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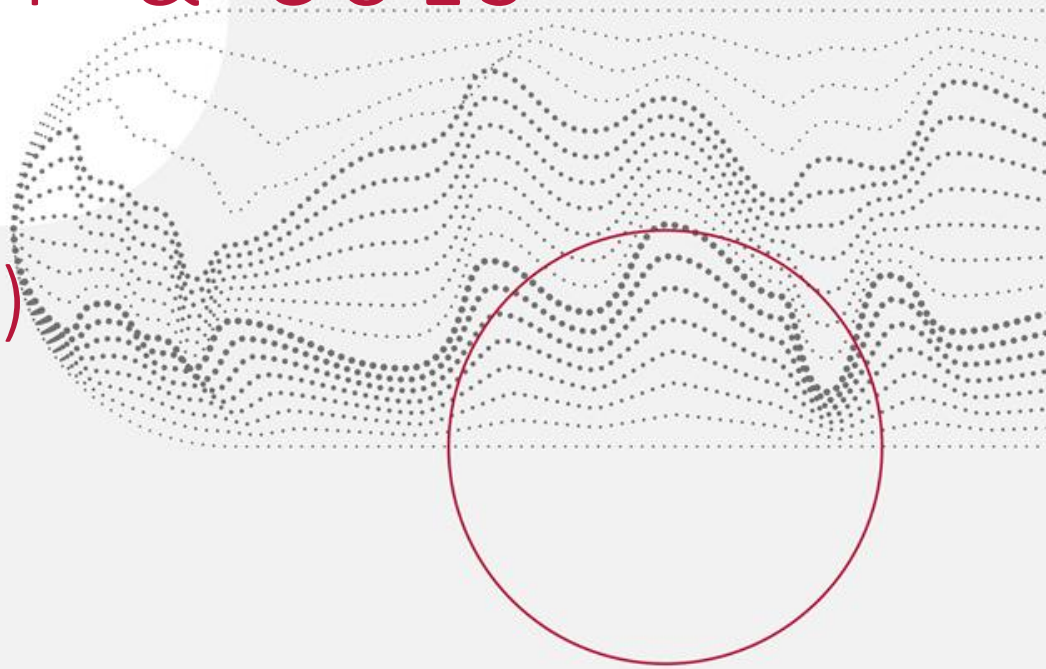
# The global distribution of routine and non-routine work. Findings from PIAAC, STEP & CULS



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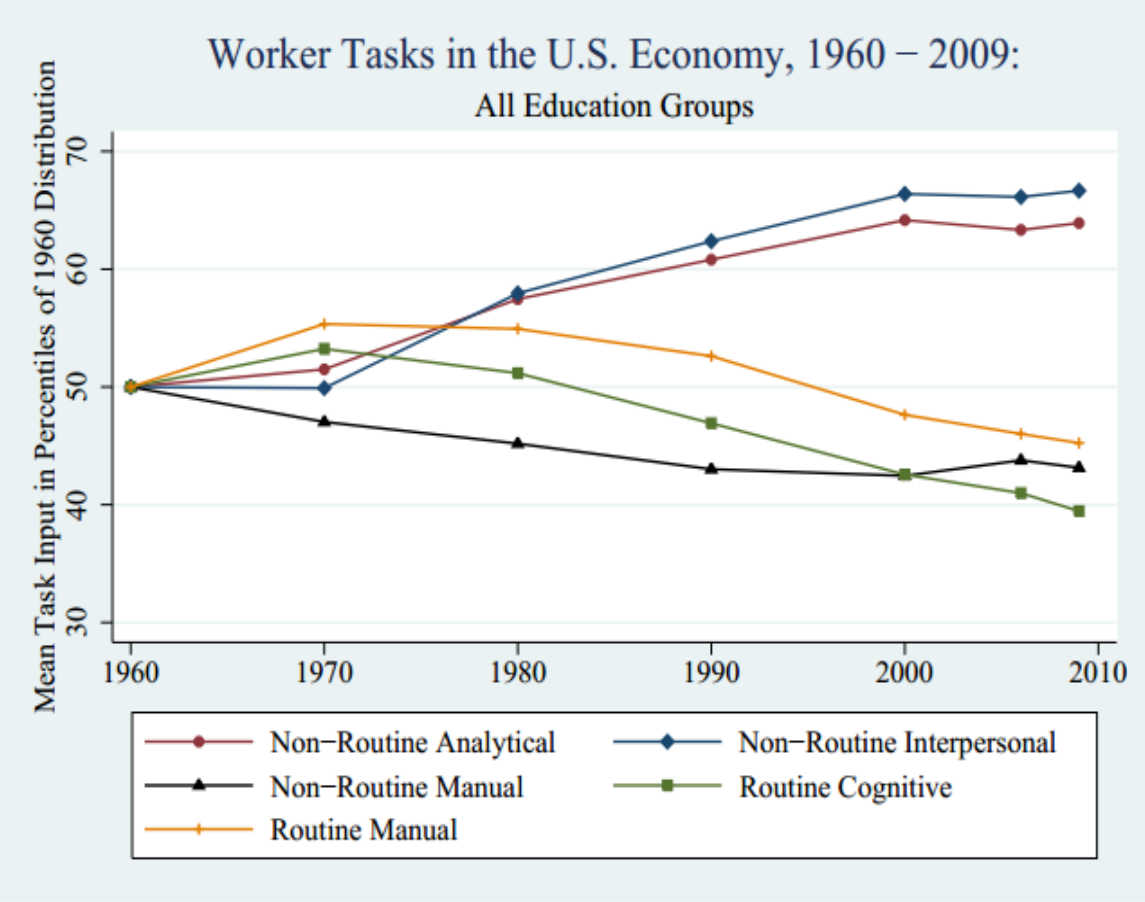
# The de-routinisation of jobs in the US and Western Europe has been attributed to the routine-biased technological progress




- Routine cognitive and manual tasks are substituted by technology and decline
- Non-routine cognitive tasks complement technology and grow
- Non-routine manual tasks rebounded but are typical for lousy jobs

Source: Autor, Price (2013)

# The aim of this paper

- Construct task content measures which:
  - Are worker-level and country specific
  - Are consistent with the established measures based on O*NET (US dataset)
  - Can be applied to PIAAC and STEP datasets

- Quantify differences in the task content of jobs around the world

- Identify factors which contribute to these differences

# Task contents are usually calculated with O*NET, a US database on occupational demands (Autor et al. 2003, Acemoglu & Autor 2011)

| Task content measure | Task items used |
|---|---|
| Non-routine cognitive analytical | Analysing data / information<br>Thinking creatively<br>Interpreting information for others |
| Non-routine cognitive interpersonal | Establishing and maintaining personal relationships<br>Guiding, directing and motivating subordinates<br>Coaching/developing others |
| Routine cognitive | The importance of repeating the same tasks<br>The importance of being exact or accurate<br>Structured vs. unstructured work |
| Routine manual | Pace determined by the speed of equipment<br>Controlling machines and processes<br>Spending time making repetitive motions |
| Non-routine manual physical | Operating vehicles, mechanized devices, or equipment<br>Spending time using hands to handle, control or feel objects, tools or controls<br>Manual dexterity<br>Spatial orientation |

# Task is not a skill – it is a unit of work activity that produces output

Occupations involve various amounts of tasks, some of them dominant

| Non-routine cognitive (analytical and personal) | Routine cognitive | Manual (routine and non-routine) |
|---|---|---|
| • Managers<br>• IT specialists<br>• Architects<br>• Engineers | • Bookkeepers<br>• Tellers<br>• Office clerks<br>• Salespersons | • Assemblers<br>• Toolmakers<br>• Drivers<br>• Farmers |

# Cross-country studies utilise O*NET assumming that it is a good proxy for occupational content outside of the US (occupations are identical)

- Handel (2012): high correlations between O*NET measures and results from country-specific skill surveys in some OECD countries

- Goos et al. (2014), Arias et al. (2014), Lewandowski et al. (2016, 2017): applications of O*NET to LFS data in the OECD and/or EU countries

- WDR (2016): Autor (2015) typology of high-, middle-, and low-skill occupations done on the US data assigned to developing countries

# Recent attempts to create routine/non-routine task measures using skill surveys with individual level data on job content

- De la Rica & Gortazar (2016), Marcolin et al. (2016) with PIAAC (OECD and partners)
- Dicarlo (2016) with STEP (10 developing countries)
- These papers are quite arbitrary in how they define tasks.

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- These papers are quite arbitrary in how they define tasks.

- Differences wrt O*NET tasks can result from different definitions (☹) or different country-specific work patterns (☺).

- We want to minimise the former and highlight the latter

- We use PIAAC (32 countries), STEP (10 countries) and CULS (China)

# We use three surveys which include comparable data on the skill use at work, literacy and labour market status

**PIAAC (OECD)**

- 32 countries surveyed between 2011 and 2015
- sample sizes: from 4000 (Russia) to 26000 (Canada)

**STEP (World Bank)**

- 10 countries surveyed between 2011 and 2015
- sample sizes: from 2400 (Ukraine) to 4000 (Macedonia) urban residents
- representative for survey areas
- skill use at work and literacy test comparable to PIAAC

**CULS (Chinese Academy of Social Science)**

- 6 cities (Guangzhou, Shanghai, Fuzhou, Shenyang, Xian, Wuhan) in 2016
- sample size 15500
- representative for the survey area
- skill use at work questionnaire as in STEP

# Representativeness of the data is limited in some countries. Bear that in mind when looking at results

## PIAAC

- Belgium – Flanders
- Russia – without Moscow municipal area
- UK – England and Northern Ireland
- Indonesia – Jakarta
- Singapore – only permanent residents (approx. 75% of population)

## STEP – urban survey with additional limitations in some countries

- Bolivia – four main cities – La Paz, El Alto, Cochabamba and Santa Cruz de la Sierra (approx. 80% of urban population)
- Colombia – 13 main metropolitan areas
- Georgia – without Abkhazia and South Ossetia
- Lao PDR – both urban and rural, but we drop rural for consistency
- China (CULS) – 6 cities

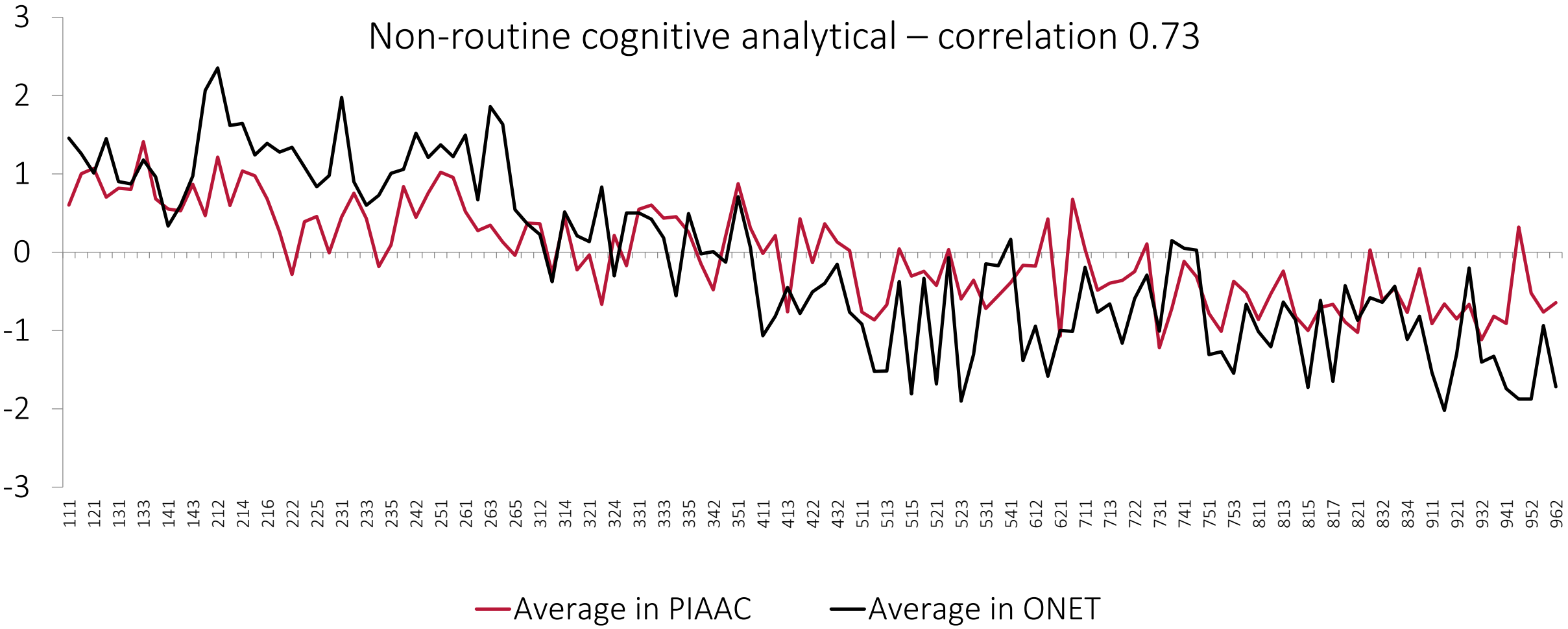
# We use the US PIAAC to construct task measures which are consistent with O*NET but are calculated at a worker level and are country-specific

- Identify task items which are included in both PIAAC and STEP
- Group them into four categories (non-routine cognitive analytical and personal, routine cognitive, manual)
- Calculate O*NET task contents (Autor & Acemoglu, 2011) on the US PIAAC
- Find combinations of items which are highly correlated with O*NET tasks at the occupation level in the US PIAAC
- Choose the best combinations for every task measure and apply them to all countries

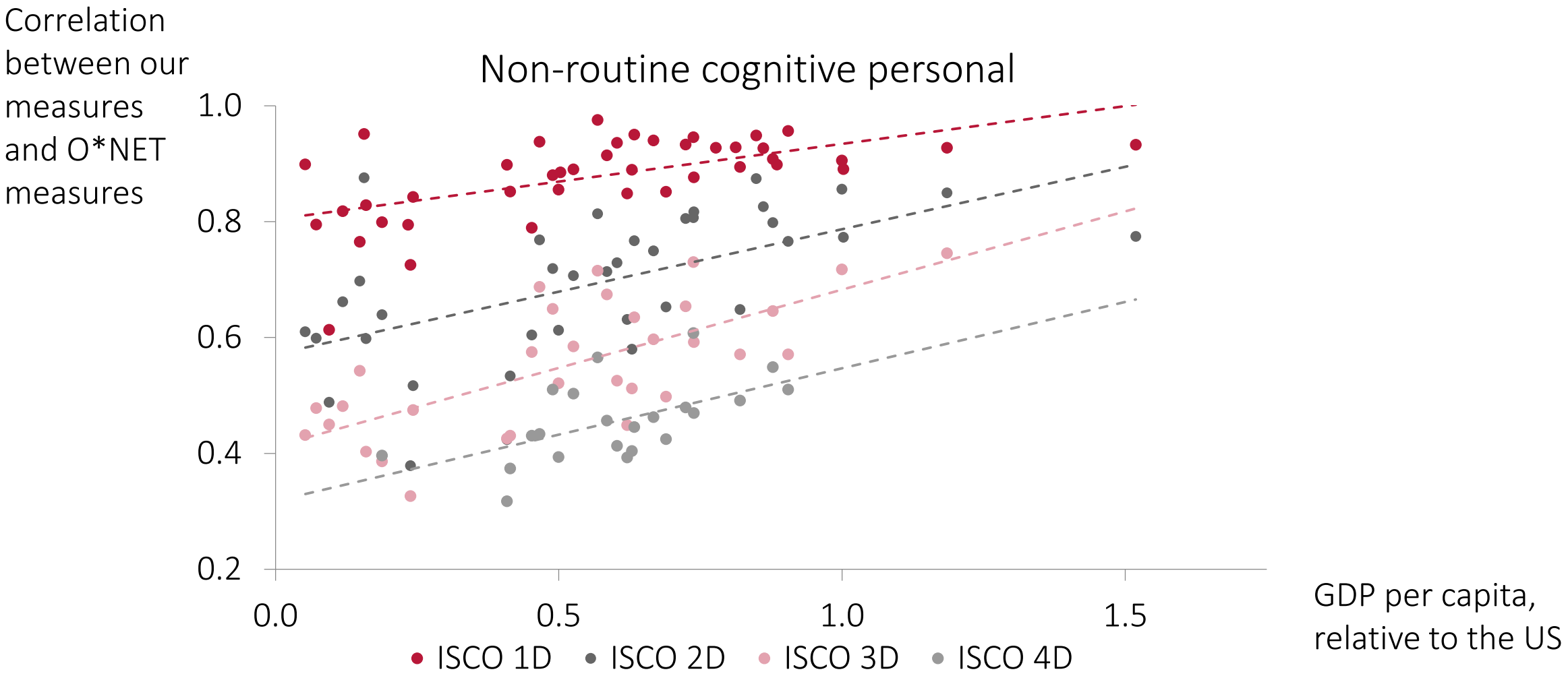
# We select the PIAAC / STEP items below and follow Autor & Acemoglu (2011) to calculate the values of tasks

| Task content measure | PIAAC / STEP task items used |
|---|---|
| Non-routine cognitive analytical | Reading bills<br>Reading news<br>Advanced math<br>Solving problems<br>Calculating prices<br>Programming |
| Non-routine cognitive interpersonal | Supervising<br>Presenting |
| Routine cognitive | Changing order of tasks (reversed)<br>Filling forms<br>Presenting (reversed) |
| Manual | Physical tasks |

# At the 3-digit occupation level in the US, the correlations between our measures and O*NET measures range from 0.61 to 0.74



# The higher is the GPD per capita, the higher are the correlations between our tasks and the O*NET tasks at the occupation level

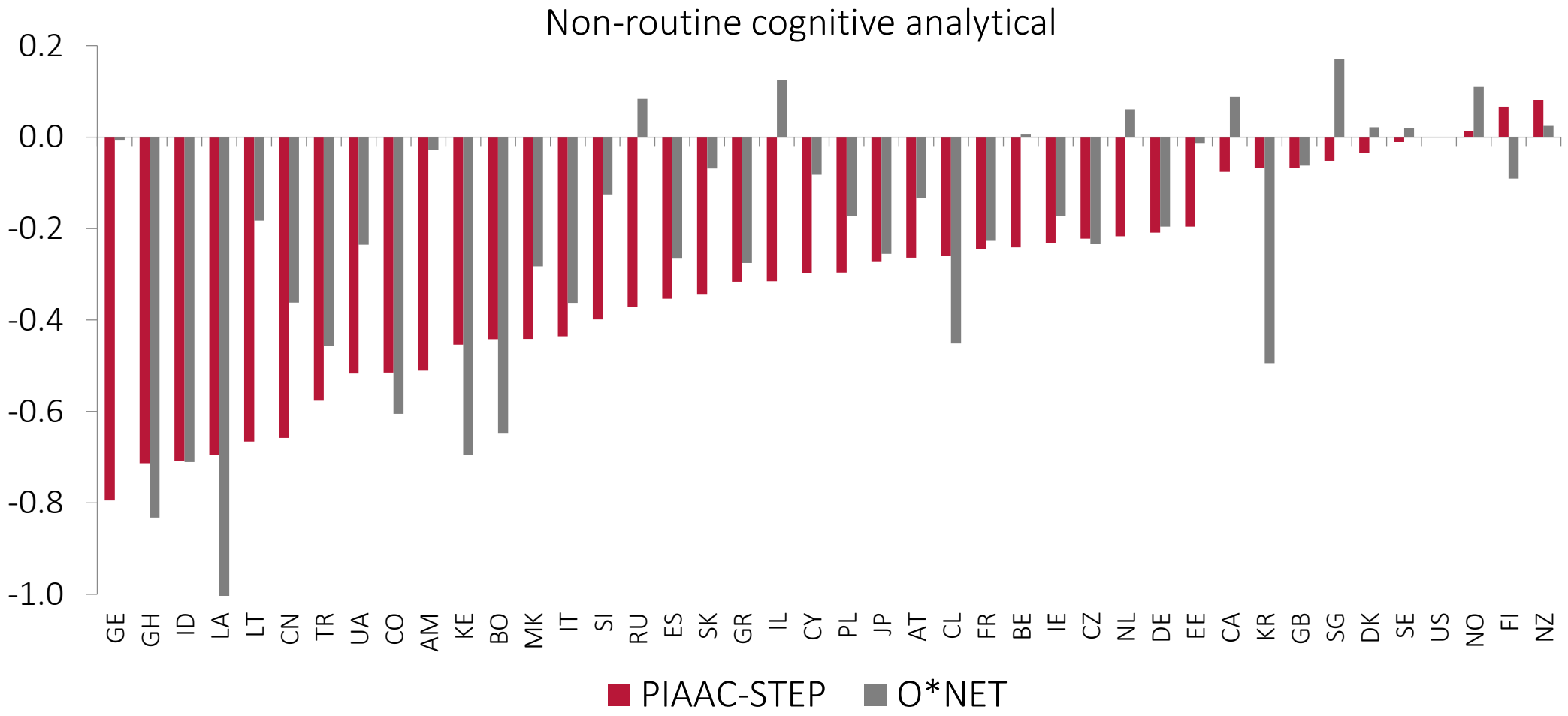


# Once we control for GDP and literacy scores, there is no significance difference between PIAAC and STEP datasets

| | Non-routine cognitive analytical | Non-routine cognitive personal | Routine cognitive | Manual |
|---|---|---|---|---|
| Base model (I) | -0.27*** | -0.03 | -0.30*** | -0.38*** |
| I+ GDP (II) | -0.08 | -0.03 | -0.39** | -0.43*** |
| II + literacy skills | -0.09 | 0.06 | -0.24 | -0.17*** |

The base regressions include dummies for gender, 10-year age groups, education, 1-digit occupations and sectors. The standard errors are clustered at a country level. The regressions with literacy scores exclude China (CULS), Laos and Macedonia due to lack of literacy skills assessment in these countries.

# In the less developed countries our measures show less non-routine task content than O*NET, the opposite is true in highly advanced countries



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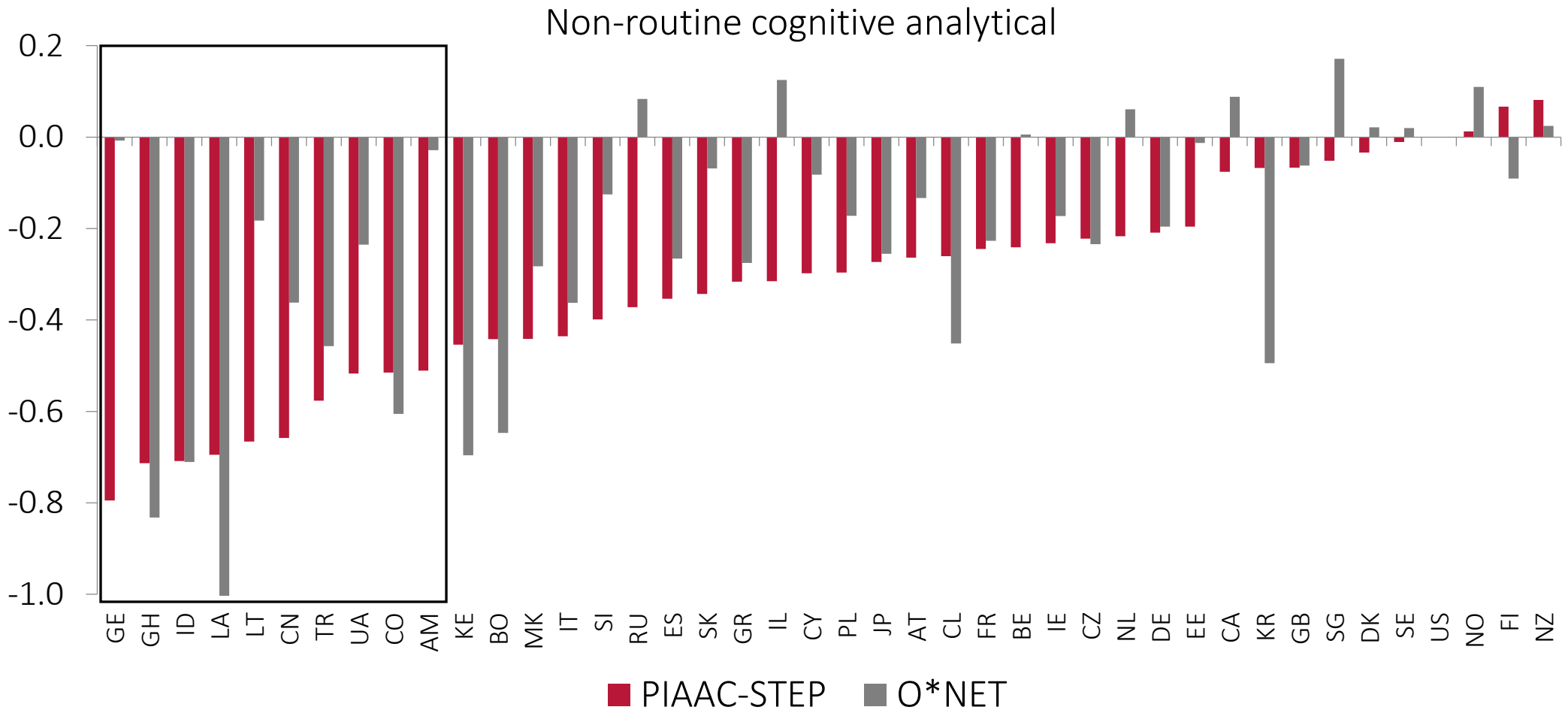

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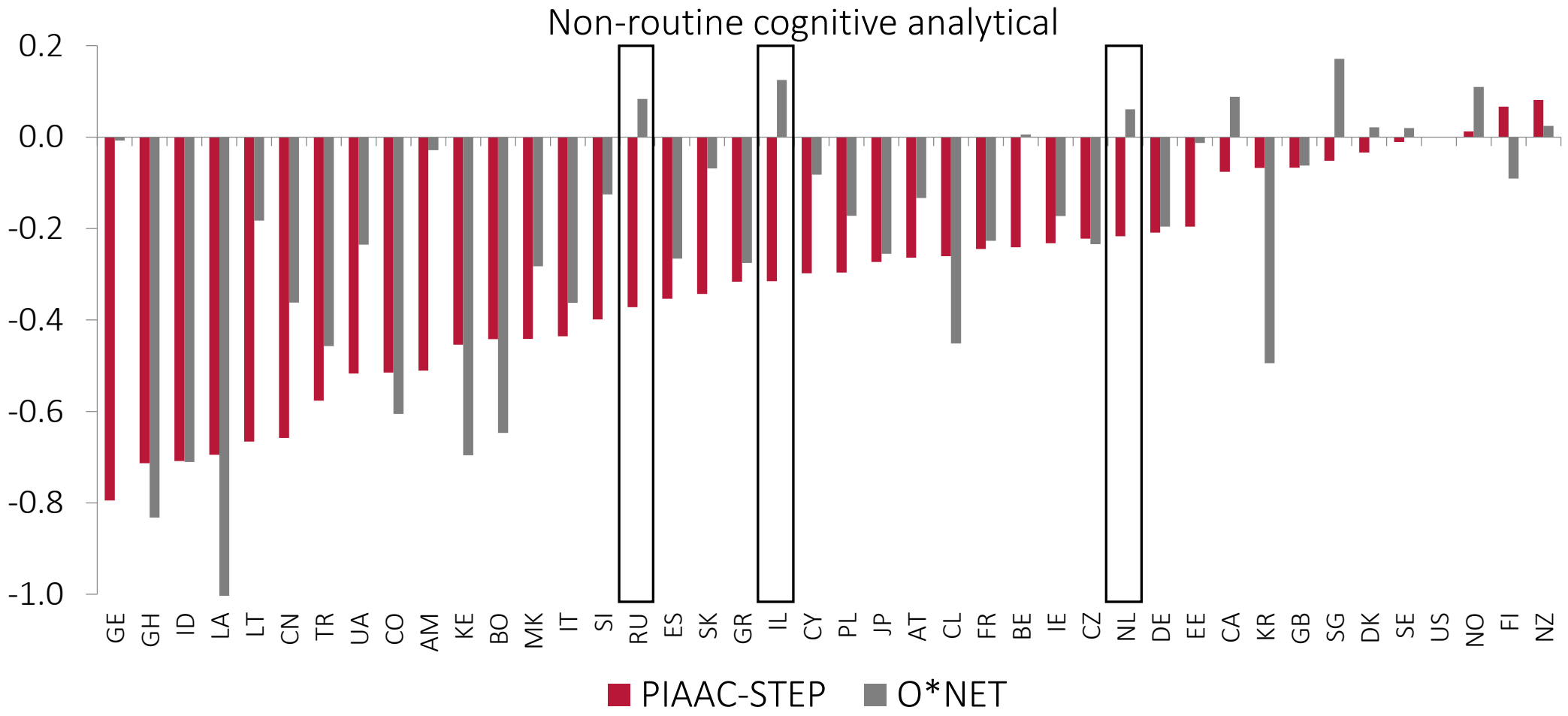

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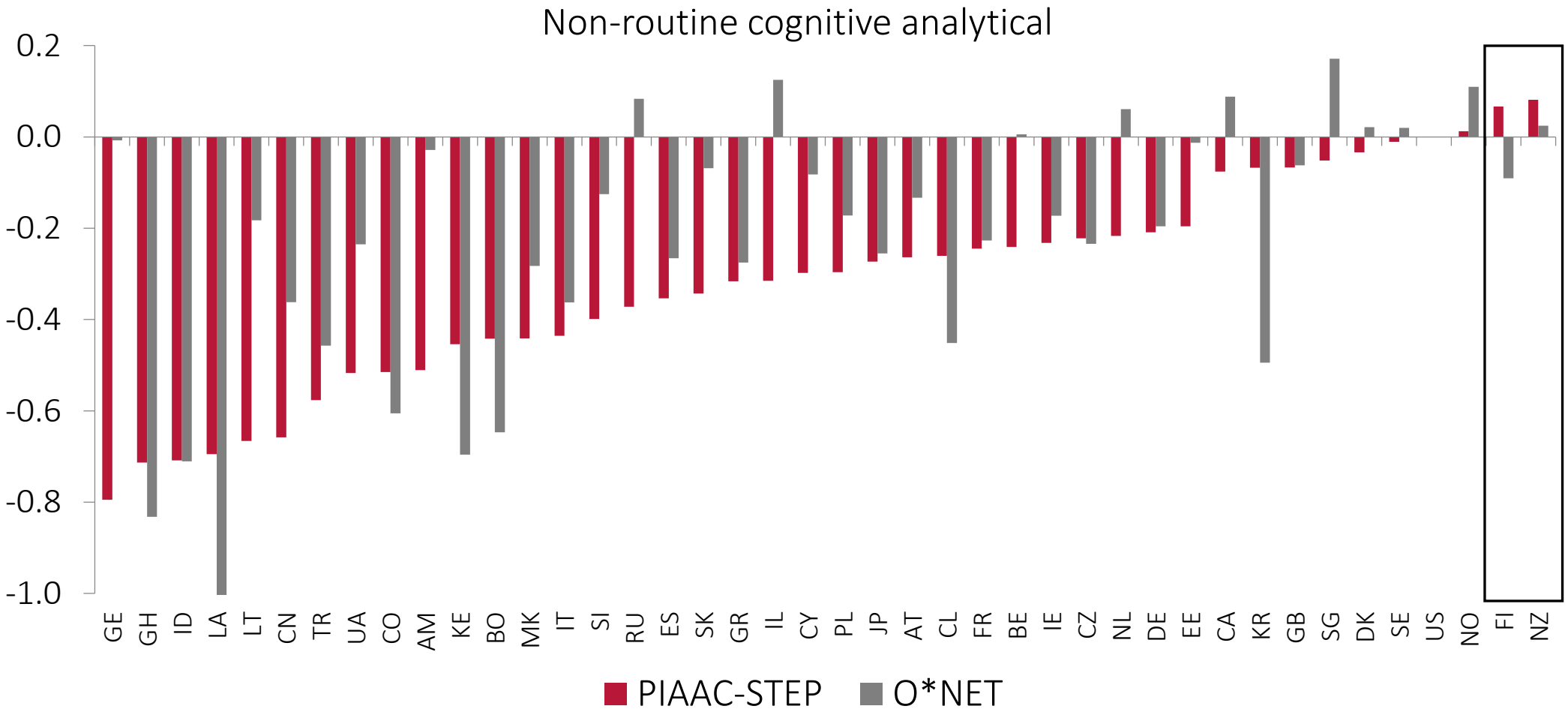
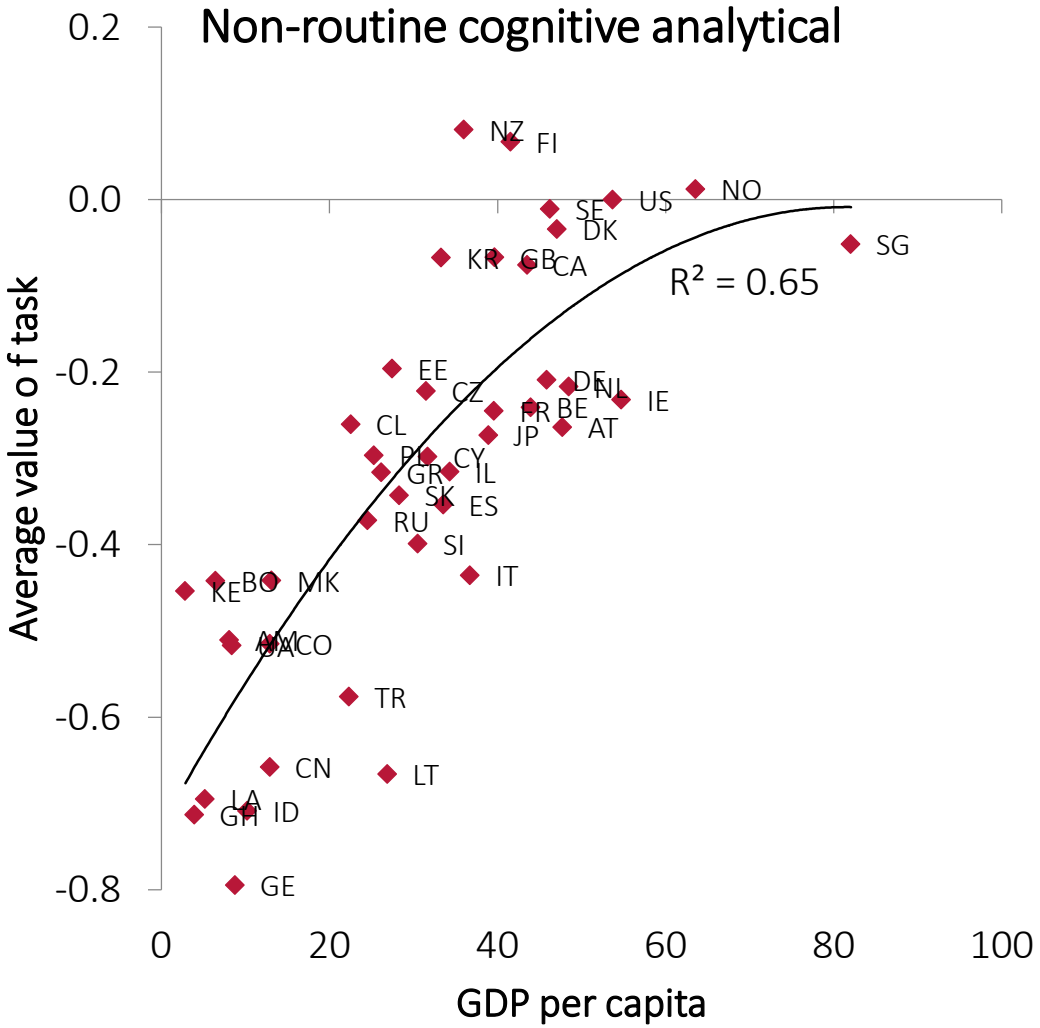
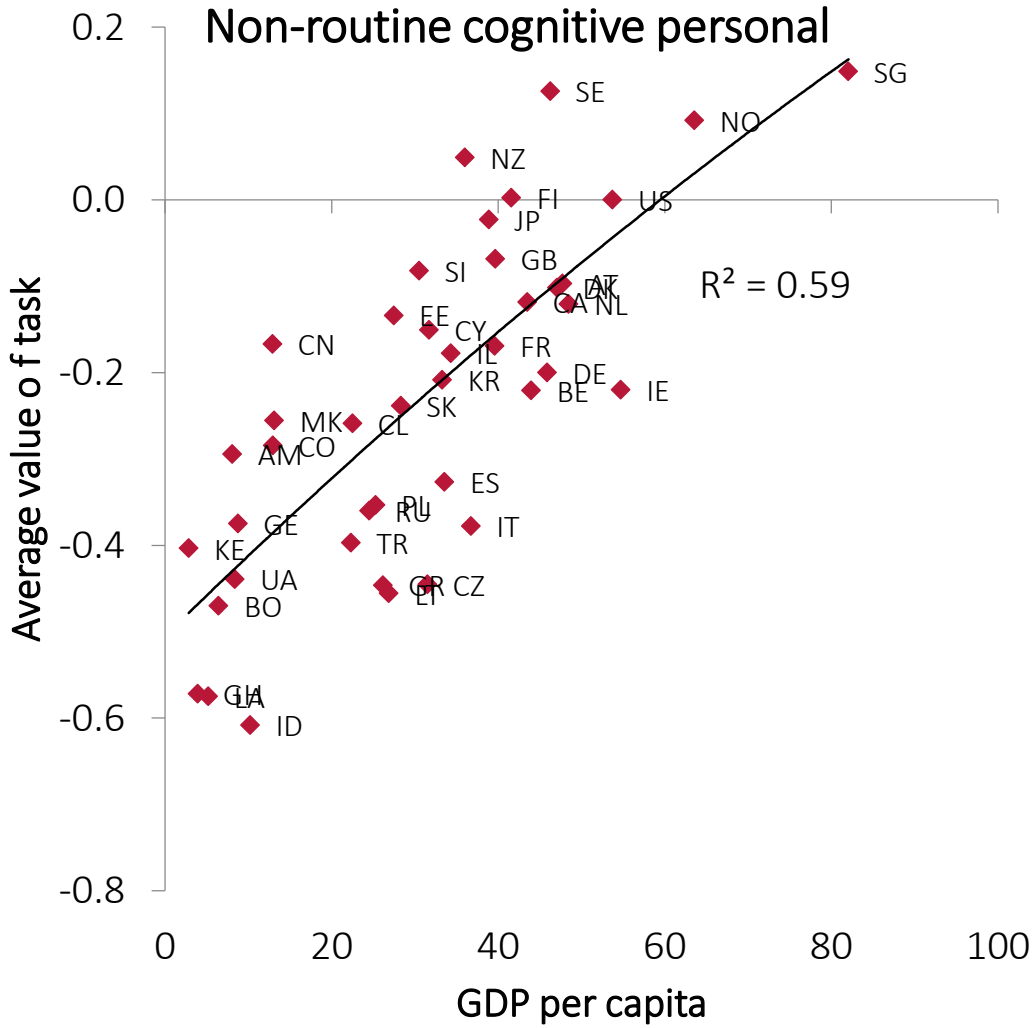
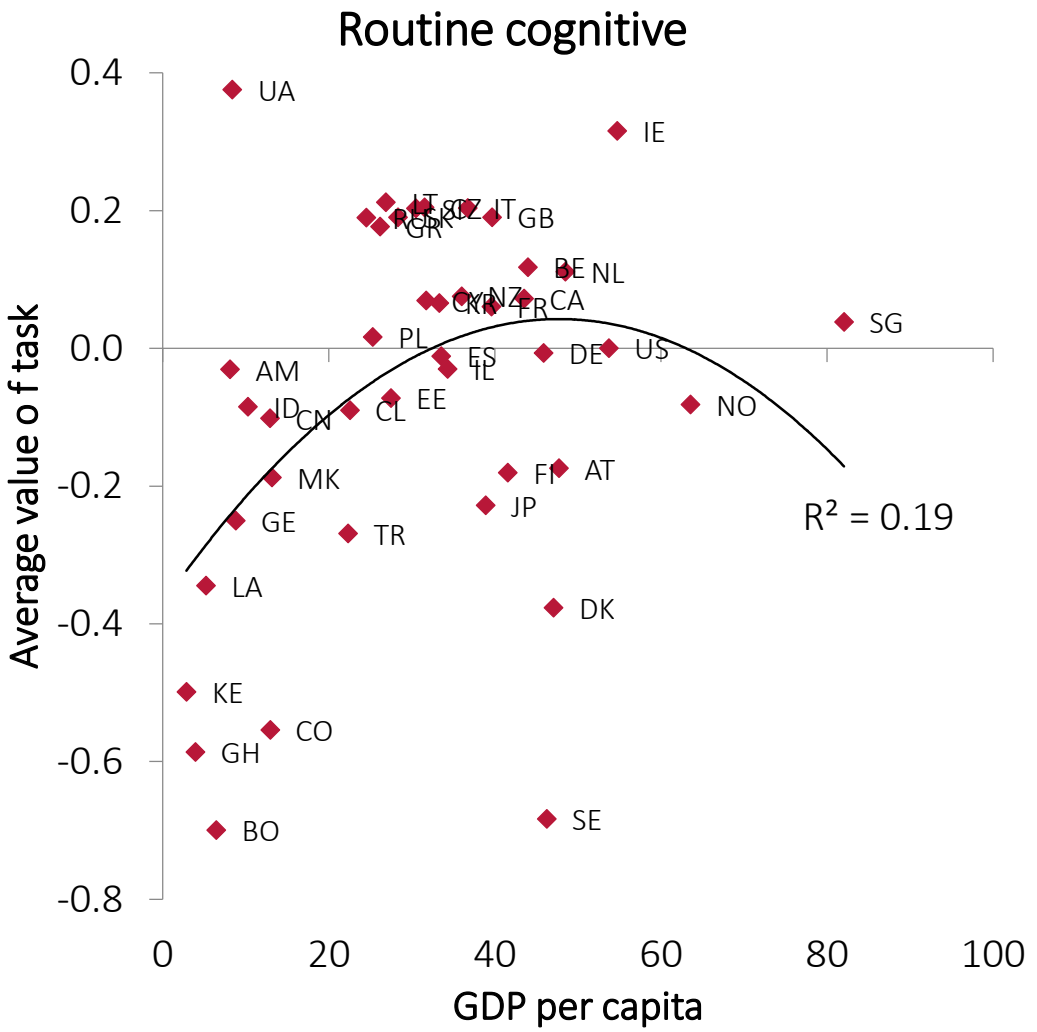


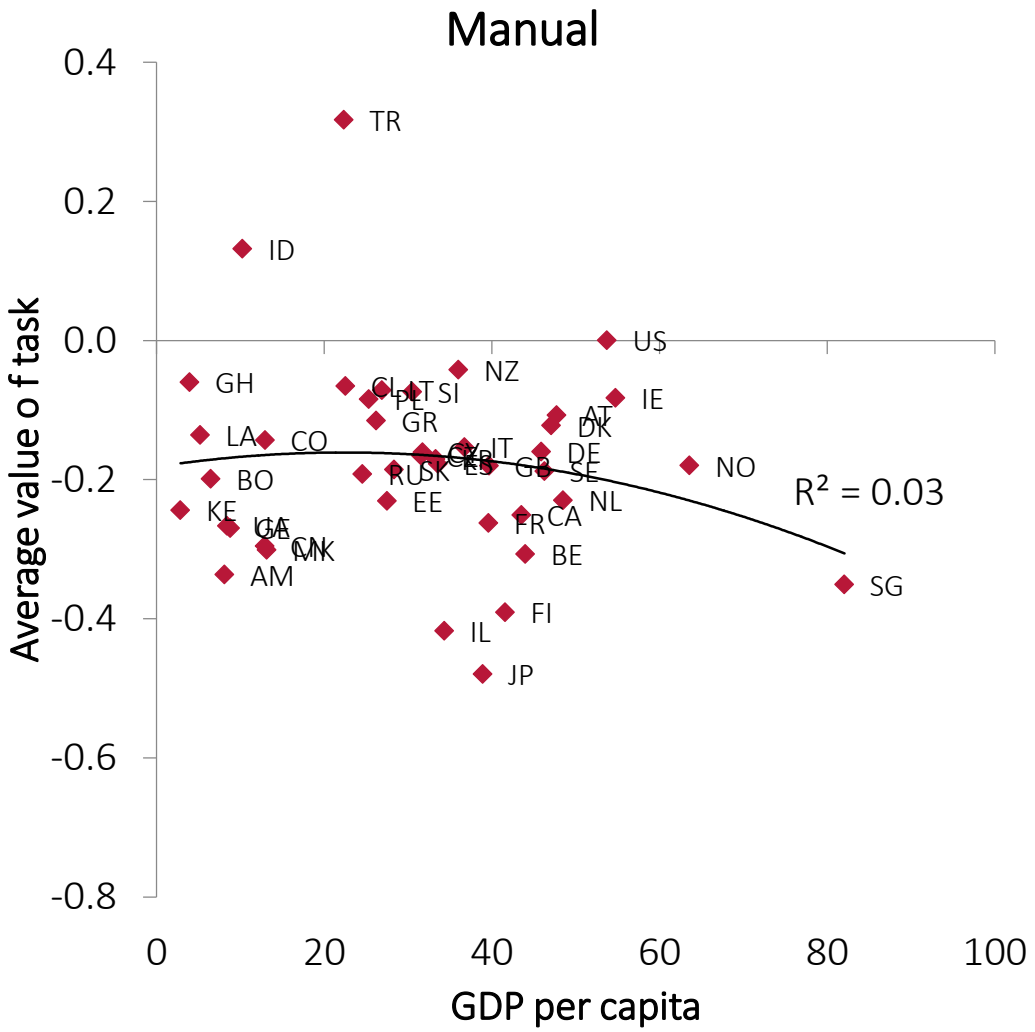
# The more developed countries exhibit higher average values of non-routine tasks than the less developed countries



# The relationship with GDP per capita is inverse U-shaped for routine cognitive tasks , and negative for manual tasks



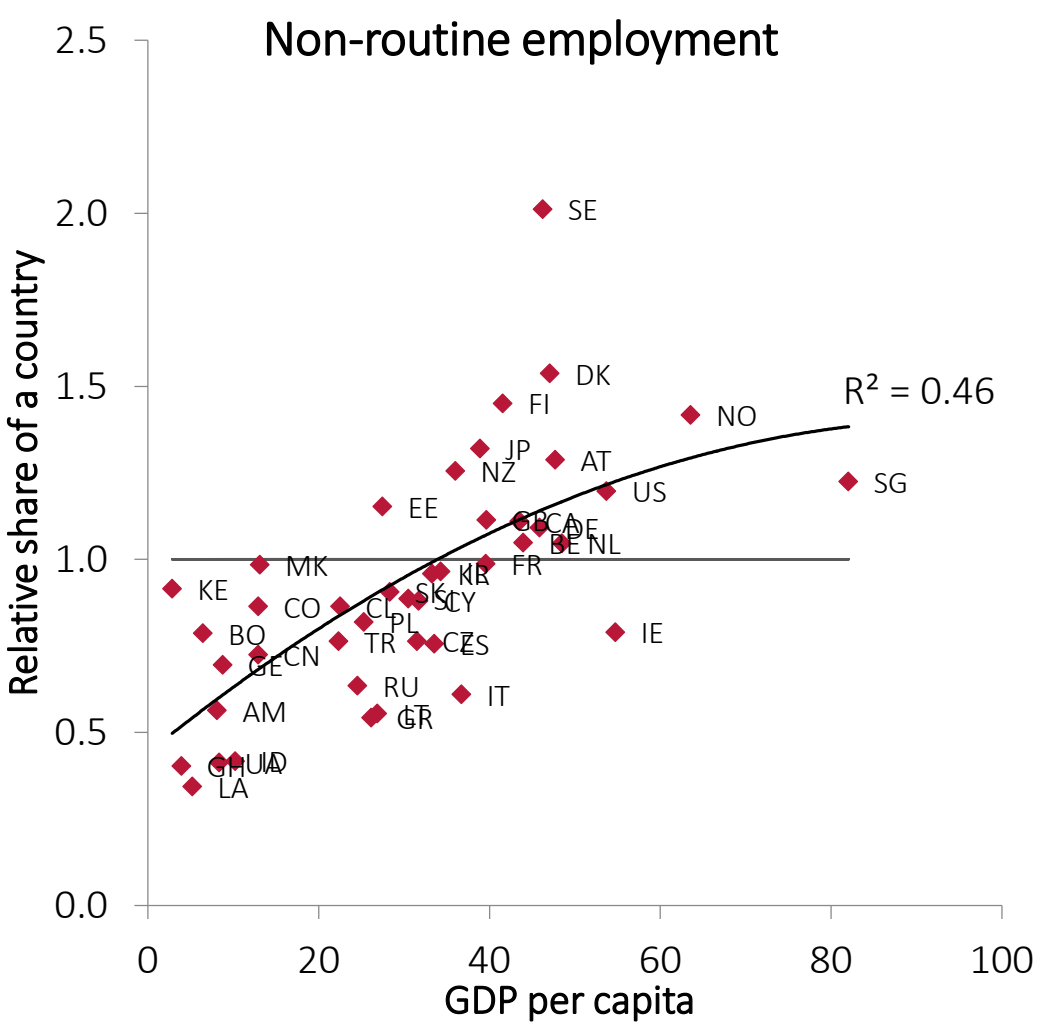
## To quantify the distribution of routine and non-routine workers we define the relative routine task intensity (RTI)

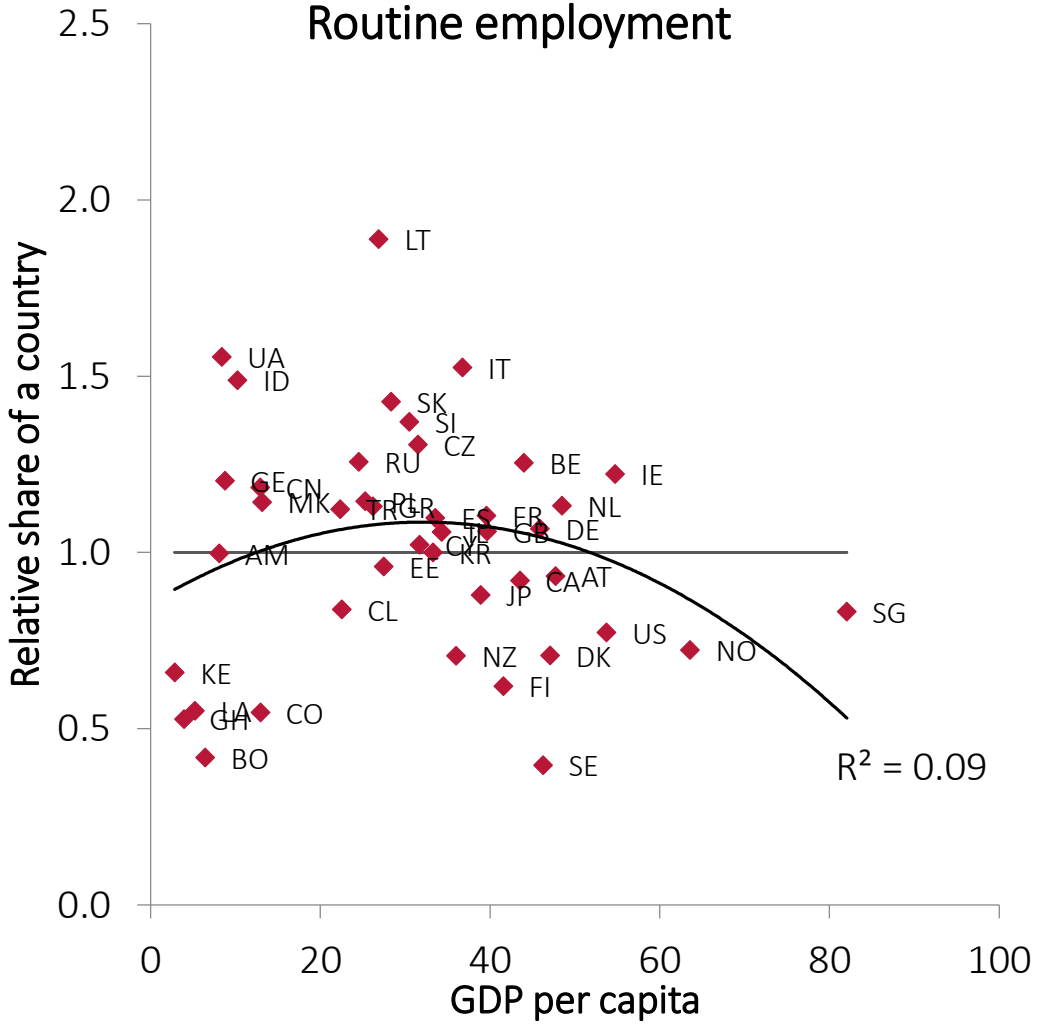
- Routine task intensity (RTI) ↗ with the relative importance of routine tasks, ↘ with the relative importance of non-routine tasks

$$RTI = \ln(1 + r_{cog}) - \ln\left(1 + \frac{nr_{analytical} + nr_{personal}}{2}\right)$$

- The pooled distribution of relative routine intensity provides:
  - Non-routine workers – 20% of individuals with the lowest RTI
  - Routine workers – 20% of individuals with the highest RTI

# The more advanced countries exhibit abundance of non-routine workers. The middle to high income countries exhibit abundance of routine workers



# Let's use a shift-share decomposition to decompose the differences of task contents between particular countries and the US

- Occupational structure

US task content *i* in occupation *j*, education *k*

$$\forall_{i \in T}\ BO_i = \sum_{j \in O} t_{i,j}^{US}\left(h_j^c - h_j^{US}\right)$$

- Educational structure

Employment share in occupation *j*, education *k*

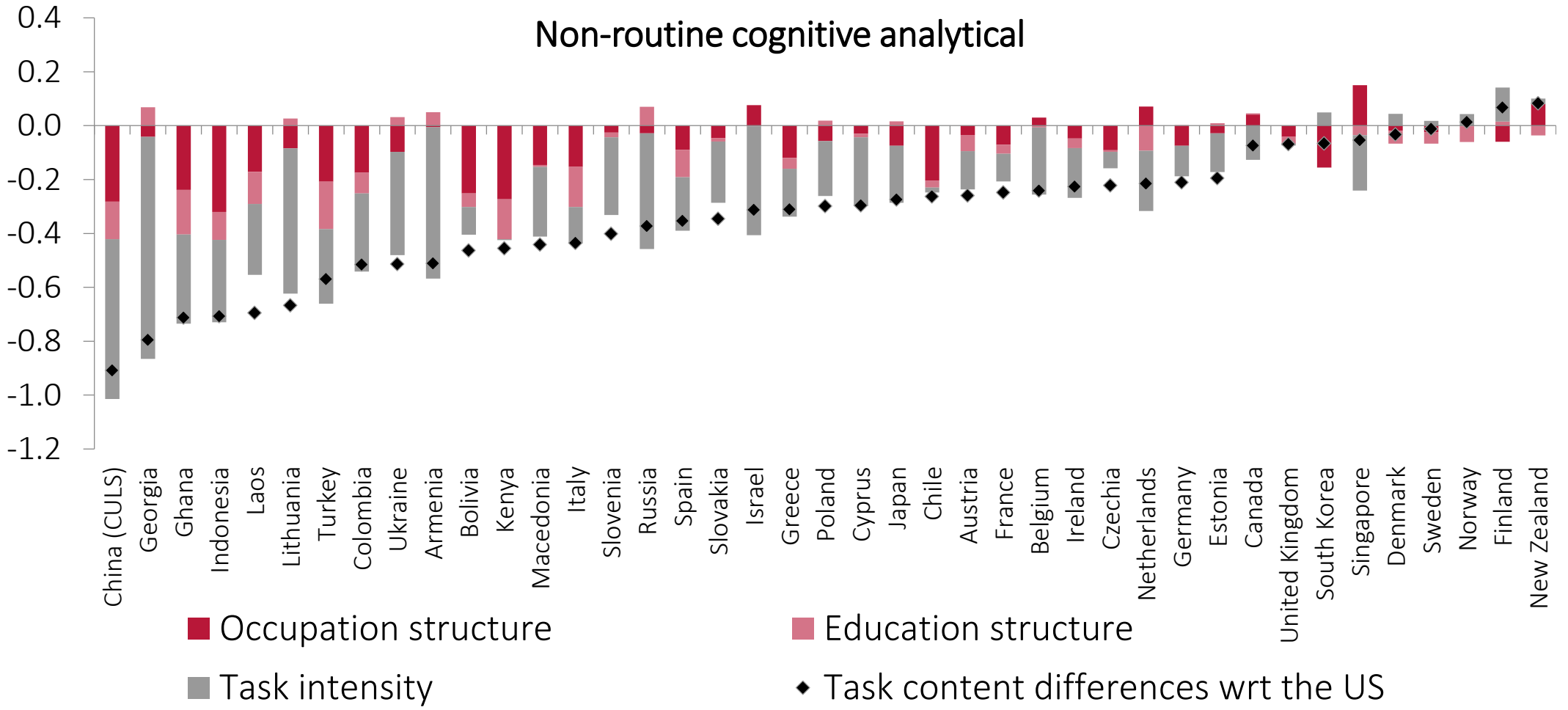
$$\forall_{i \in T}\ BE_i = \sum_{j \in O}\left[\sum_{k \in E} t_{i,j,k}^{US}\ \left(\frac{h_{j,k}^c}{h_j^c} - \frac{h_{j,k}^{US}}{h_j^{US}}\right)\right] h_j^{US}$$

- Task intensities in occupation/education cells

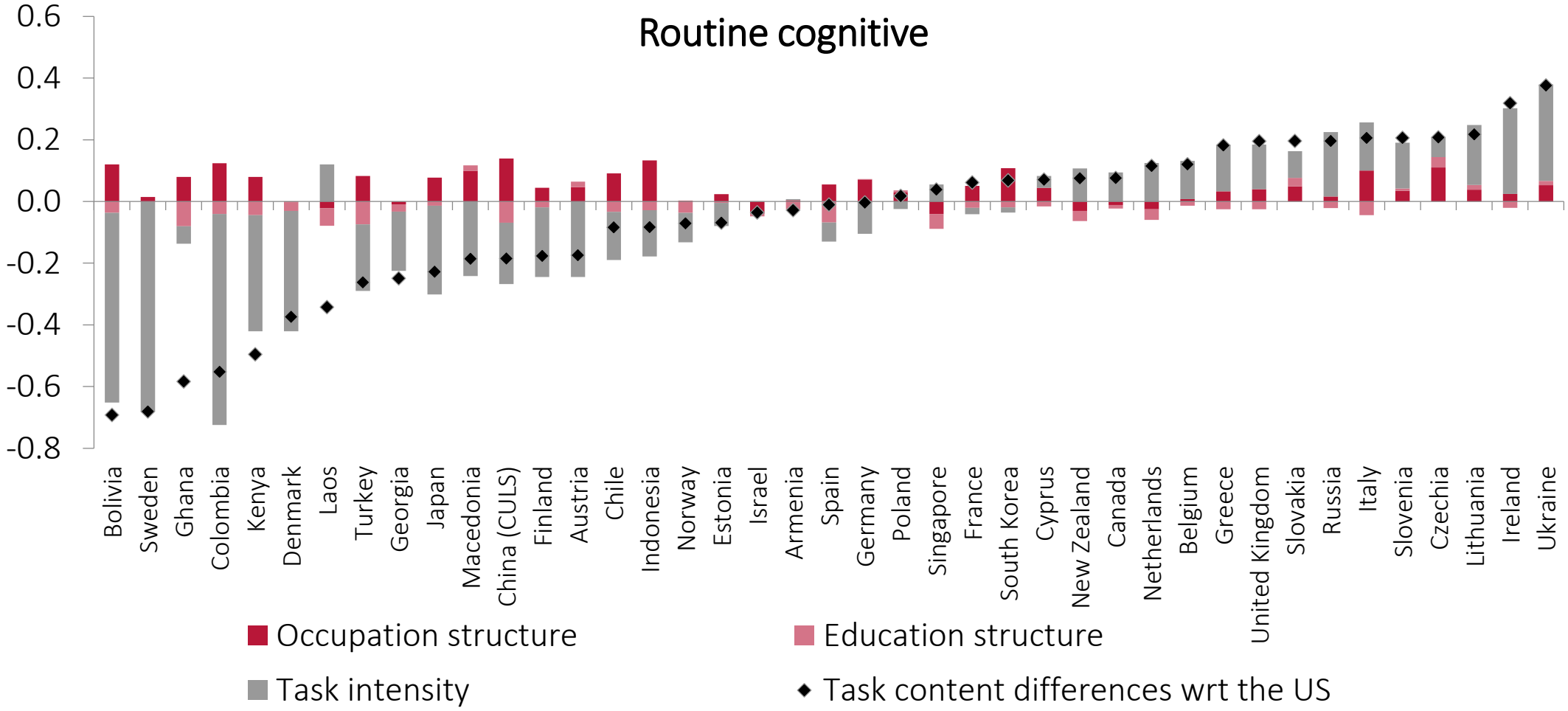
$$\forall_{i \in T}\ TI_i = \sum_{j \in O}\sum_{k \in E}\left(t_{i,j,k}^c - t_{i,j,k}^{US}\right) h_{j,k}^{US}$$

- Interaction (equation in the paper)

# Most of countries have lower NRCA task content than the US because of lower NRCA tasks within particular occupation / education cells



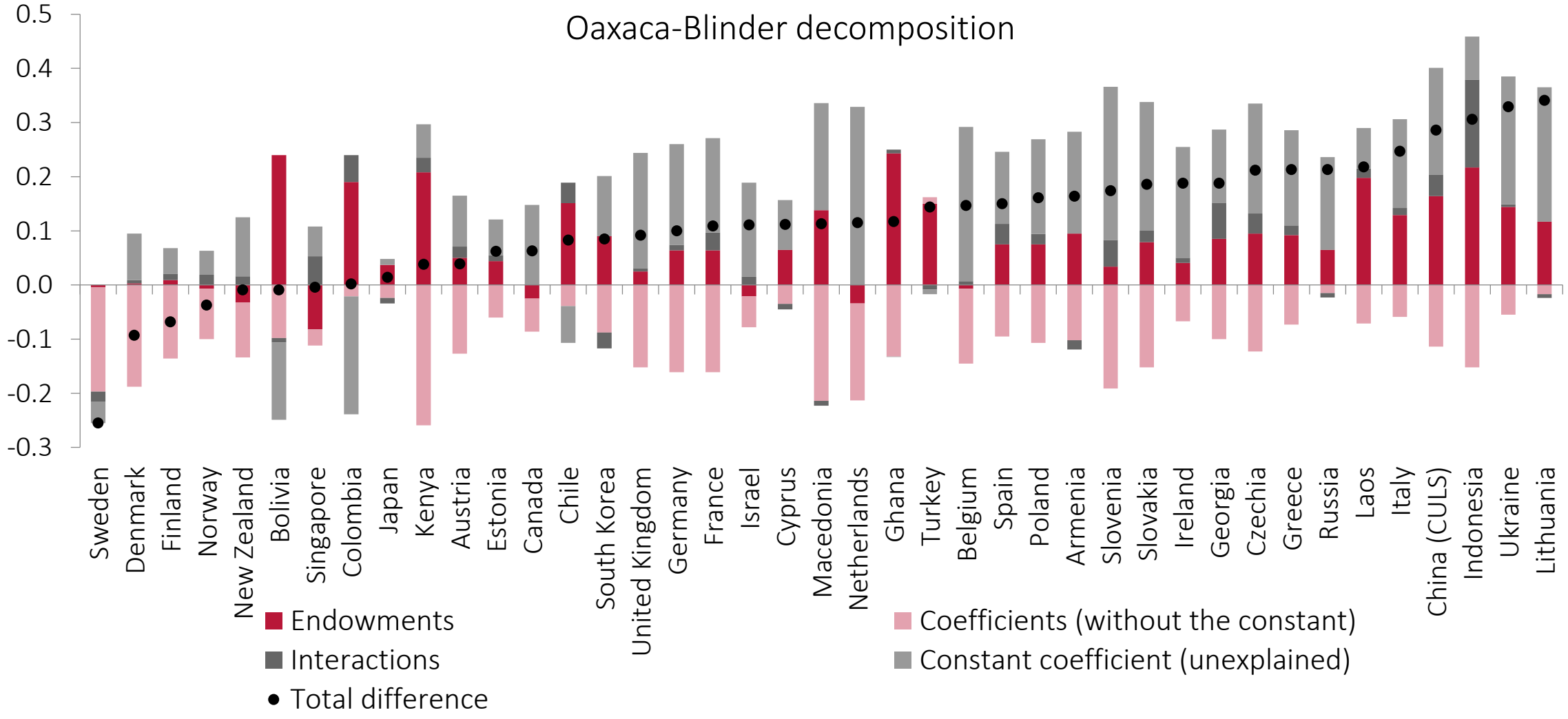
# Differences in occupational structure contribute to differences in routine cognitive task intensity, but much less than the task intensity patterns



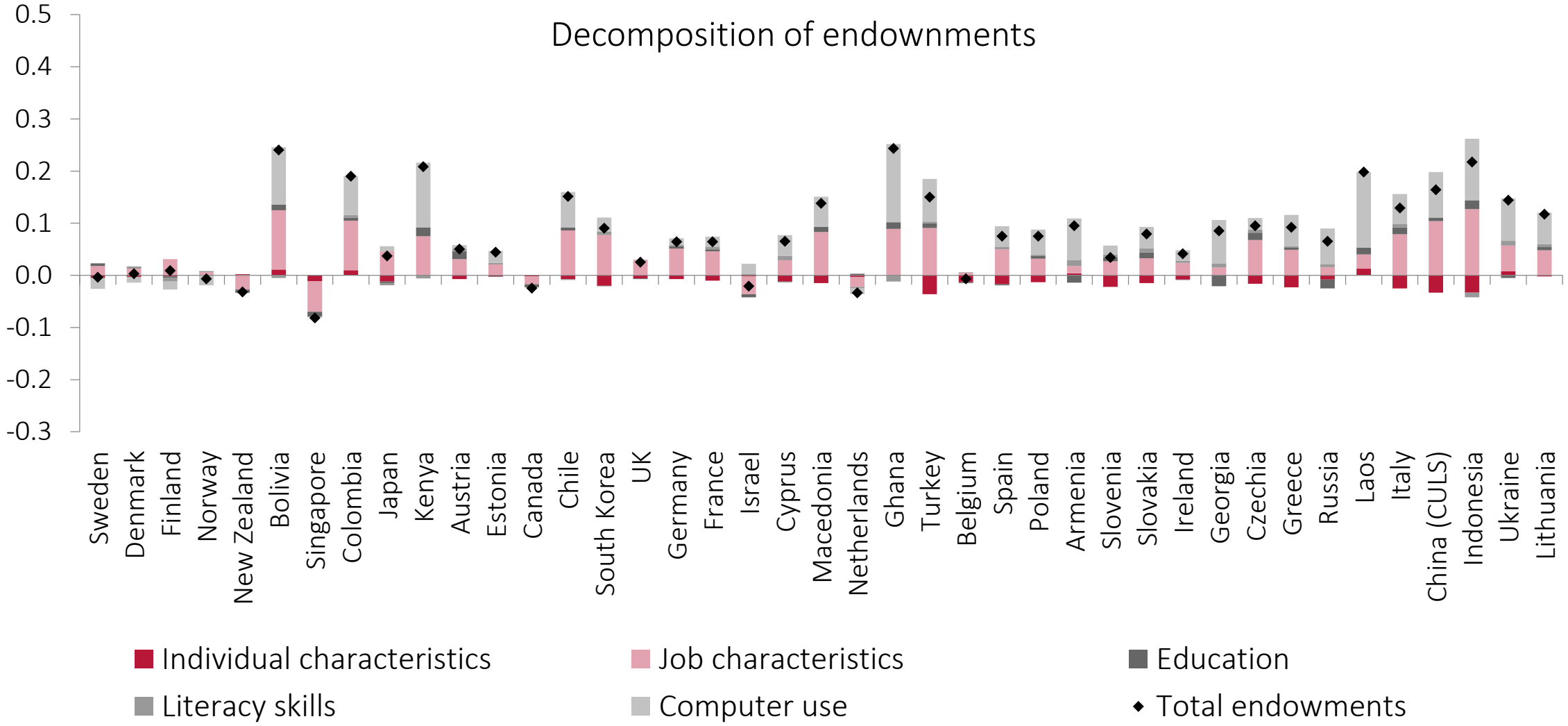
## We estimate worker-level models of routine task intensity (RTI). Routine intensity is significantly higher for workers who are

- Women
- Young
- Without college
- In the low-skilled occupations (the craft and related trades workers, plant and machine operators and assemblers)
- In manufacturing, but also in public services
- Who don’t use computer at work

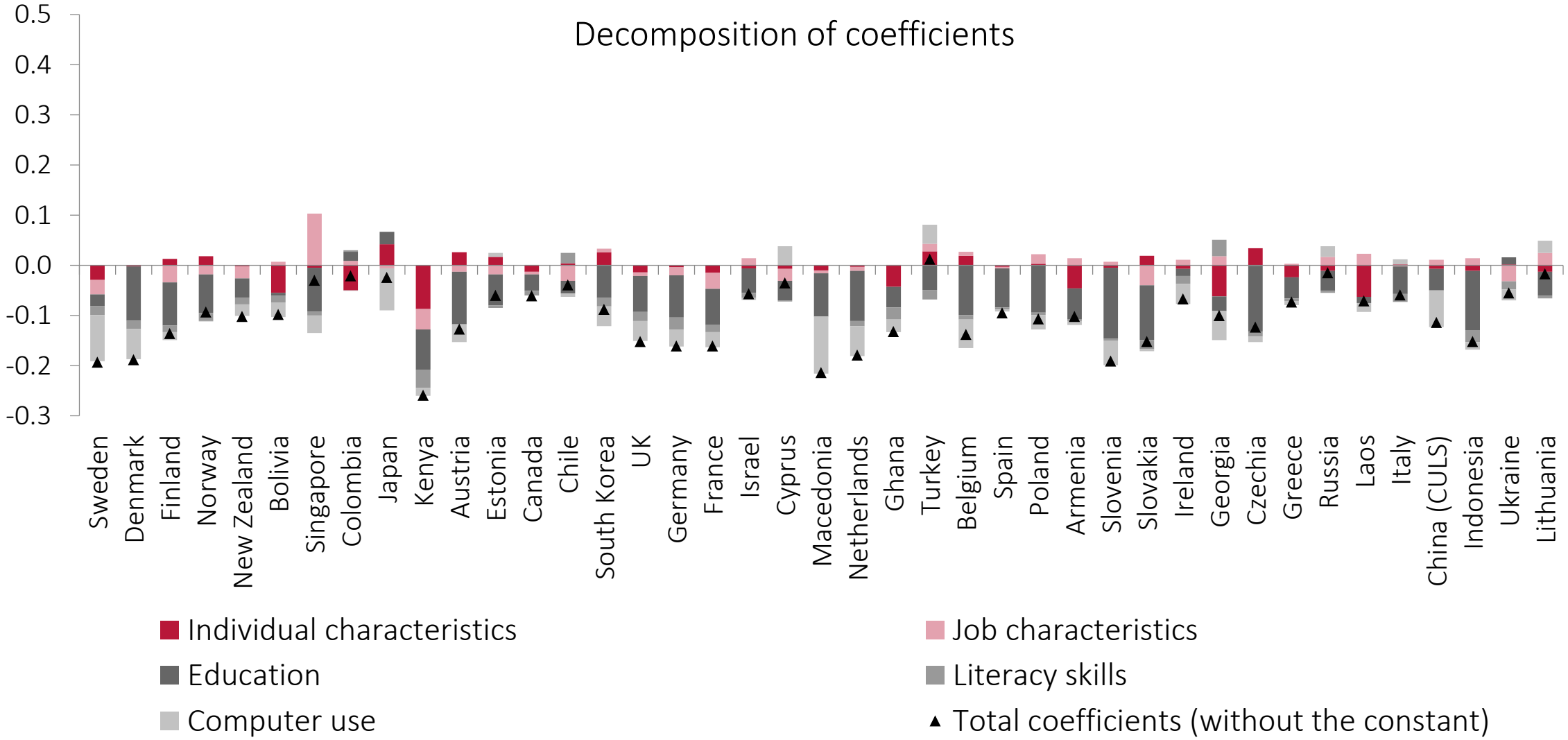
# In most countries, workforce and workplace characteristics contribute to higher routine intensity of jobs than in the US



# In most countries, the structure of job characteristics (occupations and sectors) and computer use at work raise routine intensity above the US



# But more education, better skills, and computer use reduce the routine intensity to a higher extent than in the US



# What tasks tell us about the global division of work

- We create task content measures which:
  - are worker-based and country-specific
  - but correspond with the established O*NET task content measures

- Occupations are indeed different around the world
- Non-routine work is more common in the most advanced countries
- Routine cognitive work has an inverse-U shape pattern with GDP per capita

- About a half of cross-country differences in routine intensity of jobs can be explained by differences in education, skills and employment structures

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# Thanks for listening

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