Data appendix

A. Construction of the task indices

The purposes of the research is to study (1) the task composition of workers in the Belgian labor market in 2021 and (2) the change in the task composition of workers in the Belgian labor market since 1995. Two different datasets were used to carry out the analyses:

(1) The "European Working Conditions Surveys" (EWCS) that is available on the Eurofound website https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys-ewcs

(2) The "Survey of Adult Skills" that was collected as part of the OECD "Programme for the International Assessment of Adult Competencies" survey. The data are available on the OECD website https://www.oecd.org/skills/piaac/.

The EWCS and the PIAAC are both workers' surveys and while the EWCS is conducted every five years since 1991 in all EU member states, the PIAAC is conducted every 10 years in most of the OECD countries. To date, only the results of the PIAAC 'First Cycle' of data collection, which took place between 2011-2018, are available. Three rounds of data collections have been undertaken over that period and Belgium and all of the other EU-15 countries except for Greece were involved in the first round which was implemented between 2011 and 2012. Since until now individuals were interviewed only once in each country over the data collection period, the PIAAC data does not include time variability. We thus only use the EWCS for the second part of our analysis which investigates the evolution of the task content of workers. The sample in the EWCS consists of individuals aged 15 and over and in the PIAAC of individuals aged 16 to 65.

In order to create task indices that correspond to the different elements of the task framework introduced in Table 1, we aggregate information from a set of questions present in both datasets that are related to the task element we want to measure. In Table A.1, we present the surveys' questions that were aggregated to compute each of the different task index. The selection of variables and the aggregations in Table A.1 were based on the work of Fernández-Macías, Bisello, Sarkar, & Torrejón (2016) who identified the variables that could be mapped together to get a measure of a task index. We also looked at the correlations between the variables and we performed a factor analysis to verify the consistency of the indicators.

Table A. 1: Mapping of sources to the elements in the task model.

	EWCS		PIAAC
	Variable	Time	Variable
A. In terms of the object of work/task			
1. Physical: manipulation and transformation of things			
	q30a	1991-2021	
	q30b	2005-2021	
	q30c	1991-2021	
b. Dexterity			
2. Intellectual: manipulation and transformation of ideas			
a. Information processing: processing of codified information			
I. Literacy			
i. Business			g_q01b
			g_q01g
			g_q02a

ii. Technical				g_q01a
				g_q01f
				g_q01h
				g_q02c
				g_q02d
iii. Humanities				g_q01c
				g_q01d
				g_q01e
				g_q02b
II. Numeracy: processing of numerical information				
i. Accounting				g_q03b
				g_q03b
				g_q03b
ii. Analytical				g_q03f
				g_q03g
				g_q03h
b. Problem solving: finding solutions to complex/new issues				
I. Information gathering and evaluation	q53e	1995-2015		d_q13a
	q53f	1995-2021		d_q13b
				d_q13c
II. Creativity: finding a solution	q53c	1995-2015		
	q61i	2005-2015		
3. Social: interacting with other people	q30f	1995-2021		
I. Selling				f_q02d
				f_q02e
				f_q04a
				f_q04b
II. Teaching				f_q02b
				f_q02c
III. Managing				f_q03b
				d_q08a
				d_q08b
				d_q07a
				d_q07b
B. In terms of the methods and tools used in the work/task				
1. Work organization				
a. Autonomy: self-direction and latitude	q42	2005-2015		d_q11a
	q54a	1995-2021		d_q11b
	q54b	1995-2021		d_q11c
	q54c	1995-2021		d_q11d
	q47	2010-2021		f_q03a
				f_q03c
b. Teamwork: working in small groups	q58	2000-2015		
	q60a	2005-2015		
	q60b	2005-2015		
	q60c	2010-2015		
c. Routine: Repetitiveness and standardization of the task				
I. Repetitiveness	q30e	1995-2021		
	q48a	2000-2015		
	q48b	1995-2015		
	q53d	1995-2015		
II. Standardization	q50c	1995-2015		

	q53a	1995-2015	
2. Technology			
a. Operation of mechanical machinery and tools (non-ICT)	q29a	1995-2015	
	q50d	1995-2015	
b. Operation of ICT	q30i	1991-2021	g_q05a
			g_q05c
			g_q05e
			g_q05f
			g_q05g
			g_q06

Note: Tables B.1 and B.2 give the variables information.

Before aggregating the variables, we normalized each of them separately. The normalization of variables x was done using the formula:

$$\text{norm}_x = \left(\frac{x - x_{\min}}{x_{\max} - x_{\min}}\right) * 100 \qquad (1)$$

if the scale of x was measured such that a higher value indicates a higher intensity, or using formula

$$\text{norm}_x = \left(\frac{x_{\max} - x}{x_{\max} - x_{\min}}\right) * 100 \qquad (2)$$

when scale had the reverse order. $x_{\min}$ and $x_{\max}$ refer, respectively, to the minimum and maximum values of the variable x. We also multiply by 100 to obtain task scores between 1 and 100.

Up to 2015 in the EWCS data, all variables except for q42, q50a and q50b, were measured on scales indicating lower intensity and thus were normalized using equation (2). Variables q42, q50a and q50b were, however, normalized using equation (1). In 2021, the variables were measured on reversed scales and all variables, except for the variable q47, were normalized using equation (1). All variables in the PIAAC dataset were normalized using equation (1).

In most cases, the indices were constructed by calculating the average of the normalized variables to which it was related (based on Table A.1). For example, the physical task index was constructed by taking the average of the normalized variables q24a, q24b and q24c from the EWCS:

$$\text{physical index} = \frac{\text{norm}_{q24a} + \text{norm}_{q24b} + \text{norm}_{q24c}}{3}$$

Except for "autonomy" and "teamwork" in the EWCS and "managing" in the PIAAC dataset, the creation of all other task indices was done similarly. Note that in the EWCS, variable q53e was no longer available in 2021, hence the problem solving task index in 2021 was measured only from variable q53f. Similarly, variables q30b, q48a, q42, q47 and q61i were not available in 1995 and the task indices related to those variables were computed from the other variables when studying changes in task indices. None of the variables used to construct the team work task index were available in 1995, we thus removed this task index from the analyses studying the evolution of tasks.

- Creation of the Autonomy task index in the EWCS:

Because variables q54a, q54b and q54c are dummy variables we do not directly include them in the average formula. Similarly to Fernández-Macías, Bisello, Sarkar, & Torrejón (2016), we rather assigned a

value of 33 if workers responded positively and a value of 0 if their answer was negative. Then, we generated a new variable "choose" that represented the sum of these three variables and thus took on values between 0 and 100. Finally, the autonomy task index was calculated by taking the average of the variable choose and the normalized variables of q42 and q47.

Note that, in 2021, the variables q54a, q54b and q54c were measured on a scale from 1 to 5 and variables q42 and q47 were not available. We thus only study changes in the autonomy task index between 1995 and 2015. For the first analyses on the task composition of workers (tables 2 to 4), we used the 2021 data and constructed the autonomy task index by taking the average of the (normalized) variables q54a, q54b and q54c.

- Creation of the Team work task index in the EWCS:

The main variable used for the team work index is variable q58 which asks workers whether they work in group or team with common tasks. If workers answered positively to this question, they were then asked three sub-questions q60a, q60b and q60c on whether the members of the team can decide themselves on, respectively, the division of tasks, the head of the team and the timetable of the work. We again follow Fernández-Macías, Bisello, Sarkar, & Torrejón (2016) and define the task team work index as follow: (1) we assign a value of 70 to workers who responded positive to question q58 and a value of 0 to those who responded negatively, (2) for each of the complementary questions, we assign a value of 10 for a positive answer and a value of 0 for a negative answer and (3) we added these normalized variables to obtain the team work task index which takes on values between 0 and 100.

- Creation of the Managing task index in the PIAAC:

If respondents answered positively to questions d_q08a or d_q07a on whether they have employees working for them or whether they manage or supervise other employees, they were then asked questions d_q08b and d_q07b on the number of employees or people that they supervise. We use those four questions to generate a more general variable ranging from 0 to 100 and measuring the managing of others. In order to do so, we first assigned a value of 20 to workers who responded positively to question d_q08a and/or d_q07a and a value of 0 to those who responded negatively to both questions. We then multiplied questions d_q08b and d_q07b by 20 and assigned this new value to workers who responded to the questions. The managing task index was then constructed by taking the average between this new normalized variable and the (normalized) variable f_q03b.

B. Linear trend coefficients and the decomposition analysis

The linear trend coefficients are obtained from the following regression that was performed for each different task index separately:

$$\text{task index}_j = \beta_{j,0} + \beta_{j,1}\text{year} + \epsilon_j$$

where j represents the different task indices and ϵ is the error term.

The different elements of the decomposition analysis are calculated using the following formula:

$$\overline{\text{task}}_{j,2021} - \overline{\text{task}}_{j,1995} = \sum_o \left(\text{task}_{oj,2021} \times W_{o,2021}\right) - \left(\text{task}_{oj,1995} \times W_{o,1995}\right)$$

$$within_j = \sum_o \left(W_{o,1995} \times \Delta task_{oj} \right)$$

$$between_j = \sum_o \left(\Delta W_o \times task_{oj,1995} \right)$$

$$res_j = \sum_o \left(\Delta W_o \times \Delta task_{oj} \right)$$

where o represent the ISCO-08 occupations at the one digit and j represent the different tasks indices. $\Delta task_{oj} = task_{oj,2021} - task_{oj,1995}$ represent the change in the task index j and occupation o and $\Delta W_o = W_{o,2021} - W_{o,1995}$ represent the change in the share of employment in occupation o.

C. Variables definition

This sections provides the variables definitions. Table C.1 and C.2 gives information on the variables used to construct the task indices and Table C.3 provides the ISCO-88 and ISCO-08 classifications. The EWCS contains information on ISCO-88 at the 1 digit between 1995 and 2015 and at the 2 digits between 2000 and 2015. It also contains information on ISCO-08 at the 1 digit and 2 digits between 2010 and 2021. Harmonizing the two classification is complicated because there is no exact correspondence between the codes. Yet, the two classification are approximatively identical at the 1 digit. We thus use both classifications interchangeably at the 1 digit. The PIAAC data only contains information on the ISCO-08 classification.

Table C.1: Variables description (EWCS)

EWCS variables	RENAMED	TEXT DESCRIPTION
Physical		
q30a	tiring	Please tell me, using the same scale, does your main paid job involve Tiring or painful positions?
q30b	lifting	Please tell me, using the same scale, does your main paid job involve Lifting or moving people?
q30c	hloads	Please tell me, using the same scale, does your main paid job involve Carrying or moving heavy loads?
q24d	standing	Please tell me, using the same scale, does your main paid job involve Standing?
Information gathering and evaluation		
q53e	complex	Generally, does your main paid job involve complex tasks?
q53f	learning	Generally, does your main paid job involve learning new things?
Creativity		
q53c	problems	Generally, does your main paid job involve solving unforeseen problems on your own?
q61i	ownid	Please select the response which best describes your work situation: You are able to apply your own ideas in your work.
Social		
q30f	customers	Please tell me, using the same scale, does your main paid job involve Dealing directly with people who are not employees at your workplace such as customers, passengers, pupils, patients etc.?
Autonomy		
q42	timeflex	How are your working time arrangements set?
q50a	constraint1	On the whole, is your pace of work dependent on the work done by colleagues?
q50b	constraint2	On the whole, is your pace of work dependent on direct demands from people such as customers, passengers, pupils, patients, etc.?
q54a	choose1	Are you able to choose or change your order of tasks?
q54b	choose2	Are you able to choose or change your methods of work?
q54c	choose3	Are you able to choose or change your speed or rate of work?

| q61f | **break** | Please select the response which best describes your work situation: You can take a break when you wish. |
| q47 | **timeoff** | Would you say that for you arranging to take an hour or two off during working hours to take care of personal or family matters is... |

Teamwork

q58	**team**	Do you work in a group or team that has common tasks and can plan its work?
q60a	**division**	For the team in which you work mostly, do the members decide by themselves On the division of tasks?
q60b	**head**	For the team in which you work mostly, do the members decide by themselves Who will be the head of the team?
q60c	**timetable**	For the team in which you work mostly, do the members decide by themselves The timetable of the work?

Repetitiveness

q30e	**repetitive**	Please tell me, using the same scale, does your main paid job involve Repetitive hand or arm movements?
q48a	**rep1**	Please tell me, does your job involve short repetitive tasks of less than 1 minute?
q48b	**rep10**	Please tell me, does your job involve short repetitive tasks of less than 10 minutes?
q53d	**monot**	Generally, does your main paid job involve monotonous tasks?

Standardization

| q50c | **numerical** | On the whole, is your pace of work dependent on numerical production targets or performance targets? |
| q53a | **qualstand** | Generally, does your main paid job involve meeting precise quality standards? |

Operation of mechanical machinery and tools

| q29a | **machvib** | Please tell me, using the following scale, are you exposed at work to Vibrations from hand tools, machinery etc.? |
| q50d | **pacemachine** | On the whole, is your pace of work dependent on automatic speed of a machine or movement of a product? |

Operation of ICT

| q30i | **computers** | Please tell me, using the same scale, does your main paid job involve Working with computers, laptops, smartphones etc? |
| q24i | **internet** | Please tell me, using the same scale, does your main paid job involve Using internet / email for professional purposes? |

Table C.2: Variables description (PIAAC)

PIAAC variables	RENAMED	TEXT DESCRIPTION
Business Literacy		
g_q01b	**rdletter**	In your Job/Last job, how often Do/Did you usually read letters, memos or e-mails?
g_q01g	**rdfinanc**	In your Job/Last job, how often Do/Did you usually read bills, invoices, bank statements or other financial statements?
g_q02a	**wrletter**	In your Job/Last job, how often Do/Did you usually write letters, memos or e-mails?
Technical Literacy		
g_q01a	**rddir**	In your Job/Last job, how often Do/Did you usually read directions or instructions?
g_q01f	**rdmanual**	In your Job/Last job, how often Do/Did you usually read manuals or reference materials?
g_q01h	**rddiag**	In your Job/Last job, how often Do/Did you usually read diagrams, maps or schematics?
g_q02c	**wrreport**	In your Job/Last job, how often Do/Did you usually write reports?
g_q02d	**wrform**	In your Job/Last job, how often Do/Did you usually fill in forms?
Humanities Literacy		
g_q01c	**rdnews**	In your Job/Last job, how often Do/Did you usually read articles in newspapers, magazines or newsletters?
g_q01d	**rdjourn**	In your Job/Last job, how often Do/Did you usually read articles in professional journals or scholarly publications?
g_q01e	**rdbook**	In your Job/Last job, how often Do/Did you usually read books?

g_q02b	**wrartcl**	In your Job/Last job, how often Do/Did you usually write articles for newspapers, magazines or newsletters?

Accounting Numeracy

g_q03b	**calcost**	In your Job/Last job, how often Do/Did you usually calculate prices, costs or budgets?
g_q03c	**calfraction**	In your Job/Last job, how often Do/Did you usually use or calculate fractions, decimals or percentages?
g_q03d	**usecalculator**	In your Job/Last job, how often Do/Did you usually use a calculator - either hand-held or computer based?

Analytic numeracy

g_q03f	**chartprep**	In your Job/Last job, how often Do/Did you usually prepare charts, graphs or tables?
g_q03g	**algebra**	In your Job/Last job, how often Do/Did you usually use simple algebra or formulas?
g_q03h	**usemath**	In your Job/Last job, how often Do/Did you usually use more advanced math or statistics such as calculus, complex algebra, trigonometry or use of regression techniques?

Learning

d_q13a	**learning1**	In your own job, how often do you learn new work-related things from co-workers or supervisors?
d_q13b	**learning2**	How often does your job involve learning-by-doing from the tasks you perform?
d_q13c	**learning3**	How often does your job involve keeping up to date with new products or services?

Selling

f_q02d	**selling**	How often Does/Did your Job/Last job usually involve selling a product or selling a service?
f_q02e	**advising**	How often Does/Did your Job/Last job usually involve advising people?
f_q04a	**influencing**	How often Does/Did your Job/Last job usually involve persuading or influencing people?
f_q04b	**negotiating**	How often Does/Did your Job/Last job usually involve negotiating with people either inside or outside your firm or organization?

Teaching

f_q02b	**teaching**	How often Does/Did your Job/Last job usually involve instructing, training or teaching people, individually or in groups?
f_q02c	**presenting**	How often Does/Did your Job/Last job usually involve making speeches or giving presentations in front of five or more people?

Managing

f_q03b	**thersplano**	How often Does/Did your Job/Last job usually involve planning the activities of others?
d_q08a	**job_manothers**	Do you manage or supervise other employees?
d_q08b	**job_manothernum**	How many people do you supervise or manage, directly or indirectly?
d_q07a	**business_manothers**	Do you have employees working for you? Please include family members working paid or unpaid in the business.
d_q07b	**business_manothersnum**	How many people do you employ?

Autonomy

d_q11a	**flextask**	To what extent can you choose or change the sequence of your tasks?
d_q11b	**flexwrk**	To what extent can you choose or change how you do your work?
d_q11c	**flexspeed**	To what extent can you choose or change the speed or rate at which you work?
d_q11d	**flextime**	To what extent can you choose or change your working hours?
f_q03a	**planact**	How often Does/Did your Job/Last job usually involve planning your own activities?
f_q03c	**plantime**	How often Does/Did your Job/Last job usually involve organizing your own time?

ICT

g_q05a	**mail**	In your Job/Last job, how often Do/Did you usually use email?
g_q05c	**wrkinfo**	In your Job/Last job, how often Do/Did you usually use the internet in order to better understand issues related to your work?
g_q05e	**spreadsht**	In your Job/Last job, how often Do/Did you usually use spreadsheet software, for example Excel?
g_q05f	**word**	In your Job/Last job, how often Do/Did you usually use a word processor, for example Word?
g_q05g	**progrmng**	In your Job/Last job, how often Do/Did you usually use a programming language to program or write computer code?
g_q06	**compuse**	What level of computer use Is/Was needed to perform your Job/Lastjob?

Table C.3: ISCO-88 and ISCO-08 (2 digits) groups

ISCO-88	ISCO-08

1. Legislators, senior officials and managers
    11. Legislators, senior officials and managers
    12. Corporate managers
    13. Managers of small enterprises
	1. Managers
	    11. Chief executives, senior officials and legislators
	    12. Administrative and commercial managers
	    13. Production and specialized services managers
	    14. Hospitality, retail and other services managers

2. Professionals
    21. Physical, mathematical and engineering science professionals
    22. Life science and health professionals
    23. Teaching professionals
    24. Other professionals
	2. Professionals
	    21. Science and engineering professionals
	    22. Health professionals
	    23. Teaching professionals
	    24. Business and administration professionals
	    25. Information and communications technology professionals
	    26. Legal, social and cultural professionals

3. Technicians and associate professionals
    31. Physical and engineering science associate professionals
    32. Life science and health associate professionals
    33. Teaching associate professionals
    34. Other associate professionals
	3. Technicians and associate professionals
	    31. Science and engineering associate professionals
	    32. Health associate professionals
	    33. Business and administration associate professionals
	    34. Legal, social, cultural and related associate professionals
	    35. Information and communications technicians

4. Clerks
    41. Office clerks
    42. Customer services clerks
	4. Clerical support workers
	    41. General and keyboard clerks
	    42. Customer services clerks
	    43. Numerical and material recording clerks
	    44. Other clerical support workers

5. Service workers and shop and market sales workers
    51. Personal and protective services workers
    52. Models, salespersons and demonstrators
	5. Service and sales workers
	    51. Personal service workers
	    52. Sales workers
	    53. Personal care workers
	    54. Protective services workers

7. Craft and related trades workers
    71. Extraction and building trades workers
    72. Metal, machinery and related trades workers
    73. Precision, handicraft, craft printing and related trades workers
    74. Other craft and related trades workers
	7. Craft and related trades workers
	    71. Building and related trades workers, excluding electricians
	    72. Metal, machinery and related trades workers
	    73. Handicraft and printing workers
	    74. Electrical and electronic trades workers
	    75. Food processing, wood working, garment and other craft and related trades

8. Plant and machine operators, and assemblers
    81. Stationary-plant and related operators
    82. Machine operators and assemblers
    83. Drivers and mobile plant operators
	8. Plant and machine operators, and assemblers
	    81. Stationary plant and machine operators
	    82. Assemblers
	    83. Drivers and mobile plant operators

9. Elementary occupations
    91. Sales and services elementary occupations
    92. Agricultural, fishery and related laborers
    93. Laborers in mining, constructions, manufacturing and transport
	9. Elementary occupations
	    91. Cleaners and helpers
	    92. Agricultural, forestry and fishery laborers
	    93. Laborers in mining, construction, manufacturing and transport
	    94. Food preparation assistants
	    95. Street and related sales and service workers
	    96. Refuse workers and other elementary workers

References

Fernández-Macías, E., Bisello, M., Sarkar, S., & Torrejón, S. (2016). *Methodology of the construction of task indices for the European Jobs Monitor.* Dublin: Eurofound. Retrieved from https://www.eurofound.europa.eu/sites/default/files/ef1617en2.pdf