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Occupational Tasks in the German Labour Market

An alternative measurement on the basis of an expert database

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Abstract

In recent times, the concept of tasks increasingly arises in the literature. Tasks defined as occupational tasks that individuals have to perform get more and more important in analysing different research questions. The most common application is the task-based approach (Autor/Levy/Murnane 2003) that explains rising wage inequality in many industrialised countries by changing tasks. However, the distinction between analytical/interactive and manual non-routine tasks as well as cognitive and manual routine tasks also provides a basic concept for further research on tasks like a task-based analysis of occupational segmentation of the labour market or occupational mobility.

In contrast to the existing task operationalisations in Germany that are based on survey data, we use – following the approach in the U.S. – expert knowledge about competencies and skills – that are usually required for performing an occupation. Based on an expert database (BERUFENET of the German Federal Employment Agency), we provide an alternative task operationalisation for Germany and calculate the main task type and the composition of tasks for different occupational classifications (German Classification of Occupations 1988 and German Classification of Occupations 2010) and for different classification levels (2-digit- and 3-digit-codes). In this paper, we describe our procedure and provide first descriptive results on the validity of our new task operationalisation.

Zusammenfassung

In der Forschung wird dem sogenannten Tasks-Konzept in jüngster Zeit vermehrt Aufmerksamkeit geschenkt. Tasks, verstanden als Aufgaben, die in einer bestimmten beruflichen Tätigkeit erledigt werden, haben bei der Analyse verschiedenster Forschungsfragen an Bedeutung gewonnen. Die wahrscheinlich bekannteste Anwendung ist der Task-Based-Approach (Autor/Levy/Murnane 2003), in dem die zunehmende Lohnungleichheit in vielen industrialisierten Ländern durch veränderte Tasks erklärt wird. Die Unterscheidung von analytischen/interaktiven und manuellen Nicht-Routine-Tasks sowie kognitiven und manuellen Routine-Tasks bietet auch eine gute konzeptionelle Basis für eine weiterführende Tasks-Forschung, beispielsweise einer tätigkeitsbasierten Analyse der beruflichen Segmentierung des Arbeitsmarktes oder beruflicher Mobilitätsprozesse.

Für Deutschland wurde die Tasks-Operationalisierung bislang mit Befragungsdaten vorgenommen. Im Gegensatz dazu nutzen wir jedoch – in Anlehnung an die Vorgehensweise in den USA – Expertenwissen über die Kenntnisse und Fertigkeiten, die üblicherweise für die Ausübung einer beruflichen Tätigkeit notwendig sind. Auf der Basis einer Expertendatenbank (BERUFENET der Bundesagentur für Arbeit) haben wir eine alternative Tasks-Messung für Deutschland vorgenommen und den Haupttasks-Typ und die Tasks-Komposition für verschiedene Berufsklassifikationen (Klassifikation der Berufe 1988 und Klassifikation der Berufe 2010) und Klassifikationsebenen (2-Steller und 3-Steller) berechnet. In diesem Methodenbericht dokumentieren wir unser Vorgehen und geben in einigen deskriptiven Darstellungen einen ersten Eindruck von der Validität der neuen Tasks-Operationalisierung.

Keywords: occupational tasks, task-based approach, alternative measurement of tasks, expert database BERUFENET, Germany

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1 Introduction

The term "tasks" used in the context of labour market research has its origin in the analysis of the hypothesis of skill-biased technical change (SBTC) which states that the rise in wage inequality is due to an increased demand for high-skilled individuals (Katz/Murphy 1992; Levy/Murnane 1992). Recent empirical studies reveal a polarisation of employment and wages of high-skilled and low-skilled individuals on the one hand and of medium-skilled individuals on the other hand (Acemoglu/Autor 2011; Goos/Manning 2007; Goos/Manning/Salomons 2011; Lemieux 2006). Besides a number of other approaches (an overview is given in Kierzenkowski/Koske 2012; Lemieux 2008), Autor/Levy/Murnane (2003) developed the task-based approach (TBA) which explains the rising wage inequality in many industrialised countries by a change of tasks: Machines substitute routine tasks and complement non-routine tasks. Therefore, the wages of high-skilled and low-skilled individuals increased relative to the wages of medium-skilled individuals, who are more likely to perform routine tasks (Autor 2013; Autor/Dorn 2013; Autor/Katz/Kearney 2008).

In Germany, a polarisation of employment has been observable since the 1990s (Dustmann/Ludsteck/Schönberg 2009; Spitz-Oener 2006). So far, a polarisation of wages due to changed tasks has not been found (Antoncyzk/Fitzenberger/Leuschner 2009). However, it is unclear if there is no wage polarisation in Germany or if problems with the operationalisation of tasks are responsible. To shed light on the wage polarisation in Germany, Antoncyzk/Fitzenberger/Leuschner (2009) use a task operationalisation of Spitz-Oener (2006) based on survey data (BIBB-IAB or BIBB-BAuA employee surveys). In contrast, the task operationalisation by Autor/Levy/Murnane (2003) relies on expert knowledge about the tasks which are usually performed in a specific occupation and are available in the Dictionary of Occupational Titles (DOT) or the Occupational Information Network (O*NET).

Since we have a similar expert database in Germany describing, among others, the tasks usually performed in different occupations (BERUFENET of the German Federal Employment Agency), we present an alternative task measurement for Germany in this paper. We develop five task types for the German classification of occupations 1988 (KldB 1988) and for the German classification of occupations 2010 (KldB 2010) and for different classification levels (2-digit and 3-digit code): analytical non-routine tasks, interactive non-routine tasks, cognitive routine tasks, manual routine tasks and manual non-routine tasks. This paper describes our approach and provides some descriptive results on the validity of the new task operationalisation.

The paper is structured as follows: Chapter 2 introduces the TBA as the conceptual basis of a systematic task operationalisation. Chapter 3 describes the existing task operationalisations for Germany. Chapter 4 discusses the differences between a survey-based and an expert knowledge-based task operationalisation and presents the data as well as the procedure of our alternative task measurement based on the BERUFENET expert

database. Chapter 5 provides initial descriptive results of the new task operationalisation. Chapter 6 concludes and provides an outlook.

2 The Task-based Approach as Conceptual Basis of a Systematic Task Operationalisation

Thus far, tasks have been applied to explain the polarisation of wages and employment. But tasks are becoming increasingly important in other fields of research. In particular, the question of which tasks are offshorable to other countries is the focus of a new area of task research (Blinder 2009; Blinder 2006; Grossman/Rossi-Hansberg 2008; Jensen/Kletzer 2010; Pflüger et al. 2010). Another field of research dealing with tasks considers the possibility to transfer human capital between different occupations (Fedorets/Spitz-Oener 2011; Gathmann/Schönberg 2010; Janßen/Backes-Gellner 2009). However, tasks, especially interactive tasks, also account for the difficulties of migrants to find a job (Haas/Lucht/Schanne 2013; Peri/Sparber 2009). In contrast, Gordo/Skirbekk (2013) find that tasks can explain the higher wage growth of older individuals compared with younger individuals. Moreover, tasks also explain gender-specific wage gaps (Black/Spitz-Oener 2010; Lindley 2012; Yamaguchi 2013). Hence, the task approach provides new insights into many research questions, but also enables analysing new issues.

The idea of starting at the tasks is not new. In the 1970s, the Institute for Employment Research (IAB) already came to the conclusion that in order to understand occupational substitution and mobility processes one had to go beyond analysing only occupations, but rather had to start at the single tasks (Chaberny/Fenger/Reiter 1972). However, the challenge is to reduce the complexity of theoretically distinguishable dimensions of tasks to a few key dimensions that are most important for the most relevant research questions and that provide a valid comparison of different occupations. In this context, the TBA is particularly appropriate as a conceptual basis.

Generally, tasks are defined to produce output (goods and services) (Acemoglu/Autor 2011, p. 1045). According to this definition, tasks are activities that individuals have to perform in a specific occupation. The TBA puts tasks into four categories (Autor/Levy/Murnane 2003): analytical and interactive non-routine tasks, analytical and interactive routine tasks, manual routine tasks and manual non-routine tasks. Machines may substitute routine tasks, but may complement non-routine tasks. For example, machines may complement analytical/interactive non-routine tasks such as management or formulating hypotheses, but may substitute analytical/interactive routine tasks such as accounting or routine manual tasks such as sorting. So far, manual non-routine tasks such as driving a truck are impossible to be substituted by machines.

In Germany, the interpretation of the TBA by Spitz-Oener (2006) is usually applied. Unlike Autor/Levy/Murnane (2003), she considers analytical and interactive tasks separately, which results in the following five task types (see table 1): analytical non-routine tasks, interactive

non-routine tasks, cognitive routine tasks, manual routine tasks and manual non-routine tasks.

Table 1: The Five Task Dimensions

Analytical non-routine tasks	Research, analyse, evaluate, plan, construct, design, create, work out rules/regulations, apply and interpret rules
Interactive non-routine tasks	Negotiate, represent interests, coordinate, organise, teach or train, sell, purchase, acquire customers, advertise, entertain, present, employ or manage staff
Cognitive routine tasks	Calculate, accounting, correct texts/data, measure length/height/temperature
Manual routine tasks	Operate or control machines, equip machines
Manual non-routine tasks	Repair or refurbish houses/flats/machines/vehicles, renovate paintings/monuments, serve or accommodate guests

Source: Spitz-Oener (2006), p. 243.

We determine these five task dimensions in our task operationalisation. The distinction between routine tasks and non-routine tasks refers to whether an occupational task could be performed by machines. "Analytical" refers to the necessity to think or analyse during work, whereas "interactive" denotes the need to communicate with others by oral or written means, ranging from dealing with co-workers or clients to complex interactive activities such as counselling, educating or teaching. "Manual" refers to all activities that can be performed with one's hands. Since interactive routine tasks do not exists, except for providing very simple information (e.g., announcing train departure times), we do not break down the cognitive routine tasks into analytical and interactive tasks that all other conceptual approaches also have not done.

3 Task Operationalisation in Germany

For Germany, there have only been task operationalisations based on survey data so far. Spitz-Oener (2006) assigns the activities to be performed in a job from various BIBB-IAB or BIBB-BAuA employee surveys to the task dimensions proposed in the TBA. Matthes et al. (2014) suggest a different task operationalisation using survey data: Within the scope of the German National Educational Panel Study's (NEPS) adult stage, currently employed individuals are asked a number of questions regarding the tasks they perform in their job in order to determine individual task profiles based on the TBA. The Microcensus also includes every four years questions regarding the tasks employees have to do in their job. As the

Microcensus only asks for the main activity, a valid task operationalisation is extremely error-prone and to our knowledge has not been used in any paper.

3.1 Operationalisation based on the BIBB-IAB or BIBB-BAuA Employee Surveys

The most common task operationalisation for Germany is the Spitz-Oener (2006) assignment of occupational activities to the five task dimensions presented in chapter 2. She uses the BIBB-IAB or BIBB-BAuA employee surveys for 1979, 1985/86, 1991/92 and 1998/99 to apply the TBA developed by Autor/Levy/Murnane (2003) to answer her research question. These employee surveys are representative cross-sectional surveys asking employed individuals living in Germany to give detailed information regarding the occupational activities involved in their present job. Spitz-Oener (2006) assigns these activities to the five task dimensions and calculates the following task index:

$$SO_{ijt} = \frac{\text{Number of activities in category j performed by individual i at time t}}{\text{Total number of activities in category j at time t}} * 100$$

The category j defines the five task dimensions (j=1 analytical non-routine tasks, j=2 interactive non-routine tasks, j=3 cognitive routine tasks, j=4 manual routine tasks, j=5 manual non-routine tasks). The time t describes the year of observation (t=1979, 1985/86, 1991/92 and 1998/99). If the task dimension of analytical non-routine tasks, e.g., includes four activities of which individual i performs two, this individual has an SO-task-index of 50 for analytical non-routine tasks. Thus, for each task dimension the index measures the intensity of this task type for performing the occupational activity.

Antoncyzk/Fitzenberger/Leuschner (2009) use the same data to determine the percentage of activities reported for a task dimension compared to all activities performed by a respondent. The result is an indicator of the tasks composition of an occupational activity:

$$AFL_{ijt} = \frac{\text{Number of activities of category j performed by individual i at time t}}{\text{Total number of activities performed by individual i in all categories at time t}}$$

In summary, the two task indicators are different, as we can highlight using the example of a manager: The SO-task-index (task intensity) determines the degree to which a single task dimension is necessary to perform a specific occupational activity when compared to another occupational activity. The job of a manager requires relatively high analytical skills compared to the activities of a cleaner. In contrast, the AFL-task-index (task composition) specifies the shares of the different tasks in an individual's occupational activity. In addition to high analytical demands, a manager must also meet high requirements in the other task dimensions. Therefore, the share of analytical activities is smaller compared with a researcher, for instance, who must perform analytical activities nearly exclusively.

Both indices have been criticised in many ways: the BIBB-IAB or BIBB-BAuA employee surveys were not intended to operationalise tasks, and the population, the survey mode and the questionnaire changed over time (Rohrbach-Schmidt/Tiemann 2013). Additionally, both indices are extremely sensitive to the number of characteristics included in the survey and

both operationalisations do not specify the implementation of the aggregation of the task dimensions at the occupational level.

3.2 Operationalisation based on the German National Educational Panel Study

In line with the TBA, Matthes et al. (2014) determine the tasks directly during personal phone interviews with each task dimension measured separately: analytical, interactive and manual tasks as well as routine tasks. Many of the question sets used in the interviews are based on questions developed within the scope of the Survey of Workplace Skills, Technology, and Management Practices (STAMP, cf. Autor/Handel 2013) – in particular for the measurement of analytical tasks. The measurement of the routine tasks turned out to be a special challenge in the development of the interviewing tool, since the respondents themselves had difficulties assessing whether or not their occupational activity could be replaced by machines. Thus, Matthes et al. (2014) looked for indicators which are capable of measuring activities that cannot be replaced by machines. In this context, two indicators are particularly useful for the specific situation of personal phone interviews: the task complexity and autonomy. This new interviewing tool was implemented as part of the survey of the fourth panel wave of the NEPS's survey of adults which interviews employees directly about their job requirements. Initial descriptive results show that this approach is capable of collecting valid information regarding the job requirements in personal interviews.

4 Task Operationalisation based on the BERUFENET Expert Database

In the following, we describe our operationalisation of tasks on the basis of the BERUFENET expert database. First, we provide the differences between a task operationalisation based on surveys and a task operationalisation based on expert data. Our intention is not to question the survey-based task operationalisation; rather we want to argue that workplace requirements determined in surveys measure other parameters than task operationalisations based on expert data. Second, we introduce the BERUFENET expert database. Third, we describe the assignment of requirements to the occupational tasks, the determination of the main task type and the task composition and the aggregation at the 2- and 3-digit level of the different occupational classifications (KldB 1988 and KldB 2010). We provide our task operationalisation to the scientific community in the form of various STATA datasets, for which we describe the variables and labels in the end.

4.1 Survey-based vs. Expert Knowledge-based Task Operationalisations

The first and most important difference between survey-based and expert knowledge-based task operationalisations is that surveys put the focus on the workplace and not on the occupation (Autor 2013). Respondents describe which activities they have to perform in their job and which challenges they are facing. Experts on the other hand assess which competencies and skills are usually required in a specific occupational activity (occupation) based on apprenticeship regulations, job descriptions, job postings, etc. The respondents are unaware of the purpose of the questions. However, the experts are well-aware of the

background, as they are usually qualified or trained to provide such complex information in a way that is suitable for a specific target group.

Second, measuring tasks in personal interviews results in a variance between occupations, but not for task operationalisations based on expert knowledge.[1] However, it is unclear if the variance between occupations measured by surveys can be put down to the bandwidth of requirements actually necessary for working in a specific occupation or to incorrect occupational coding: an occupational title recorded during an interview is usually assigned to an occupational code by a coder. Such an assignment is not trivial and the magnitude of the error depends on the accuracy of the used occupational classification.[2] On the other hand, requirements within an occupation may vary. Expert data describe each occupation only once; consequently such data cannot be used to determine the variance in a real working environment.

Third, surveys are capable of measuring changed requirements in an occupational activity more quickly. To include changed job requirements in expert data, e.g., the apprenticeship regulations have to be updated, the modified job requirements have to be applied to job postings, or similar basic changes have to be implemented. In the case of expert data, it may take longer until such changes are absorbed by experts and subsequently by the corresponding information platforms. Surveys, on the other hand, acquire less stable (institutionalised) changes in job requirements, whereas task operationalisations based on expert knowledge focus more on stable changes.

Fourth, the surveys usually do not consider all occupations or not in a representative way. For example, measurements for rare occupations are frequently unavailable, or the respondents in the corresponding occupations are not representative of the employees in this occupation. Expert data in contrast refer to a large number or to all known occupations.

4.2 The BERUFENET Expert Database

BERUFENET[3] is a free online information portal provided by the German Federal Employment Agency for all occupations known in Germany which are mainly used in career guidance and job placement. Job titles are included in BERUFENET if there is a corresponding initial or further vocational training which is regulated legally or quasi-legally, or if an occupational activity is relevant for the labour market. This holds if the occupational title is used in collective agreements, if a certain number of employees are working in this occupation or if generally binding further trainings are available in this occupation. In

1 Since in the case of O*NET, experts are asked to assess different occupations, this approach allows measuring the variance between the experts.

2 Several 2- and 3-digit codes in the KldB 1988 were at a particularly high risk of misassignment (e.g., office clerks who could have either code 781 (office clerks, otherwise undisclosed) or code 762 (senior and administrative state officials) according to KldB 1988).

3 For more information, please visit the BERUFENET homepage provided by the German Federal Employment Agency: http://berufenet.arbeitsagentur.de/berufe/index.jsp. To view information on the occupations, simply enter the occupational title (e.g., cook) and select the corresponding link (e.g., for the dual education profession of a cook http://berufenet.arbeitsagentur.de/berufe/start?dest=profession&prof-id=3726).

summary, BERUFENET includes nearly all job titles used in Germany (Matthes/Burkert/Biersack 2008).[4]

These job titles are linked to approximately 3,900 current single occupations in BERUFENET[5] for which a rich set of occupational information is provided (e.g., information on the required tasks in an occupational activity, the equipment used, the working conditions, required qualifications or legal regulations). By clicking the "Kompetenzen" (competencies) link, users can view the corresponding requirements for each of these single occupations.[6] BERUFENET uses a database which assigns approximately 8,000 requirements to the single occupations. The so-called requirement matrix was created from the “key system of occupational characteristics for computer-aided job placement in the job centres” used in the 1980s to assign different occupational characteristics to occupations (4-digit code of KldB 1988) in order to make job offers and applications more specific. In 2003, a professional publishing company integrated the requirement matrix into the computer-aided job placement service within the scope of developing the online job platform of the German Federal Employment Agency. The BERUFENET and the requirement matrix have been continuously updated since then, e.g., by employer specifications when searching for suitable employees, by analysing job postings and further training offers or in the context of the Customer Response Management of the German Federal Employment Agency. Each month, about ten new requirements are checked for redundancy, and if necessary they are immediately added to the requirement catalogue and assigned to the single occupations. As a result, the requirement matrix is always up-to-date so that underestimating actual changes in occupational activities should not be relevant in the case of the BERUFENET expert database.[7]

The requirement matrix assigns the requirements that an individual has to perform in an occupational activity to each single occupation. The underlying assignment scheme is not systematic; rather it is based on practical principles of job placement.[8] Table 2 lists the first assignment level with selected examples to give an impression of the included requirements.

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4 The database comprises more than 300,000 job titles, including male, female and neutral job titles, synonyms as well as English and French job titles. Approximately 10,000 single occupations are assigned to them.

5 A single occupation (status E=end point) is the latest or newest job title for a specific occupation. For example, older job titles exist for the occupation "automotive mechatronics technician" such as "auto mechanic" or more specific job titles such as "automotive mechatronics technician (car body technology)" which are each linked to the requirements of the occupation "automotive mechatronics technician".

6 The German Federal Employment Agency uses the term "competencies" to describe the competencies and skills needed to perform in an occupation. This term, however, is not the standard definition used by scientists. For the sake of a clear definition, we will use the term "requirements" instead in our paper.

7 One of the main problems of the US expert databases DOT or O*NET is that they are not up-to-date, making it impossible to analyse task changes over time (Autor 2013). However, the requirement matrices from BERUFENET database have been available for analyses in Germany since 2008.

8 The requirement catalogue is downloadable from BERUFENET at: http://download-portal.arbeitsagentur.de/files/.

We categorise the requirements listed in table 2 as follows:

a) Skills: list of the fields of applications and activities (e.g., customer consulting and service), practical skills (e.g., mason, scan, give infusions), processes and technologies used (e.g., printing technology, care expert opinion, aircraft equipment) or tools (e.g., soldering and welding equipment, musical instruments, vehicles)

b) Competencies: list of the fields of competencies (e.g., pharmacognosy, orientalism, neurophysiology) or practical competencies (e.g., IT knowledge, languages, knowledge of goods and products)

c) Job placement-relevant additional information: specifying groups of persons (e.g., older people, unemployed), wage brackets, sectors (e.g., music, insurance, photography), licences, permits and driver's licences (e.g., captain's licence, driving instructor licence), places of work, etc.

Requirements are generally assigned to an occupation if they are usually required to perform the occupation.[9] "Usually" here means that these requirements have been selected on the basis of educational, training or study guidelines or according to analyses of applications and job offers. In this context, we distinguish between core requirements, additional requirements and requirement groups: core requirements are requirements which are mandatory to work in the occupation, because they are essential for the occupation. For occupations that usually require a vocational education or further training, these are the competencies and skills learned during vocational education or further training. In occupations requiring no formal training or education, these are the competencies and skills that are essential to perform the corresponding occupation. Additional requirements are those that could be important to perform an occupational activity, but are not mandatory. Thus, a requirement may be a core requirement in one occupation, while being an additional requirement in another occupation. The requirement "knitting" is a core requirement for the occupation "knitter" and an additional requirement for the occupation "machine and system operator - textile engineering (stitches). The requirement groups specify tools that may be necessary to perform the activity (e.g., IT programming languages, musical instruments, etc.). For example, different travel agency software products are combined and listed as a requirement group for several occupations in tourism in the requirement matrix. Table 3 provides an example for the occupation “cook” for the core requirements, additional requirements and requirement groups. A cook's core requirements include, e.g., cooking dishes or making calculations.

In summary, the requirement matrix does not follow a consistent assignment scheme, but the requirements needed to perform an occupation are described very detailed: all competencies and skills required to describe an occupation are included, and we can assume that the competencies and skills required to perform an occupation are assigned to the occupations in the requirement matrix, as this matrix is used for career guidance and job placement.

[9] Soft skills, places of work and sectors are not occupation-specific so that these requirements are not assigned to occupations. For this reasons, they were not assigned to tasks.

Table 2: Requirements in BERUFENET

Assignment Level	Selected Requirements
Agriculture, forestry and horticulture	Arrange flowers and foliage, sort wood, cemetery flower shop, plant breeding, rabbit breeding, feeding livestock, winepress
Production, processing, technology	Manufacturing of concrete block and terrazzo, pattern programming, hot vulcanising, paper technology, colourants and essences act, turning, boat building, PLC programming
Construction, architecture	Painting, excavating, concrete spraying methods, calibration, rendering, construction machine studies, building acoustics
Economy, administration	Property appraisal, auctioning, part master data management, pricing, operating resource planning, municipal law, firefighting, creating press releases
Transport, traffic	Palletising, procurement logistics, conducting driving tests, mooring (ship), postal code system, aircraft fuelling, air freight management, engine driving
Hotels, restaurants, tourism	Hotel reception, hotel management, flambéing, banquet cuisine, ticket sales, health resort management, bartender, event catering
Services	Grave maintenance, security control, interpreting in court, sweeping, assessing event criteria, telephone information service, safety engineering, nutritional consulting, phone interviews
IT, DP, computers	ALIAS CAD application, CNC, NC program Cybelec, Flotran simulation software, Mozilla Firefox web browser, ABB PLC system, R statistics software, creating batch programs
Science, research, development	Social anthropology, banking management, neurolinguistics, criminology, communication psychology, history of art, using CAE (Computer-aided Engineering) systems
Social, education, health, sports	Braille, liturgy, debt counselling, Montessori education, diagnosis, medical fee schedule, hair dying, teeth preservation, ice hockey, sailing instructor licence A
Media, art, design	Conjuring tricks, caricaturing, pyrotechnics, preparing, baritone, flute, jazz, children's dance, staging, fun rides, signing, vision mixing, digital photography, aerial photography, editorial work: local, presenting
Language	Arabic, German dialect (Berlin)
Types of work and usage	Working alone, offshore
Knowledge of goods and products	Butter, feedstuff, pipe tobacco, wedding dresses, welding robots, die cast tools, fish traps, bath furniture, BMW, bombardier (aircraft), burglar alarms, books, investment funds, inlays
Licences, permits, driver's licences	Driving instructor licence/DE driver's licence, licence to practice, welder's qualification test DIN EN 287-1 (steel), proof of competence for over-the-counter drugs (Article 50 AMG[1)])
Soft skills	Flexibility, leadership qualities, capacity for teamwork, reliability
Places of work	Restaurant, oil rig
Sectors	Employer associations, construction industry, chemical industry, floristry, health services, heating, chambers of industry and commerce, motor traffic, waste incineration, broadcasting, sports associations, animal care

Source: BERUFENET (November 2013): http://download-portal.arbeitsagentur.de/files/

Notes: 1) AMG is the German Pharmaceuticals Act.

Table 3: Requirements for the Occupation Cook from BERUFENET

Core requirements	Work according to recipes Preparing side dishes Cooking roasts Purchasing, acquisition Garnishing (dishes) Preparing vegetables, salad Calculations Pâtisserie, desserts Preparing sauces and marinades Compiling menus, menu plans Cooking and arranging dishes Making soup Making starters Receipt of goods, incoming goods control
Additional requirements	À la carte cuisine Work preparation Baking Banquet cuisine Instruction acc. to the infection protection act (health certificate) Beverage skills Food hygiene Party catering Quality control, quality assurance Restaurant catering Creating recipes Making dough Vegan cuisine Vegetarian cuisine Supply inventory
Requirement groups	Meat and fish, delicatessen Regional and international cuisine

Source: BERUFENET (May 2014): http://berufenet.arbeitsagentur.de/berufe/start?dest=profession&prof-id=3726

4.3 Assigning Requirements to Tasks

In order to determine the main task type and the task composition (the distribution of the five task types in an occupation), we first have to assign the requirements used in the requirement matrix to a task type. Three coders assign the listed requirements to the five task types independently of one another and without using the requirement matrix (which assigns the occupations to the requirements): analytical non-routine tasks (1), interactive non-routine tasks (2), cognitive routine tasks (3), manual routine tasks (4) and manual non-routine tasks (5). This triple coding assures a high validity of the task assignment. First, it enables identifying requirements that allow a clear task assignment. Second, the underlying coding rules were stated more precisely in the discussion of varying assignments. For example, the assignment of requirements to task types varies over time: once an activity can be performed by machines, we classify it as a routine task. Activities such as driving an underground train, which were formerly defined as manual non-routine tasks, are now substituted by machines and classified as manual routine tasks.

During the process of coding, we focus on the following basic rules (see table 4):[10]

1. We assign the requirements to the task type that best matches the competencies and skills used in the requirements list, e.g.: "operating resource planning" is assigned to the analytical non-routine tasks (1), "telephone information service" to the interactive non-routine tasks (2), "part master data management" to the cognitive routine tasks (3), "hot vulcanising" to the manual routine tasks (4) and "mason" to the manual non-routine tasks (5). This assignment essentially follows the Spitz-Oener (2006) approach. We made the fundamental decisions listed in table 4 for a number of (sub-)terms so that we always assign specific requirements involving identical or similar concepts and contents to the same task type. Deviations from these fundamental decisions are only allowed in well-founded individual cases. For example, we assign the term "management" (fund management or quality management) to the analytical non-routine tasks (1). The only exception is "mail management" that is assigned to the cognitive routine tasks (3), because the management of incoming and outgoing mail can be replaced by computers today.

2. If it is uncertain whether a task is a routine or non-routine task type, we research explicitly whether it is actually possible today to have the requirement performed by machines: the term "routine" in the TBA context refers less to the common meaning denoting a usual way of doing things; rather it means that an activity can be broken down into machine-programmable sub-elements and can be replaced by machines.

3. If we cannot clearly assign a requirement to one task type, we do not make any assignment at all: requirements are not assigned if they cannot be interpreted as a competence or skill, but were included in the requirement matrix to specify the job search. For this reason, we do not assign any job-placement relevant additional information (such as groups of persons, sectors[11], licences, permits and driver's licences) to a task type.

4. If a row of the requirement list contains more than one term that cannot be clearly assigned to a task type, we assign these requirements to two different task types: In few cases, a row of the requirement list includes two requirements that could not be assigned to the same task type. Let us consider the requirement "mountain forest (care, management)" as an example: since care primarily denotes the actual doing part, it is a manual non-routine task, whereas management focuses more on the cost/usage aspects and thus on analytical non-routine tasks.

[10] The documentation of the complete assignment list of requirements to task types would go beyond the scope of our paper, but is available upon request.

[11] Sectors are, e.g., different editorial or music sectors.

Table 4: Fundamental Decisions for (Sub-)Terms

Task type	Requirements
Analytical non-routine tasks (1)	Management, planning, planning and supervision, fields of competencies, economy, leadership, direction, controlling, sciences, software development, programming languages, network certifications, monitoring, music, singing, ballet, musical instruments, optics, applying laws, design, design (art), analysis, control, therapy, programming
Interactive non-routine tasks (2)	Commerce, counselling, service, support, training, marketing, advertising
Cognitive routine tasks (3)	Technology, metrics, administration, graphics, network technology, network protocols, operating systems, certificates, languages, knowledge of goods and products, competencies, sensor technology, electronics, mechanics, mechatronics, hydraulics, processing, revision, test, inspection, measurement, monitoring, procedures, diagnostics
Manual routine tasks (4)	Cultivation, farming, construction, manufacture, production, harvesting, operating machines, setting up machines, typesetting
Manual non-routine tasks (5)	Dancing, refurbishing, service, therapy (manual focus), special/custom/bespoke productions, handicraft businesses (e.g., bakery, carpentry)

4.4 Calculation and Aggregation

In order to assign requirements to tasks, we use the requirement matrices of October 2011, November 2012 and November 2013. Table 5 shows the number of occupations and requirements in the respective requirement matrices. The requirement matrices only contain activities (with the exception of vocational trainings according to Article 66 BBiG[12]). The number of occupations changed only slightly from 2011 to 2013 and comprises about 3,900 single occupations each. The number of requirements, however, increased from about 6,500 to about 6,700.

Table 5: Number of Occupations and Requirements in the respective Requirement Matrices

Year	2011	2012	2013
Number of Occupations	3893	3910	3935
Number of Requirements	6561	6670	6709

When calculating the main task type and the task composition, we only use the core requirements listed for the occupations. We do not employ additional requirements, because they are not the core of the occupational activity and thus rather hinder a clear task assignment. The requirement groups are also not considered, because they specify tools (specific software products, musical instruments, etc.) and do not contribute information to the task operationalisation. Only few single occupations do not have any core requirements listed in the requirement matrix. We exclude these occupations from the following task operationalisation.[13]

We calculate the shares of the five task types relating to the total number of requirements listed for this occupation in the requirement matrix for each single occupation (7-digit code based on KldB 1988 or 8-digit code based on KldB 2010) with each requirement receiving a weight of 1. Our DMP-task-index is defined as follows:

$$DMP_{ijt} = \frac{\text{Number of requirements in task type j in occupation i in year t}}{\text{Total number of requirements in occupation i in year t}}$$

Thus, the DMP-task-index indicates the share of requirements in the single occupation i in the respective task type j (analytical non-routine tasks (1), interactive non-routine tasks (2), cognitive routine tasks (3), routine manual tasks (4) and non-routine manual tasks (5)) for the year t (t=2011, 2012, 2013) in relation to the total number of requirements in the single occupation i for the year t.

[12] BBiG is the German Vocational Training Act.

[13] No information on core requirements is available for the following occupations: all military professions, psychologist for the requirements matrices from 2012 and 2013, magician, electric welder, TIG welder, oxyacetylene welder, hyperbaric welder and solder for the 2011 requirement matrix.

We determine the main task type both for KldB 1988 and KldB2010 at the 3-digit and 2-digit level, respectively, with the DMP-task-indices at the single occupational level being aggregated to the 3-digit or 2-digit level by employing a weight. The task type with the highest weighted DMP-task-index on the basis of the 3-digit or 2-digit code is the main task type for this 3-digit or 2-digit code.

The weighted DMP-task-index (WDMP) is defined as follows:

$$WDMP_{jkt} = \sum_{i \in k}^{K} DMP_{ijt} * g_{it}$$

with the DMP-task-indices at the single occupational level i being aggregated to 3-digit or 2-digit level (k) of KldB 1988 or KldB 2010 for each task type j in the year t (t=2011, 2012, 2013) with the weight (g) at the single occupational level i in the year t (t=2012).

We calculate the weight on the basis of the 2012 employee figures available for the 5-digit code of KldB 2010. We obtain the weight (g) for the year t (t=2012) for the 3-digit or 2-digit code of KldB 1988 or KldB 2010 from the number of employees at the single occupational level (i) divided by the number of employees at 3-digit or 2-digit level (k) of KldB 1988 or KldB 2010. For this purpose, we distribute the number of employees at the 5-digit level of KldB 2010 equally on the single occupational level (7-digit code based on KldB 1988 or 8-digit code based on KldB 2010) and aggregate the number of employees to the 3-digit or 2-digit code of KldB 1988 or KldB 2010.[14]

$$w_{it} = \frac{N_{it}}{N_{kt}}$$

The weight ensures that the main task type at the 3-digit and 2-digit level is determined mainly by occupations that occur frequently and thus have high employee numbers.

There are no clear main task types available for some 3-digit codes[15] of KldB 1988. We have defined the following rules to determine the main task type for these 3-digit codes: If the weighted DMP-task-index for the task types "analytical non-routine tasks" and "interactive non-routine" tasks have the same proportions, we define the "interactive non-routine tasks" as the main task type. If the weighted DMP-task-index for the task types "cognitive routine tasks" and "manual routine tasks" or " manual non-routine tasks" are the same, we determine "manual routine tasks" or "manual non-routine tasks" as the main task type. If, however, the task types "cognitive routine tasks", "manual routine tasks" and "manual non-routine tasks" have the same shares of the weighted DMP-task-index, we define "manual non-routine tasks" as the main task type. Table 1 in the Appendix shows the occupations and individual decisions in more detail.

[14] After the introduction of the new 2011 activity key (employers have to provide information on the activities of their employees to the social insurances in Germany), the employee figures according to KldB 2010 at the 5-digit level for 2012 are available for the first time. Earlier employee figures according to KldB 1988 are only available for the 3-digit level. Distributing the employee figures of the 5-digit level on the lowest breakdown level is the best approximation at the moment.

[15] In 2011, these are five 3-digit codes, in 2012 seven 3-digit codes and in 2013 nine 3-digit codes of 334 3-digit codes in total that do not have a clearly defined main task type.

4.5 Datasets

We provide four datasets in Stata format: http://doku.iab.de/fdz/reporte/2014/MR_12-14_data.zip. Each dataset contains the main task type and the task composition for the three years 2011, 2012 and 2013. The data are available both for the 3-digit code of KldB 1988 and of KldB 2010 (tasks_kldb1988_3.dta and tasks_kldb2010_3.dta) as well as for the 2-digit code of KldB 1988 and KldB 2010 (tasks_kldb1988_2.dta and tasks_kldb2010_2.dta).

Table 2 in the Appendix describes the variables included in the datasets. Each dataset contains nine variables. The variables *kldb1988_3*, *kldb2010_3*, *kldb1988_2* and *kldb2010_2* contain the codes of the corresponding 3-digit or 2-digit codes depending on the dataset under examination. The variable *bezeichnung* specifies the name of the 3-digit or 2-digit code of the respective KldB 1988 or KldB 2010, whereas the variable *jahr* specifies the year of the requirement matrix (2011, 2012, 2013). The variables *haupttask* and *gwkomp1-gwkomp5* include the main task type and the task composition for each 3-digit or 2-digit code of KldB 1988 or KldB 2010.

5 Descriptive Results

The following sections provide descriptive results at the 3-digit level of KldB 1988 (section 5.1) and KldB 2010 (section 5.2) for the main task types and for the task composition. We only employ the year 2011 for the description of the task composition.

5.1 Descriptive Results based on KldB 1988

5.1.1 Main Task Type

Table 3 in the Appendix shows the shares of the main task types for KldB 1988 defined as percentage of all 3-digit codes of KldB 1988 for the years 2011, 2012 and 2013 (in columns 2, 4 and 6). The shares change only slightly over the years. The most common task type is manual routine tasks with 32% followed by manual non-routine tasks with 21% and cognitive routine tasks with 20%. About 17% of all 3-digit codes of KldB 1988 contain analytical non-routine tasks as main task type and about 5% interactive non-routine tasks. In contrast, previous studies for Germany such as Antoncyzk/Fitzenberger/Leuschner (2009) show that the most common task type are interactive non-routine tasks with up to 40% in 2006. These large differences in the shares of the interactive non-routine tasks might be explained by the fact that Antoncyzk/Fitzenberger/Leuschner (2009) consider management activities as interactive non-routine tasks, whereas we assign them to the analytical non-routine tasks.

5.1.2 Task Composition

In the following, we describe the task composition (in %) of the five task types for five selected occupations at the 3-digit level of KldB 1988.[16] Figure 1 in the Appendix shows the task composition for medical doctors (3-digit code KldB 1988: 841). While the main task type for doctors comprises interactive non-routine tasks (2), the task composition reveals that analytical non-routine tasks with 47% and interactive non-routine tasks with 51% are nearly equally represented. A very small percentage of cognitive and manual routine tasks (less than 2%) are also observable. The example of university/college professors and related teaching professionals (3-digit code KldB 1988: 871) shows that analytical and interactive non-routine task differ more noticeably (see Figure 2 in the Appendix). Professors and related teaching professionals perform 72% analytical non-routine tasks as main task type, while 28% are allocated to interactive non-routine tasks.

The task compositions of the following 3-digit codes, however, have a broader distribution. Figure 3 in the Appendix presents the task composition for office clerks (3-digit code KldB 1988: 781). As expected, the main task type involves cognitive routine tasks with 51%, whereas analytical and interactive non-routine tasks amount to 34% and 13%, respectively. Figure 4 in the Appendix shows the task composition for motor vehicle drivers (3-digit code KldB 1988: 714) who mainly perform manual non-routine tasks. This result is in line with the previous literature, e.g., Autor/Levy/Murnane (2003) consider the manual activity of driving a motor vehicle as not (yet) substitutable by machines. Tailors and dressmakers (3-digit code KldB 1988: 351) on the other hand perform manual routine tasks with 44%, manual non-routine tasks with 28% and cognitive routine tasks with 18% (see Figure 5 in the Appendix).

Table 4 in the Appendix shows the top 4 occupations based on the 3-digit codes with the highest task composition per task type. Legislators, ministers and elected officials (3-digit code KldB 1988: 761) rank first in the analytical non-routine task type followed by architects and civil and structural engineers (3-digit code KldB 1988: 603), by veterinarians (3-digit code KldB 1988: 843) and by authors, journalists, editors and announcers (3-digit code KldB 1988: 821). Interpreters and translators (3-digit code KldB 1988: 822), commercial sales representatives and sales agents (3-digit code KldB 1988: 687), employment, vocational training, study, careers advisors (3-digit code KldB 1988: 863) and energy and other consumer advisors (3-digit code KldB 1988: 922) hold the top 4 ranks with the interactive non-routine tasks. The top 4 ranks in the cognitive routine tasks are represented by chemical laboratory workers (3-digit code KldB 1988: 142), radio operators (3-digit code KldB 1988: 733), data entry operators (3-digit code KldB 1988: 783) and telecommunications mechanics and craftsmen (3-digit code KldB 1988: 312). However, rubber products machine operators (3-digit code KldB 1988: 143), metal drawers and extruders (3-digit code KldB 1988: 193), tanners, gut string makers and other leather-preparing-machine operators (3-digit code KldB 1988: 371) and sheet metal pressers, drawers and punchers (3-digit code KldB 1988: 211) hold the top 4 ranks in the manual routine task type. In contrast, the top 4 ranks in the

[16] We do not provide complete tables for the task composition of the five task types for all 3-digit codes of KldB 1988, but the tables are available upon request.

manual non-routine task category are occupied by paviors and pavers (3-digit code KldB 1988: 461), earth-moving and related plant operators (3-digit code KldB 1988: 545), machinery, plant, tube and container cleaners (3-digit code KldB 1988: 937) and locomotive engine, tram and subway drivers (3-digit code KldB 1988: 711).

In summary, the task composition of the five selected occupations at the 3-digit level of KldB 1988 as well as the top 4 occupations deliver reasonable results in line with our expectations.

5.2 Descriptive Results based on KldB 2010

5.2.1 Main Task Type

Columns 3, 5 and 7 in Table 3 in the Appendix show the shares of the main task types for KldB 2010 defined as percentage of all 3-digit codes of KldB 2010 for the years 2011, 2012 and 2013. While manual routine tasks have been the most common task type for KldB 1988 in section 5.1.1, analytical non-routine tasks are now the most common task type with about 33%. One reason for this difference between the occupational classifications is that the KldB 1988 contains technical and skilled manual occupations in a highly differentiated way (Paulus/Matthes 2013) and these occupations in particular involve manual routine tasks.[17] However, 21% of all 3-digit codes of KldB 2010 involve manual non-routine tasks, approximately 19% and 17%, respectively, cognitive and manual routine tasks.

5.2.2 Task Composition

Figures 6 to Figure 10 in the Appendix show the task compositions for five selected occupations based on the 3-digit codes of KldB 2010 that are comparable with the five occupations (3-digit codes of KldB 1988) of section 5.1.1.[18] Figure 6 in the Appendix shows the task composition for human medicine and dentistry (3-digit code KldB 2010: 814). Again, we find interactive non-routine tasks with approximately 50% as the main task type, whereas analytical non-routine tasks amount approximately to 47%.

Figure 7 in the Appendix presents the task composition for teachers and researchers at universities (3-digit code KldB 2010: 843) in comparison with the professors and related teaching professionals in section 5.1.1. The results are comparable: analytical non-routine tasks are represented with 73% and interactive non-routine tasks with 27%.

Figure 8 in the Appendix shows the task composition for occupations in offices and secretariats (3-digit code KldB 2010: 714). Again, cognitive routine tasks are the main task type with 57%. Figure 9 in the Appendix illustrates for driver of vehicles in road traffic (3-digit code KldB 2010: 521) that manual non-routine tasks form the majority with 68%. Lastly, we

[17] When KldB 1988 was developed, technical and skilled manual occupations were more important in the German labour market, whereas KldB 2010 focuses more on the actual labour market situation (e.g., service jobs, ICT jobs).

[18] We do not provide complete tables for the task composition of the five task types for all 3-digit codes, but the tables are available upon request.

examine occupations in textile processing (3-digit code KldB 2010: 282) in comparison with the occupation of a tailor and dressmaker of KldB 1988 (see Figure 10 in the Appendix). Again, the results are similar: routine manual tasks are represented with 56%.

Subsequently, we compare the five task types with the 5th digit level of KldB 2010 which contains the requirement levels. The KldB 2010 includes four different requirement levels based on the vocational qualification levels (Paulus/Matthes 2013): unskilled and semi-skilled activities (1), specialist activities (2), complex specialist activities (3) and highly complex activities (4). Usually, medium-skilled individuals (requirement level 2) perform routine tasks, whereas the high-skilled individuals (requirement level 3 and 4) carry out analytical and interactive non-routine tasks and the low-skilled individuals (requirement level 1) manual non-routine tasks. By comparing the requirement levels with the five task types, we should find a corresponding distribution.

Table 5 in the Appendix presents the task composition for the four different requirement levels for the years 2011, 2012 and 2013. Unskilled activities (1) that require no educational qualification are characterised in particular by manual non-routine tasks with nearly 43% and by manual routine tasks with 29%. Specialist activities (2) are widely spread across all five task types. Cognitive routine tasks represent the highest share with 34% followed by manual non-routine tasks with approximately 23%. Complex specialist activities (3) or highly complex activities (4) are characterised by analytical non-routine tasks with 45% and 61%, respectively. Complex specialist activities also include a high level of cognitive routine tasks with nearly 32%.

In summary, we also find reasonable task compositions for the 3-digit codes of KldB 2010 and the comparison of the fifth digit of KldB 2010 with the task composition reveals expected results.

6 Conclusion and Outlook

So far, task-related information in Germany has been collected by means of surveys, especially the activities collected within the scope of the BIBB-IAB or BIBB-BAuA employee surveys (Spitz-Oener 2006). Expert databases are an alternative to operationalising tasks through surveys. The BERUFENET expert database for Germany is comparable with the US expert database "Dictionary of Occupational Titles (DOT)" used by, e.g., Autor/Levy/Murnane (2003).

The BERUFENET expert database of the German Federal Employment Agency contains detailed descriptions of approximately 3,900 current single occupations and is used, e.g., for career guidance. BERUFENET comprises a requirement matrix which links approximately 8,000 requirements to the single occupations. We assign each requirement to the corresponding task type using a three-coder approach. We distinguish five different task types: Analytical non-routine tasks (1), interactive non-routine tasks (2), cognitive routine tasks (3), manual routine tasks (4) and manual non-routine tasks (5).

We use the requirement matrices of 2011, 2012 and 2013 as our data basis. We determine the main task type and the task composition both for KldB 1988 and KldB 2010 at the 3-digit and 2-digit level, respectively. For this purpose, we aggregate the different task types at the single occupational level weighted with the 2012 employee figures for the 5-digit code of KldB 2010.

Our results show that the shares of the corresponding task type differ between the two occupational classifications, KldB 1988 and KldB 2010: Manual routine tasks are predominant with 32% of the 3-digit codes of KldB 1988 followed by 21% of manual non-routine tasks. In contrast, the shares of the main task types of KldB 2010 have the highest share of analytical non-routine tasks with about 33%. One reason is that KldB 1988 mapped technical and skilled manual occupations in a highly differentiated way (Paulus/Matthes 2013) and these occupations in particular involve manual routine tasks. Moreover, we present the task compositions both for KldB 1988 and KldB 2010 for five selected 3-digit codes. Overall, the results meet our expectations and are quite similar across different occupational classifications. As expected, medical doctors according to KldB 1988 and human medicine and dentistry according to KldB 2010, e.g., involve high shares of interactive and analytical non-routine tasks. When comparing the task types with the requirement levels of KldB 2010 (5th digit), our results imply a similar pattern as found in the previous literature: Medium-skilled individuals (requirement level 2) usually perform cognitive routine tasks, whereas the high-skilled (requirement level 3 and 4) mainly carry out analytical non-routine tasks and the low-skilled individuals (requirement level 1) perform manual non-routine tasks.

Our task operationalisation for Germany based on the BERUFENET expert database is a good alternative and complement to survey-based operationalisations. In particular, it is now possible for Germany to compare and combine task operationalisations based on surveys with operationalisations based on expert databases. Since expert databases enable measuring potential task profiles, we can now differentiate between real and potential task profiles in Germany. Additionally, this alternative task measurement allows us to review again the polarisation hypothesis for Germany. Since our data only date back to 2011, we cannot (yet) make any statement regarding the change of the tasks over time. But it is possible to prepare older data from the 1980s to analyse such a task change.

References

Acemoglu, Daron; Autor, David (2011): Chapter 12 - Skills, Tasks and Technologies: Implications for Employment and Earnings. In: David, Card; Orley, Ashenfelter (Eds.) (2011): Handbook of Labor Economics: Elsevier, p. 1043-1171.

Antoncyzk, Dirk; Fitzenberger, Bernd; Leuschner, Ute (2009): Can a Task-Based Approach Explain the Recent Changes in the German Wage Structure? In: Journal of Economics and Statistics, 229(2+3), p. 214-238.

Autor, David H. (2013): The “task approach” to labor markets: an overview. In: Journal for Labour Market Research, 46(3), p. 185-199.

Autor, David H.; Dorn, David (2013): The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market. In: The American Economic Review, 103(5), p. 1553-1597.

Autor, David H.; Handel, Michael J. (2013): Putting Tasks to the Test: Human Capital, Job Tasks, and Wages. In: Journal of Labor Economics, 31(2), p. S59-S96.

Autor, David H.; Katz, Lawrence F.; Kearney, Melissa S. (2008): Trends in U.S. Wage Inequality: Revising the Revisionists. In: Review of Economics and Statistics, 90(2), p. 300-323.

Autor, David H.; Levy, Frank; Murnane, Richard J. (2003): The Skill Content of Recent Technological Change: An Empirical Exploration. In: The Quarterly Journal of Economics, 118(4), p. 1279-1333.

Black, Sandra E.; Spitz-Oener, Alexandra (2010): Explaining women's success: Technological change and the skill content of women's work. In: The Review of Economics and Statistics, 92(1), p. 187–194.

Blinder, Alan S. (2009): How many US jobs might be offshorable? In: World Economics, 10(2).

Blinder, Alan S. (2006): Offshoring: The Next Industrial Revolution? In: Foreign Affairs, 85(2), p. 113-128.

Chaberny, Annelore; Fenger, Herbert; Reiter, Annefried (1972): Tätigkeitsschwerpunkt als Strukturmerkmal in der Erwerbsstatistik. In: Mitteilungen aus der Arbeitsmarkt- und Berufsforschung, 5(3), p. 230-257.

Dustmann, Christian; Ludsteck, Johannes; Schönberg, Uta (2009): Revisting the German Wage Structure. In: The Quarterly Journal of Economics, 124(2), p. 843-881.

Fedorets, Alexandra; Spitz-Oener, Alexandra (2011): Flexibilität und Anpassungsfähigkeit von Beschäftigten mit dualer Berufsausbildung. In: Zeitschrift für Arbeitsmarktforschung, 44(1-2), p. 127-134.

Gathmann, Christina; Schönberg, Uta (2010): How General Is Human Capital? A Task-Based Approach. In: Journal of Labor Economics, 28(1), p. 1-49.

Goos, Maarten; Manning, Alan (2007): Lousy and Lovely Jobs: The Rising Polarization of Work in Britain. In: Review of Economics and Statistics, 89(1), p. 118-133.

Goos, Maarten; Manning, Alan; Salomons, Anna (2011): Explaining job polarization: the roles of technology, offshoring and institutions. Open Access publications from Katholieke Universiteit Leuven.

Gordo, Laura Romeu; Skirbekk, Vegard (2013): Skill demand and the comparative advantage of age: Jobs tasks and earnings from the 1980s to the 2000s in Germany. In: Labour Economics, 22(0), p. 61-69.

Grossman, Gene M.; Rossi-Hansberg, Esteban (2008): Trading Tasks: A Simple Theory of Offshoring. In: American Economic Review, 98(5), p. 1978-1997.

Haas, Anette; Lucht, Michael; Schanne, Norbert (2013): Why to employ both migrants and natives? A study on task-specific substitutability. In: Journal for Labour Market Research, 46(3), p. 201-214.

Janßen, Simon; Backes-Gellner, Uschi (2009): Skill obsolescence, vintage effects and changing tasks. In: Applied economics quarterly, 55(1), p. 83-103.

Jensen, J. Bradford; Kletzer, Lori G. (2010): Measuring Tradable Services and the Task Content of Offshorable Services Jobs. In: Abraham, Katharine G. ; Spletzer, James R. ; Harper, Michael (Eds.) (2010): Labor in the New Economy: University of Chicago Press, p. 309 - 335.

Katz, Lawrence F.; Murphy, Kevin M. (1992): Changes in Relative Wages, 1963-1987: Supply and Demand Factors. In: The Quarterly Journal of Economics, 107(1), p. 35-78.

Kierzenkowski, Rafal; Koske, Isabell (2012): Less Income Inequality and More Growth – Are they Compatible? Part 8. The Drivers of Labour Income Inequality – A Literature Review. OECD Economics Department Working Papers No. 931. OECD Publishing.

Lemieux, Thomas (2008): The changing nature of wage inequality. In: Journal of Population Economics, 21(1), p. 21-48.

Lemieux, Thomas (2006): Increasing Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill? In: The American Economic Review, 96(3), p. 461-498.

Levy, Frank; Murnane, Richard J. (1992): U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations. In: Journal of Economic Literature, 30(3), p. 1333-1381.

Lindley, Joanne (2012): The gender dimension of technical change and the role of task inputs. In: Labour Economics, 19(4), p. 516-526.

Matthes, Britta; Burkert, Carola; Biersack, Wolfgang (2008): Berufssegmente: Eine empirisch fundierte Neuabgrenzung vergleichbarer beruflicher Einheiten. IAB-Discussion Paper No. 35/2008. Institut für Arbeitsmarkt- und Berufsforschung Nürnberg.

Matthes, Britta; Christoph, Bernhard; Janik, Florian; Ruland, Michael (2014): Collecting information on job tasks—an instrument to measure tasks required at the workplace in a multi-topic survey. In: Journal for Labour Market Research**,** p. 1-25.

Paulus, Wiebke; Matthes, Britta (2013): Klassifikation der Berufe. Struktur, Codierung und Umsteigeschlüssel. FDZ Methodenreport Nr. 08/2013 (DE).

Peri, Giovanni; Sparber, Chad (2009): Task Specialization, Immigration, and Wages. In: American Economic Journal: Applied Economics, 1(3)**,** p. 135-169.

Pflüger, Michael; Blien, Uwe; Möller, Joachim; Moritz, Michael (2010): Labor Market Effects of Trade and FDI: Recent Advances and Research Gaps. IZA Discussion Paper No. 5385.

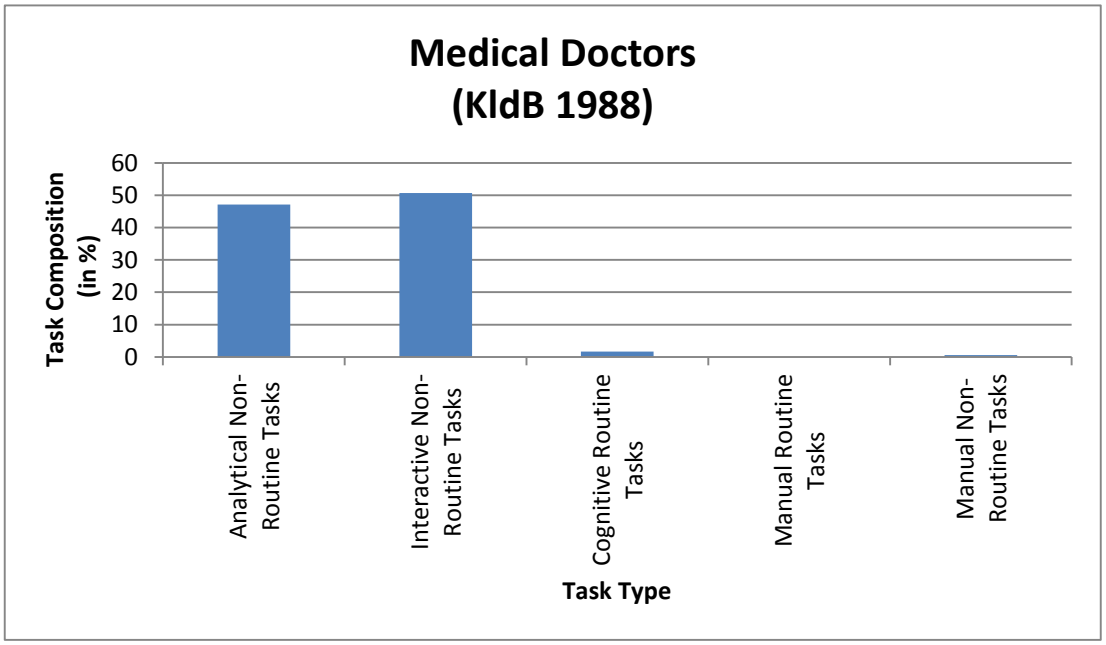
Rohrbach-Schmidt, Daniela; Tiemann, Michael (2013): Changes in workplace tasks in Germany-evaluating skill and task measures. In: Journal for Labour Market Research, 46(3)**,** p. 215-237.

Spitz-Oener, Alexandra (2006): Technical Change, Job Tasks, and Rising Educational Demands: Looking outside the Wage Structure. In: Journal of Labor Economics, 24(2)**,** p. 235-270.

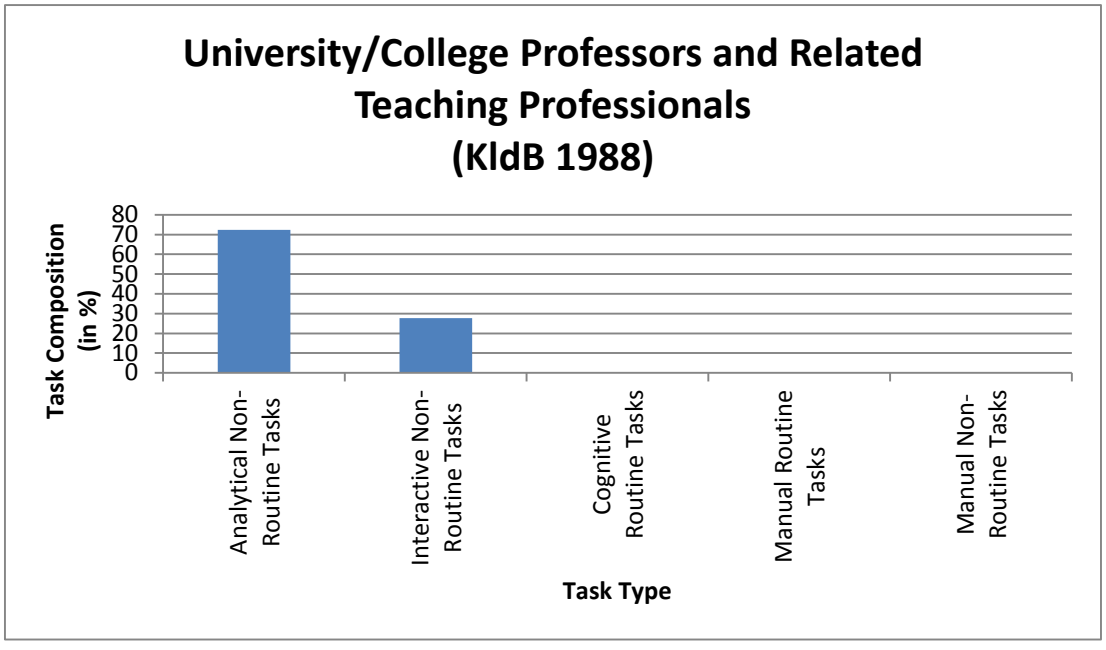
Yamaguchi, Shintaro (2013): Changes in Returns to Task-Specific Skills and Gender Wage Gap. Department of Economics Working Paper Series 2013-01 McMASTER University.

Appendix

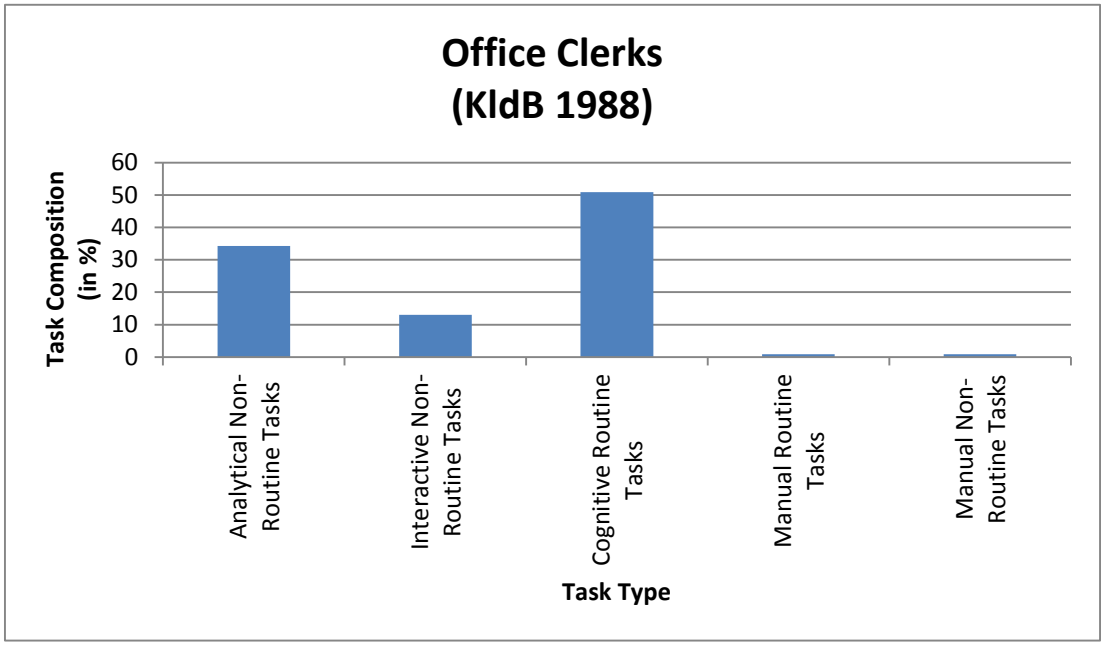
Appendix-Figure 1: Task Composition for Medical Doctors (KldB 1988)



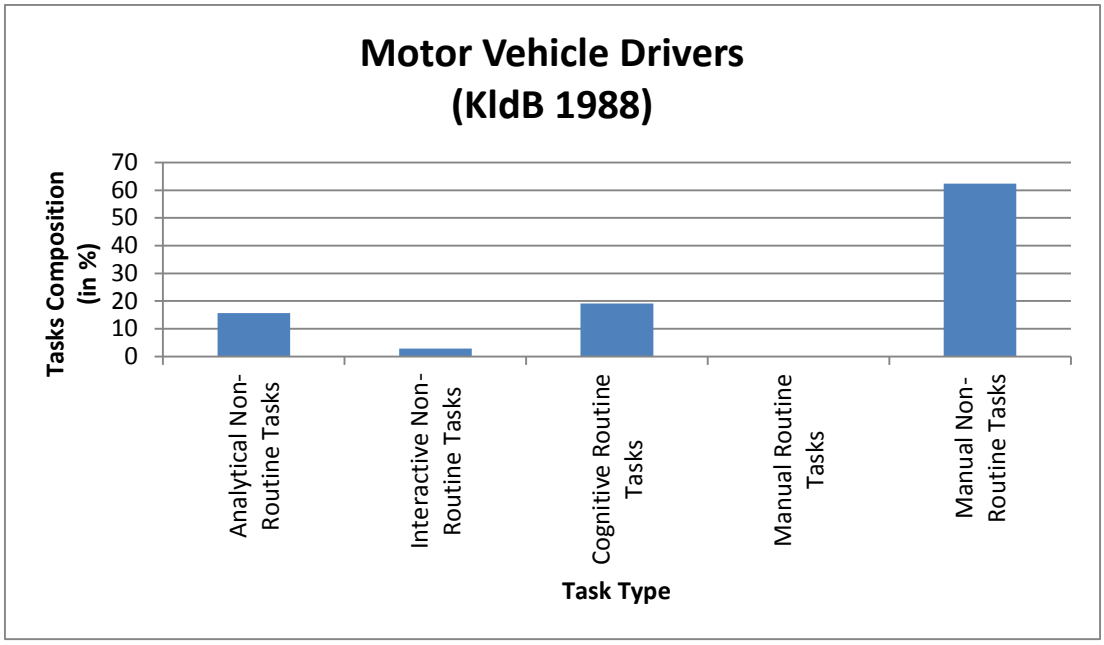
Appendix-Figure 2: Task Composition for University/College Professors and Related Teaching Professionals (KldB 1988)



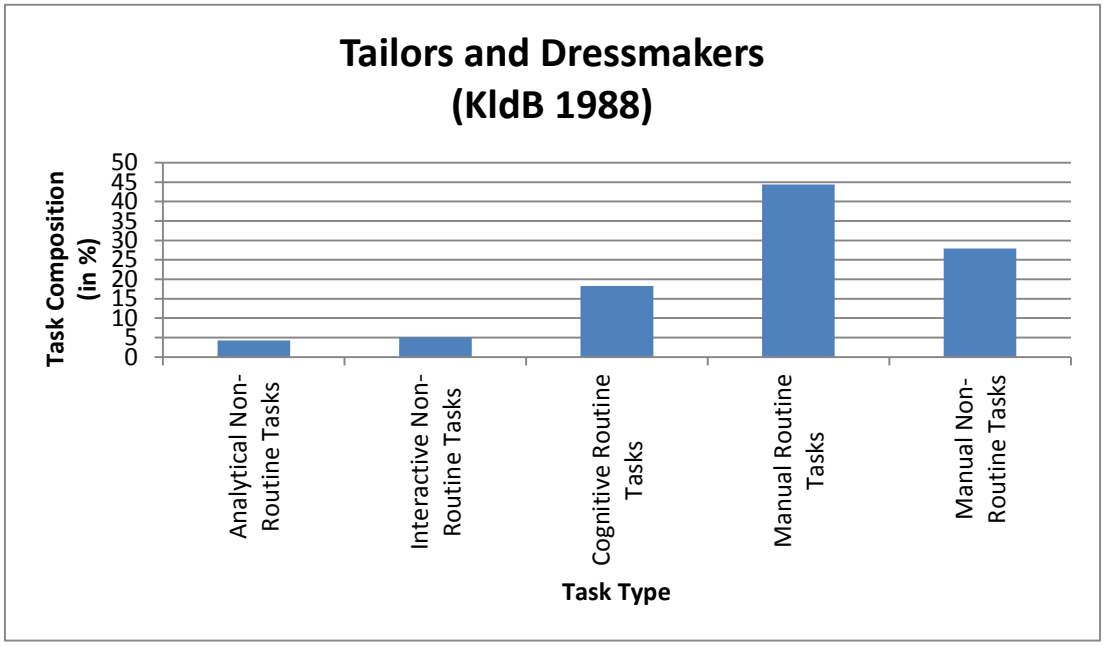
Appendix-Figure 3: Task Composition for Office Clerks (KldB 1988)



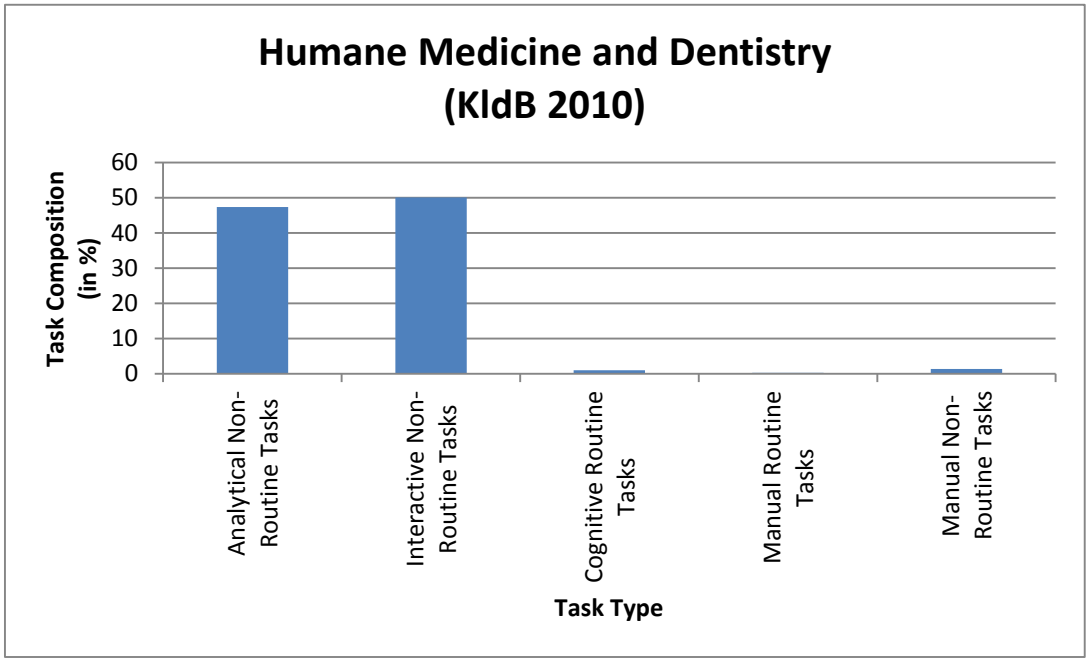
Appendix-Figure 4: Task Composition for Motor Vehicle Drivers (KldB 1988)



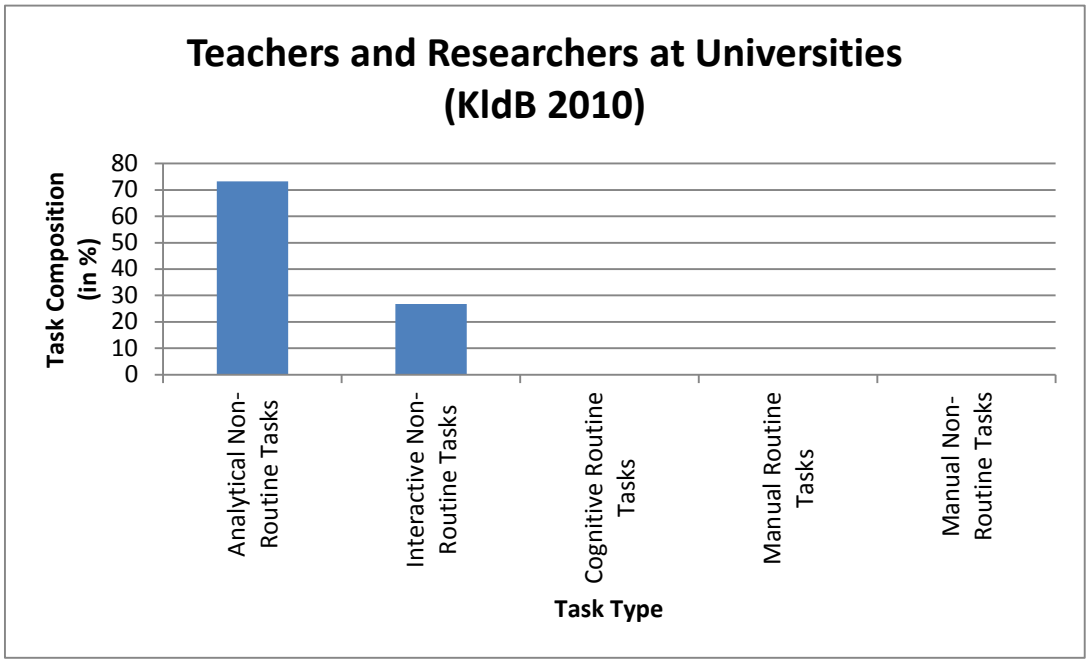
Appendix-Figure 5: Task Composition for Tailors and Dressmakers (KldB 1988)



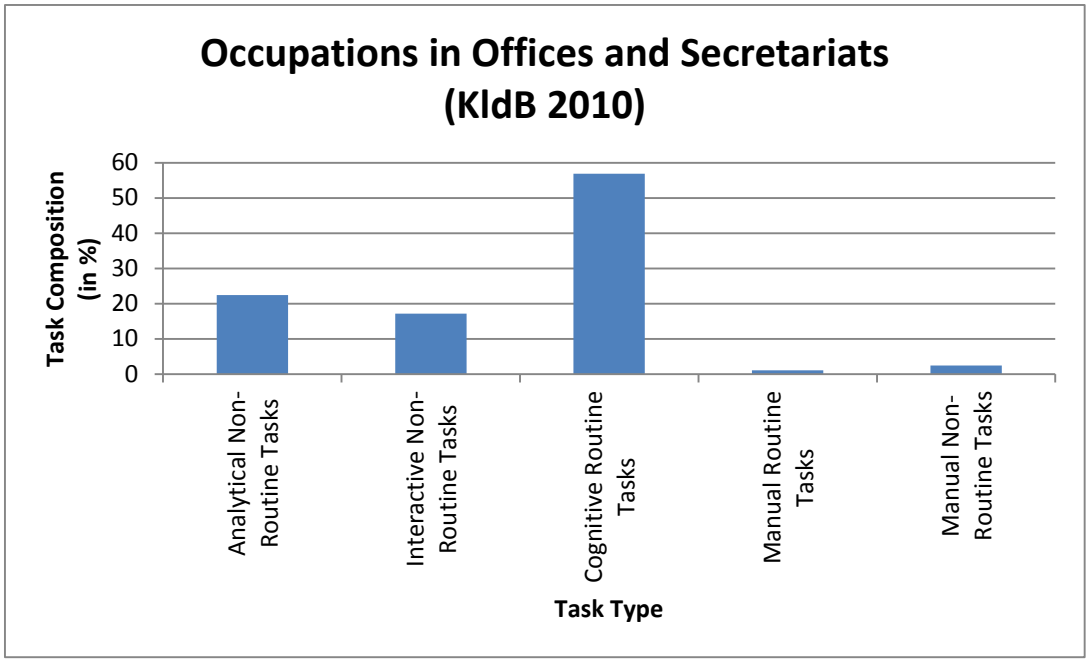
Appendix-Figure 6: Task Composition for Human Medicine and Dentistry (KldB 2010)



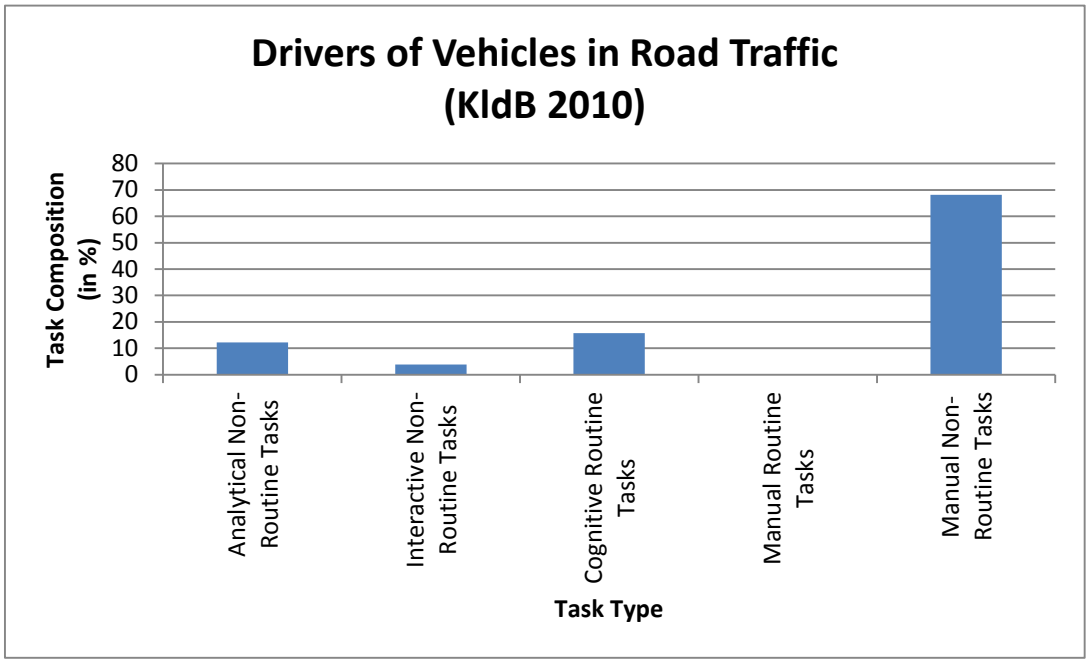
Appendix-Figure 7: Task Composition for Teachers and Researchers at Universities (KldB 2010)



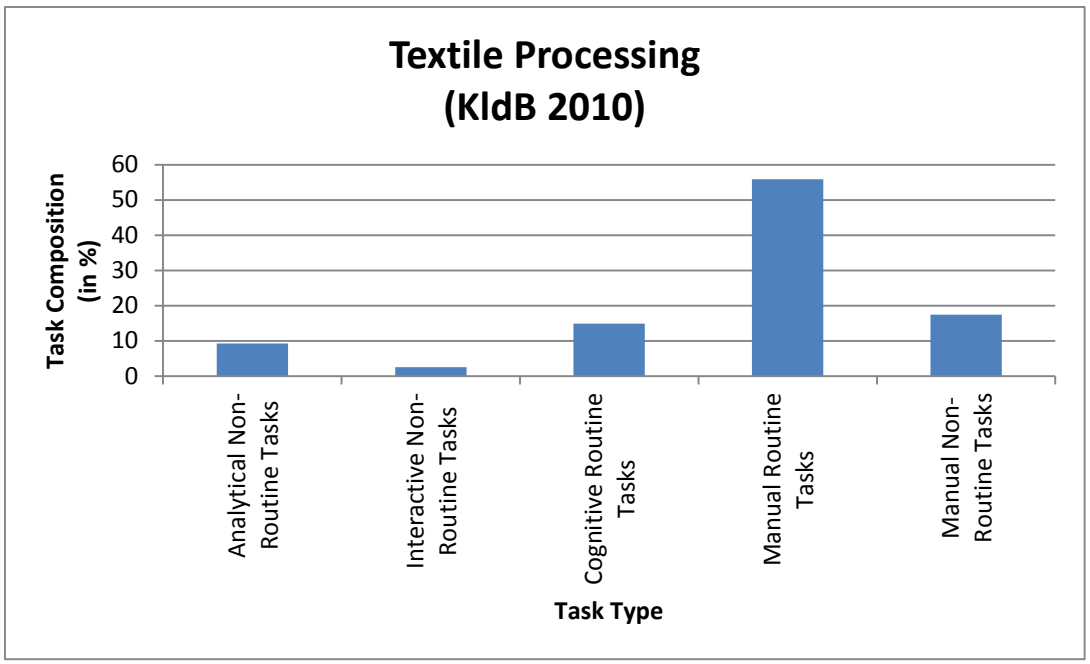
Appendix-Figure 8: Task Composition for Occupations in Offices and Secretariats (KldB 2010)



Appendix-Figure 9: Task Composition for Drivers of Vehicles in Road Traffic (KldB 2010)



Appendix-Figure 10: Task Composition for Occupations in Textile Processing (KldB 2010)



Appendix-Table 1: Individual Decisions for Overlappings of the Main Task Types for KldB 1988

		Main Task Type					
3-digit Code of KldB 1988	Occupational Title	1	2	3	4	5	Final Main Task Type
Year 2011							
203	Casters of semi-finished products and other mould casters			X	X		4
223	Metal planers			X	X		4
548	Boilerpersons, incinerators and related plant operators			X	X	X	5
715	Cabby			X		X	5
892	Nuns, friars and other religious associate professionals	X	X				2
Year 2012							
203	Casters of semi-finished products and other mould casters			X	X		4
223	Metal planers			X	X		4
242	Solderers			X	X		4
344	Knitters and knitting-machine operatrors			X	X		4
548	Boilerpersons, incinerators and related plant operators			X	X	X	5
715	Cabby			X		X	5
892	Nuns, friars and other religious associate professionals	X	X				2
Year 2013							
203	Casters of semi-finished products and other mould casters			X	X		4
222	Metal milling cutters			X	X		4
223	Metal planers			X	X		4
242	Solderers			X	X		4
344	Knitters and knitting-machine operatrors			X	X		4
548	Boilerpersons, incinerators and related plant operators			X	X	X	5
715	Cabby			X		X	5
742	Lift, lifting-trucks and other materials handling equip. operators			X	X		4
892	Nuns, friars and other religious associate professionals	X	X				2

Remarks: 1: analytical non-routine tasks, 2: interactive non-routine tasks, 3: cognitive routine tasks, 4: manual routine tasks, 5: manual non-routine tasks

Appendix-Table 2: Description of the Datasets

Variable name	Variable label
Different for the four datasets:	
kldb1988_3	3-digit code of KldB 1988
kldb2010_3	3-digit code of KldB 2010
kldb1988_2	2-digit code of KldB 1988
kldb2010_2	2-digit code of KldB 2010
Not different for the four datasets:	
bezeichnung	Occupation title of the 3-digit codes and 2-digit codes for KldB 1988 and Kldb 2010, respectively.
jahr	Year of the requirement matrix (2011, 2012, 2013)
haupttask	Main task type with
	1=analytical non-routine tasks
	2=interactive non-routine tasks
	3=cognitive routine tasks
	4=manual routine tasks
	5=manual non-routine tasks
	.=missing information
gwkomp1	weighted share of analytical non-routine tasks (task type 1)
gwkomp2	weighted share of interactive non-routine tasks (task type 2)
gwkomp3	weighted share of cognitive routine tasks (task type 3)
gwkomp4	weighted share of manual routine tasks (task type 4)
gwkomp5	weighted share of manual non-routine tasks (task type 5)

Appendix-Table 3: Share of Main Task Types based on the 3-digit Codes of KldB 1988 and KldB 2010 (in %)

	2013		2012		2011	
Task Type	Share of Main Task Type KldB 1988	Share of Main Task Type KldB 2010	Share of Main Task Type KldB 1988	Share of Main Task Type KldB 2010	Share of Main Task Type KldB 1988	Share of Main Task Type KldB 2010
Analytical Non-Routine Tasks	17.07	32.64	17.07	32.64	17.07	32.64
Interactive Non-Routine Tasks	4.79	8.33	4.79	8.33	4.79	8.33
Cognitive Routine Tasks	19.76	18.75	19.76	18.75	19.16	18.06
Manual Routine Tasks	31.74	16.67	31.74	16.67	31.74	16.67
Manual Non-Routine Tasks	20.96	20.83	20.96	20.83	21.26	21.53
Missing	5.69	2.78	5.69	2.78	5.99	2.78

Appendix-Table 4: Top 4 Occupations based on the 3-digit Codes of KldB 1988 with the Highest Task Composition per Task Type

Task Type	Top 4
Analytical Non-Routine Tasks	100%: Legislators, ministers and elected officials
	84%: Architects and civil and structural engineers
	83%: Veterinarians
	79%: Authors, journalists, editors and announcers
Interactive Non-Routine Tasks	98%: Interpreters and translators
	72%: Commercial sales representatives and sales agents
	70%: Employment, vocational training, study and career advisors
	63%: Energy and other consumer advisors
Cognitiv Routine Tasks	100%: Chemical laboratory workers
	100%: Radio operators
	100%: Data entry operators
	94%: Telecommunications mechanics and craftsmen
Manual Routine Tasks	100%: Rubber products machine operators
	100%: Metal drawers and extruders
	100%: Tanners, gut string makers and other leather-preparing-machine operators
	100%: Sheet metal pressers, drawers and punchers
Manual Non-Routine Tasks	100%: Paviors and pavers
	100%: Earth-moving and related plant operators
	100%: Machinery, plant, tube and container cleaners
	100%: Locomotive engine, tram and subway drivers

Appendix-Table 5: Task Composition by Requirement Levels for KldB 2010

	2013					2012					2011				
Requirement Levels	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Unskilled Activities (1)	6.6	4.7	17.0	29.0	42.7	6.6	4.7	16.7	29.4	42.6	6.6	4.7	17.0	29.0	42.7
Specialist Activities (2)	17.6	14.2	33.6	11.8	22.8	17.6	14.4	33.5	11.9	22.5	17.6	14.2	33.6	11.8	22.8
Complex Specialist Activities (3)	44.9	14.1	31.6	1.9	7.6	44.5	14.0	32.0	1.9	7.6	44.9	14.1	31.6	1.9	7.6
Highly Complex Activities (4)	61.1	18.7	18.5	0.3	1.4	61.2	18.4	18.6	0.3	1.5	61.1	18.7	18.5	0.3	1.4

Remarks: 1: analytical non-routine tasks, 2: interactive non-routine tasks, 3: cognitive routine tasks, 4: manual routine tasks, 5: manual non-routine tasks

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