000031
NFB	0.000023	0.000002	0.000001	0.000006	0.000000	0.000007	0.000015	0.000002	0.000295	0.000007	0.000047	0.000002
HTH	0.000001	0.000000	0.000000	0.000002	0.000000	0.000017	0.000002	0.000000	0.000311	0.000008	0.000160	0.000028
TAI	0.000012	0.000002	0.000001	0.000002	0.000004	0.000014	0.000312	0.000000	0.000464	0.000044	0.000988	0.000220

Part 4:

Code	JJW	ASC	ELA	RWM	FBV	TLP	PCP	ALU	MIS	DMA	MTE	SER
JJW	1.922018	0.000004	0.000001	0.000003	0.000001	0.000111	0.000038	0.000000	0.000174	0.000011	0.000012	0.000153
ASC	0.000002	1.560528	0.000000	0.006553	0.000000	0.000008	0.000007	0.000000	0.000085	0.000002	0.000001	0.000000
ELA	0.000002	0.000001	0.543154	0.000057	0.000003	0.003213	0.000047	0.000179	0.021194	0.001139	0.000066	0.000005
RWM	0.000001	0.000001	0.000001	1.920684	0.000000	0.001706	0.000411	0.000003	0.017614	0.000453	0.000004	0.000002
FBV	0.000003	0.000001	0.000001	0.000003	0.387936	0.000008	0.000014	0.000000	0.000074	0.000014	0.000081	0.000137
TLP	0.000010	0.000003	0.000002	0.000002	0.000088	3.486286	0.002724	0.000000	0.002906	0.000008	0.000059	0.000378
PCP	0.000018	0.000004	0.000235	0.000003	0.000142	0.003041	1.941414	0.000000	0.005286	0.000014	0.000355	0.000979
ALU	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	7.832767	0.000001	0.000000	0.000000	0.000000
MIS	0.000036	0.000005	0.000641	0.000004	0.000004	0.000134	0.000261	0.000000	16.915131	0.000013	0.000809	0.000779
DMA	0.000005	0.000002	0.000002	0.000001	0.000000	0.000012	0.000027	0.000000	0.000146	0.543138	0.000012	0.000010
MTE	0.000010	0.000003	0.000005	0.000003	0.000003	0.000034	0.000059	0.000000	0.000638	0.000005	1.561714	0.000358
SER	0.000807	0.000012	0.000829	0.000001	0.001046	0.010300	0.005197	0.000000	0.029852	0.000054	0.001729	0.390927