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The CHAT Dataset

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Working Paper

10-035

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ABSTRACT

This note accompanies the Cross-country Historical Adoption of Technology (CHAT) dataset. CHAT is an unbalanced panel dataset with information on the adoption of over 100 technologies in more than 150 countries since 1800. The data is available for download at:

http://www.nber.org/data/chat

 We discuss the main aim of CHAT, its scope and limitations, as well as several ways in which we have used the data so far and ways to potentially use the data for other research.

Suggested acknowledgment:

If you use the CHAT dataset for your research, please include the following citation:

"Our technology measures come from the CHAT data set which is an extension of the data set described in Comin and Hobijn (2004)"

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1. INTRODUCTION

There is a wealth of cross-country data on measures related to national accounts, social indicators, institutions, etc. One of the stylized facts that come out of the many empirical analyses done with these data is that most cross-country differences in standards of living seem due to differences in Total Factor Productivity, rather than observable inputs.

Because, by nature, TFP is essentially a residual derived from the difference between the level of output and the contributions of measured inputs, this fact begs the question what factors that are not included in the TFP calculation underlie these TFP differentials.

The most conventional interpretation of TFP would be that it reflects differences in **technologies** used across countries. In addition, there are many other factors, like institutions, climate, policies, that could also affect relative TFP levels. As for the conventional technology-centric interpretation, in order to study what part of cross-country differentials in productivity levels are due to the differences in technologies that countries use one would need a dataset that contains information on the use of many technologies in many countries, as well as, preferably, many years.

The Cross-country Historical Adoption of Technology (CHAT) dataset that we introduce here is meant to be such a dataset. It contains information on the diffusion of about 104 technologies in 161 countries during the last 200 years. It extends the data used in Comin and Hobijn (2004) and Comin, Hobijn, and Rovito (2006).

In the rest of this note we aim to do two things. First, we discuss the goals we strived for in the collection of CHAT, the scope of the dataset, as well as its limitations. Second, we review some of the research we have already done with the data and touch on some ideas for future research.

2. AIM AND SCOPE OF CHAT

When collecting the data contained in CHAT, we aimed for the following three goals:

- As long a time series as possible.

- As large a sample of countries as possible.

- As many technologies as possible.

FREQUENCY OF OBSERVATION AND LENGTH OF SAMPLE

Almost all of our source data is only available at an annual frequency. Because of that and because our main focus is long-run economic growth rather than short-run fluctuations, the dataset uses an annual frequency of observation. For some of the older technologies, like steamships, data go back until the early Nineteenth Century. The last year in the sample is 2003. Some data, especially in the earlier part of the sample, is not available at an annual frequency.

DEFINITION OF COUNTRIES

Because the CHAT dataset contains data for a very long time period, countries have fragmented and unified over the sample period. When assembling the data set, we dealt with country fragmentations and reunification processes in the following way:

- When *a majority of the territory remained after the fragmentation* or a *majority of the unified territory corresponded to just one of the pre-unification countries* we identified the unified country with the larger part. In cases of country fragmentation, we identified a successor country where a large portion of the territory remained as a single country; in cases of unification, we identified a precursor country in a similar manner. For example, Russia and the U.S.S.R have been treated as one national entity, as have Germany and West Germany.

- In cases where *a country divided into or merged from a number of more or less equal pieces*, we chose to treat the whole and the parts as different countries. Examples of this approach include Yugoslavia, Czechoslovakia, and Korea.

The resulting sample contains 161 countries.

TECHNOLOGIES

According to Merriam-Webster's Collegiate Dictionary, technology is

"*a manner of accomplishing a task especially using technical processes, methods, or knowledge*"

The technology measures in CHAT capture a similar intuition. They are either: (*i*) the number of capital goods specifically related to accomplishing particular tasks, (*ii*) the amounts of particular tasks that have been accomplished, (*iii*) the number of users of a particular manner to accomplish a task.

These three types of measures are best illustrated with three examples. (*i*) The number of sail ships (measured in tonnage) in use in a country; (*ii*) Metric tons of steel produced using blast-oxygen steel furnaces; (*iii*) the number of households that subscribe to cable tv services.

Throughout the collection of CHAT, our philosophy has been to apply as broad a definition of technology as possible, allowing the user of the data to decide which (sub-) sample of technologies in the data is most appropriate for the specific research question at hand.

The result of this broad interpretation is that the CHAT data set contains information on the diffusion of 104 technologies. Table 1 lists the technology measures it contains and the source for each technology.

These technology measures provide a thorough representation of the technologies utilized in eight major sectors of economic activity (agriculture, finance, health, steel, telecommunications, textiles, tourism, and transportation). These range from 2 technologies in tourism to 44 in healthcare. Table 2 presents the number of technologies covered by the CHAT data set in each of the eight sectors and specifies the technology measures that pertain to each sector.

In addition, CHAT also contains information on three, what are commonly considered, general purpose technologies that cannot be categorized by sector. These three technologies are electricity production, the number of computers, and the number of internet users.

For a majority of the variables, CHAT contains the original source data and therefore the data in CHAT are as comparable across countries and over time as in the original source. In certain instances the definition of the variable[1] changes in the original source data or because we merge different data sources. In those cases we have applied a merging method that makes the whole series consistent with the most recent definition of the variable and backward extrapolates that time series using the pre-redefinition data.

Beyond technology measures, CHAT also contains information on a few non-technological variables such as GDP, enrollment at different education levels and population.

USE OF CHAT DATA

Broadly speaking, measures of individual technologies fall into two categories: extensive and intensive. Extensive measures of technology adoption capture the fraction of potential adopters that have adopted a given technology. One example is the fraction of farmers that have adopted hybrid corn in Griliches' (1957) classic study.[2] Alternately, intensive measures of technology adoption capture the number of units of the new technology that each adopter uses. One example is the number of personal computers per capita. This measure both captures the fraction of population that uses personal computers as well as the average number of personal computers they use.

The CHAT data set contains both extensive and intensive measures of technology adoption.

Extensive measures of technology are intuitive and easy to interpret. However, they have three significant drawbacks. First, they require an assessment of who is in the set of initial adopters. This might actually vary over time; For example when the use and penetration of the technology lead to subsequent improvements in the technology which may extend the size of the potential adopters.

Second, they ignore the intensive margin, i.e. the equivalent of capital deepening, variations in which can be important to understand economic outcomes. For instance, Clark (1987) showed that the measure explaining the margin of cross-country variations in labor productivity in the textile industry was the number of spindles operated per spinner.

Finally, a key drawback of traditional extensive measures is that they are hard to compute because they require micro data. As a result, 50 years after Griliches (1957) information on the adoption of technologies is minimal and available for only a few countries for a finite number of years.

CHAT uses two types of intensive measures of technology adoption. These consist in counting either how many units of capital embodying the technology there are in the economy (i.e. number

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[1] An example would be the number of steam and sail ships in Denmark. Until 1831 the series excludes ferries and fishing vessels while after 1831 these vessels are included. For 1831 we have both the number of ships under both definitions. We use this information to construct a proxy pre-1831 variable that includes ferries and fishing ships.

[2] See also Mansfield (1961), Gort and Klepper (1982), and Skinner and Staiger (2005).

of cell phones) or how many units of a given output have been produced with the technology (i.e. tons of Bessemer steel produced).

Intensive measures of technology adoption do not suffer from the three drawbacks of extensive technology measures but they are not perfect either. By definition they also capture how many units of technology each adopter has adopted in addition to the extensive margin of adoption. To compute them we do not need to define who is a potential adopter nor do we need micro data. The drawback of intensive measures of technology adoption is that they can be difficult to interpret.

One possibility is to construct a model with implications for the measures of technology for which data is available. Then it is possible to estimate structurally the model to obtain information on the desired parameters. We have taken this approach in Comin and Hobijn (2008) where the curvature of intensive measures of technology adoption at a given moment depends on the lag with which these technologies are adopted in the country. This prediction allows us to estimate a (constant) adoption lag per technology and country.

However, many researchers would like to have technology measures that can be interpreted easily without the need of a structural model. In Comin and Hobijn (2009) we propose one approach to do that which consists of the following steps. First, the intensive technology measure is scaled by population. Then the variable is log transformed to remove the units from the technology measures and make them more comparable across technologies. Finally, in the regression stage, a full set of technology-year dummies is included to remove the average diffusion path for a technology across countries. This approach basically captures factors such as externalities, sunk costs, etc that affect the frictionless diffusion path in different ways.[3] Note that this is possible only because CHAT is a three-dimensional data set (i.e. time, country and technology).

A different way to transform the intensive technology measures consists of taking a given country (e.g. the US) as benchmark and measuring how many years behind (or ahead) the US a given is country in adopting the technology. This approach is utilized by Comin, Hobijn and Rovito (2008). Specifically, the usage lag of technology x in country c at year t is defined as the answer to the following question: How many years before year t did the United States last have a usage intensity of technology x that country c has in year t? One advantage of these time lags is that, naturally, they are expressed in the same unit (i.e. years) for all technologies.

Finally, there is one important practical consideration to bear in mind when using CHAT to explore the diffusion process of technologies. Authors that have this goal should be aware that since technologies typically become dominated at some point in time, CHAT contains information also of the phase where technologies are substituted. To explore the diffusion phase, it may be desirable to censor the time series at the point when the technology becomes obsolete or dominated. There are different approaches that can be followed to do that:

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[3] Comin and Hobijn (2009) use this approach to estimate the effects of lobbies on technology adoption. Additionally, Comin and Nanda (2009) use the same method to estimate the effect of financial market development on technology diffusion.

a. Use information on the invention date of the new technology to censor the data for the dominated technology. This approach however may not be optimal given that technologies, especially those that are antiquated, are adopted with very long lags in developing countries.

b. Observe when the distribution of technology across countries becomes stable (i.e. reaches a state that resembles a balanced growth path). Like the first approach, this may be hard to do when the study includes both developing and developed economies.

c. Use a different censoring year per technology and country which corresponds to the year when the technology reaches the maximum adoption level in the country.

CONCLUSION

We hope that this public-use version of CHAT will contribute to furthering our understanding of how the diffusion of technologies has contributed and still contributes to the standards of living in different parts over the world.

The CHAT Dataset

Table 1

VARIABLE NAME	DEFINITION	SOURCE
ag_harvester	Number of self-propelled machines that reap and thresh in one operation	FAOSTAT (2004)
ag_milkingmachine	Number of installations consisting of several complete milking units	FAOSTAT (2004)
ag_tractor	Number of wheel and crawler tractors (excluding garden tractors) used in agriculture	FAOSTAT (2004)
atm	Number of electromechanical devices that permit authorized users, typically using machine-readable plastic cards, to withdraw cash from their accounts and/or access other services	BIS (various years) and ECB (various years)
aviationpkm	Civil aviation passenger-KM traveled on scheduled services by companies registered in the country concerned. Not a measure of travel through a country's airports	Mitchell (1998)
aviationtkm	Civil aviation ton-KM of cargo carried on scheduled services by companies registered in the country concerned. Not a measure of travel through a country's airports	Mitchell (1998)
bed_acute	Number of beds available for those seeking in-patient acute care, including diagnosis or treatment of an injury or illness and performance of surgery	OECD (2005)
bed_hosp	Number of beds, including inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centers. In most cases beds for both acute and chronic care are included	WORLD BANK (2005)
bed_longterm	Number of beds for people who need assistance on a continuing basis due to chronic impairments and a reduced degree of independence in activities of daily living (including those in both hospitals and nursing homes)	OECD (2005)

The CHAT Dataset

VARIABLE NAME	DEFINITION	SOURCE
cabletv	Number of households that subscribe to a multi-channel television service delivered by a fixed line connection	WORLD BANK (2007)
cellphone	Number of users of portable cell phones	WORLD BANK (2007)
cheque	Number of payments by cheque (in millions)	BIS (various years), ECB (various years), EMEAP (2002)
computer	Number of self-contained computers designed for use by one person	WORLD BANK (2007)
creditdebit	Payments by credit and debit cards (in millions)	BIS (various years), ECB (various years), EMEAP (2002)
eft	Number of transactions using payment cards at points of service (retail locations)	BIS (various years) and ECB (various years)
elecprod	Gross output of electric energy (inclusive of electricity consumed in power stations) in KwHr	Mitchell (1998), WORLD BANK (2007)
fert_total	Metric tons of fertilizer consumed. Aggregate of 25 individual types listed in source	FAOSTAT (2004)
internetuser	Number of people with access to the worldwide network	WORLD BANK (2007)
irrigatedarea	Area equipped to provide water to crops, including those with full and partial control irrigation or spate irrigation and equipped wetland or inland valley bottoms	FAOSTAT (2004)
kidney_dialpat	Number of patients receiving dialysis treatments, both at centers and at home	OECD (2005)
kidney_homedialpat	Number of patients receiving dialysis treatments at home	OECD (2005)

The CHAT Dataset

VARIABLE NAME	DEFINITION	SOURCE
loom_auto	Number of operable looms (of a certain size) in place at year end and are either automatic or have automatic attachments (as opposed to ordinary looms)	International Cotton Bulletin (various years)
loom_total	Number of operable looms in place at year end, including those that are automatic (as defined above) and those that are ordinary.	International Cotton Bulletin (various years)
mail	Number of items mailed/received, with internal items counted one and cross-border items counted once for each country. May or may not include newspapers sent by mail, registered mail, or parcel post	Mitchell (1998)
med_catscanner	Number of computed tomography (CT) scanners, also known as 'CAT' scans for computed axial tomography	OECD (2005)
med_lithotriptor	Number of extracorporeal shock wave lithotripters, a machine typically used to break down kidney stones	OECD (2005)
med_mammograph	Number of dedicated mammography machines	OECD (2005)
med_mriunit	Number of magnetic resonance imaging (MRI) units	OECD (2005)
med_radiationequip	Number of pieces of equipment for treatment with x-rays or radionuclide	OECD (2005)
newspaper	Number of newspaper copies circulated daily. Note that there is a tendency for news circulation to be under-reported, since data for weekly and biweekly publications are not included	Banks (2004)
pctdaysurg_cataract	Percent of cataract surgeries performed without a hospital stay	OECD (2005)
pctdaysurg_cholecyst	Percent of cholecystectomies performed without a hospital stay	OECD (2005)
pctdaysurg_hernia	Percent of hernia procedures performed without a hospital stay	OECD (2005)
pctdaysurg_lapcholecyst	Percent of laparoscopic cholecystectomies performed without a hospital stay	OECD (2005)

The CHAT Dataset

VARIABLE NAME	DEFINITION	SOURCE
pctdaysurg_tonsil	Percent of tonsillectomies (with or without adenoidectomy) performed without a hospital stay	OECD (2005)
pctdaysurg_varicosevein	Percent of varicose veins procedures performed without a hospital stay	OECD (2005)
pcthomedialysis	Percent of dialysis patients who receive treatment at home	OECD (2005)
pctimmunizdpt	Percent of children aged 12-23 months who received a DPT immunization (including all three doses) before the age of one year	WORLD BANK (2007)
pctimmunizmeas	Percent of children aged 12-23 months who received a measles immunization (one dose only) before the age of one year	WORLD BANK (2007)
pctirrigated	Irrigated area (as defined above) as a share of cultivated land, which includes land used for permanent and temporary crops, pasture, land used for temporary crops, and land lying temporarily fallow	FAOSTAT (2004)
pctmvbyarea	Share, by area, of cropland planted with modern varieties. Weighted average of modern variety percentage for all crops included in Evenson dataset (barley, cassava, etc)	Evenson and Gollin (2003)
pest_total	Metric tons of active ingredients in pesticides used in or sold to the agricultural sector. Aggregate of 32 individual types. Some countries may have reported formulation weight (instead of active ingredients)	FAOSTAT (2004)
pos	Number of retail locations at which payment cards can be used Note: Per-capita data was converted to level data using WORLD BANK (2007) population data	BIS (various years) and ECB (various years)
radio	Number of radios	Banks (2004)
railline	Geographical/route lengths of line open at the end of the year. Narrow gauge lines generally included, but mountain railways, purely industrial lines not open to the public, and urban systems generally excluded	Mitchell (1998)
railp	Thousands of passenger journeys by railway. Free passengers typically excluded but may be included for some countries	Mitchell (1998)

The CHAT Dataset

VARIABLE NAME	DEFINITION	SOURCE
railpkm	Passenger journeys by railway in passenger-KM. Free passengers typically excluded but may be included for some countries	Mitchell (1998)
railt	Metric tons of freight carried on railways (excluding livestock and passenger baggage). Freight for servicing of railroads is typically excluded but may be included for some countries	Mitchell (1998)
railtkm	Ton-KM of freight carried on railways (excluding livestock and passenger baggage). Freight for servicing of railroads is typically excluded but may be included for some countries	Mitchell (1998)
ship_all	Number of ships of all kinds (above a minimum weight) in use at midyear. Please see also general note on all ship-related series at end of list	Mitchell (1998)
ship_motor	Number of motor ships (above a minimum weight) in use at midyear. Please see also general note on all ship-related series at end of list	Mitchell (1998)
ship_sail	Number of sail ships (above a minimum weight) in use at midyear	Mitchell (1998)
ship_steam	Number of steam ships (above a minimum weight) in use at midyear	Mitchell (1998)
ship_steammotor	Number of steam and motor ships (above a minimum weight) in use at midyear	Mitchell (1998)
shipton_all	Tonnage of ships of all kinds (above a minimum weight) in use at midyear	Mitchell (1998)
shipton_motor	Tonnage of motor ships (above a minimum weight) in use at midyear	Mitchell (1998)
shipton_sail	Tonnage of sail ships (above a minimum weight) in use at midyear	Mitchell (1998)
shipton_steam	Tonnage of steam ships (above a minimum weight) in use at midyear	Mitchell (1998)

VARIABLE NAME	DEFINITION	SOURCE
shipton_steammotor	Tonnage of steam and motor ships (above a minimum weight) in use at midyear	Mitchell (1998)
spindle_mule	Number of mule spindles in place at year end	International Cotton Bulletin (various years)
spindle_ring	Number of ring spindles in place at year end	International Cotton Bulletin (various years)
steel_acidbess	Crude steel production (in metric tons) by the acid Bessemer process (an early steel process)	International Iron and Steel Institute (various years)
steel_basicbess	Crude steel production (in metric tons) by the basic Bessemer process (an early steel process)	International Iron and Steel Institute (various years)
steel_bof	Crude steel production (in metric tons) in blast oxygen furnaces (a process that replaced Bessemer and OHF processes)	International Iron and Steel Institute (various years)
steel_eaf	Crude steel production (in metric tons) in electric arc furnaces (a process that complemented and improved upon Bessemer and OHF processes)	International Iron and Steel Institute (various years)
steel_ohf	Crude steel production (in metric tons) in open hearth furnaces (a process that complemented the Bessemer process)	International Iron and Steel Institute (various years)
steel_other	Crude steel production (in metric tons) by methods other than those listed here	International Iron and Steel Institute (various years)
steel_stainless	Stainless steel production (in metric tons). Stainless and crude steel have different functions	International Iron and Steel Institute (various years)
surg_appendectomy	Number of appendectomies performed	OECD (2005)

The CHAT Dataset

VARIABLE NAME	DEFINITION	SOURCE
surg_breastcnsv	Number of breast conservation surgeries performed	OECD (2005)
surg_cardcath	Number of cardiac catheterizations (insertion of a catheter into a chamber or vessel of the heart) performed	OECD (2005)
surg_cataract	Number of cardiac catheterizations (insertion of a catheter into a chamber or vessel of the heart) performed	OECD (2005)
surg_cholecyst	Number of cholecystectomies (gallbladder removals) performed, either laparoscopically or by other methods	OECD (2005)
surg_corbypass	Number of coronary bypass surgeries performed	OECD (2005)
surg_corinterven	Number of percutaneous coronary interventions (used to reduced or eliminate the symptoms of coronary artery disease) performed	OECD (2005)
surg_corstent	Number of coronary stenting procedures performed. This is a particular type of percutaneous coronary intervention	OECD (2005)
surg_csection	Number of Caesarean sections performed	OECD (2005)
surg_hernia	Number procedures performed to correct inguinal and femoral hernias (the most common types)	OECD (2005)
surg_hipreplace	Number of hip replacement surgeries performed	OECD (2005)
surg_hysterectomy	Number of vaginal hysterectomies performed (does not include abdominal or laparoscopic procedures)	OECD (2005)
surg_kneereplace	Number of knee replacement surgeries	OECD (2005)
surg_lapcholecyst	Number of cholecystectomies (gallbladder removals) performed laparoscopically	OECD (2005)
surg_mastectomy	Number of mastectomies performed	OECD (2005)
surg_pacemaker	Number of pacemaker implantation procedures performed	OECD (2005)

VARIABLE NAME	DEFINITION	SOURCE
surg_prostatetrans	Number of transurethral prostatectomies performed. This is the most common type of prostatectomy procedure	OECD (2005)
surg_prostatextrans	Number of non-transurethral prostatectomies performed. This category of procedures tends to include more advanced prostatectomy procedures	OECD (2005)
surg_tonsil	Percent of tonsillectomies (with or without adenoidectomy) performed	OECD (2005)
surg_varicosevein	Number of varicose vein correction procedures (including litigation and stripping) performed	OECD (2005)
telegram	Number of telegrams sent	Mitchell (1998)
telephone	Number of mainline telephone lines connecting a customer's equipment to the public switched telephone network as of year end	Mitchell (1998), WORLD BANK (2007)
transplant_bonemarrow	Number of bone marrow transplants performed	OECD (2005)
transplant_heart	Number of heart transplants performed	OECD (2005)
transplant_kidney	Number of kidney transplants performed	OECD (2005)
transplant_liver	Number of liver transplants performed	OECD (2005)
transplant_lung	Number of lung transplants performed.	OECD (2005)
tv	Number of television sets in use	Banks (2004) and WORLD BANK (2007)
txtlmat_artif	Weight of artificial (cellulosic) fibers used in spindles	International Cotton Bulletin (various years)
txtlmat_otherraw	Weight of other types (besides artificial, synthetic, and standard raw cotton) of fibers used in spindles	International Cotton Bulletin (various years)

The CHAT Dataset

VARIABLE NAME	DEFINITION	SOURCE
txtlmat_synth	Weight of synthetic (non-cellulosic) fibers used in spindles	International Cotton Bulletin (various years)
txtlmat_totalraw	Weight of all types of fibers used in spindles	International Cotton Bulletin (various years)
vehicle_car	Number of passenger cars (excluding tractors and similar vehicles) in use. Numbers typically derived from registration and licensing records, meaning that vehicles out of use may occasionally be included.	Mitchell (1998), WORLD BANK (2007)
vehicle_com	Number of commercial vehicles, typically including buses and taxis (excluding tractors and similar vehicles), in use. Numbers typically derived from) registration and licensing records, meaning that vehicles out of use may occasionally be included	Mitchell (1998)
visitorbeds	Number of visitor beds available in hotels and elsewhere	World Tourism Organization (various years)
visitorrooms	Number of visitor rooms available in hotels and elsewhere.	World Tourism Organization (various years)
xlpopulation	Population	Maddison (2007), Mitchell (1998), Penn World Table (2007)
xlrealgdp	Scaled level of real GDP	Maddison (2007), Mitchell (1998), Penn World Table (2007)
pctivprimeenroll	Primary school enrollment rate	Mitchell and Banks
pctivsecenroll	Secondary school enrollment rate	Mitchell and Banks

The CHAT Dataset

VARIABLE NAME	DEFINITION	SOURCE
pctivprivateinv	Private investment as a share of GDP	Penn World Table (2007)
pctivpublicinv	Public investment as a share of GDP	Penn World Table (2007)
pctivliteracy	Percent literate (usually calculated on the basis of non-literate (unable to read and write) 15 years and older)	Banks (2004)

Table 2

SECTOR	# OF TECHNOLOGIES	VARIABLES
Agriculture	8	ag_harvester, ag_milkingmachine, ag_tractor, fert_total, irrigatedarea, pctirrigated, pctmvbyarea, pest_total
Finance	5	atm, cheque, creditdebit, eft, pos
Health	44	bed_acute, bed_hosp, bed_longterm, kidney_dialpat, kidney_homedialpat, med_catscanner, med_lithotriptor, med_mammograph, med_mriunit, med_radiationequip, pctdaysurg_cataract, pctdaysurg_cholecyst, pctdaysurg_hernia, pctdaysurg_lapcholecyst, pctdaysurg_tonsil, pctdaysurg_varicosevein, pcthomedialysis, pctimmunizdpt, pctimmunizmeas, surg_appendectomy, surg_breastcnsv, surg_cardcath, surg_cataract, surg_cholecyst, surg_corbypass, surg_corinterven, surg_corstent, surg_csection, surg_hernia, surg_hipreplace, surg_hysterectomy, surg_kneereplace, surg_lapcholecyst, surg_mastectomy, surg_pacemaker, surg_prostatetrans, surg_prostatextrans, surg_tonsil, surg_varicosevein, transplant_bonemarrow, transplant_heart, transplant_kidney, transplant_liver, transplant_lung
Steel	7	steel_acidbess, steel_basicbess, steel_bof, steel_eaf, steel_ohf, steel_other, steel_stainless
Telecommunications	8	cabletv, cellphone, mail, newspaper, radio, telegram, telephone, tv
Textiles	8	loom_auto, loom_total, spindle_mule, spindle_ring, txtlmat_artif, txtlmat_otherraw, txtlmat_synth, txtlmat_totalraw
Tourism	2	visitorbeds, visitorrooms
Transportation	19	aviationpkm, aviationtkm, railline, railp, railpkm, railt, railtkm, ship_all, ship_motor, ship_sail, ship_steam, ship_steammotor, shipton_all, shipton_motor, shipton_sail, shipton_steam, shipton_steammotor, vehicle_car, vehicle_com

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