

**Technical change and automation of routine tasks:
Evidence from local labor markets in France over 1990-2011 ***

Pauline Charnoz and Michael Orand

On-line complements

Online complement C1 - Occupations and tasks

We match the 1982 French classification of occupations with data published by Autor and Dorn (2013), based on Autor et al. (2003). These data are computed using the US Department of Labor's *Dictionary of Occupational Titles* (DOT) (US Department of labor, 1977). They provide measures of task contents for each occupation and classify them into three categories: abstract, routine and manual tasks. We calculate the content of abstract, routine and manual tasks for each occupation in the 1982 French classification. Doing this, we assume that the tasks of jobs with a similar denomination in the French and US classification are similar. Moreover, the task contents of occupations may evolve over time. In particular, tasks of occupations with high routine contents may be upgraded with the development of computer without changing denomination. This is not taken into account in the Autor and Dorn (2013) measure, which is based on 1977 DOT. However, we use this task contents only to classify occupations in 1982 and then we analyse the share of occupations overtime. This conservative methodology, which is also that of Autor and Dorn (2013), probably underestimates the decline overtime in routine tasks.

We also separate occupations between support and production functions as an application of Duranton and Puga (2005) theoretical model. Table C1-1 shows occupations in the 1982 French classification, defined as support functions. We keep management, administrative functions and medium-skilled commercial occupations when the main activity of the firm is not trade. Table C1-2 presents the high-skilled occupations, and Table C1-3 the service occupations.

Table C1-1

Occupations defined as support functions

| PCS 1982 | Description |
|----------|--|
| 23 | Higher managerial employees |
| 33 | Senior Government Officials |
| 37 | Business and administration professionals |
| 38 | Science and engineering professionals |
| 45 | Civil technicians and associate professionals |
| 46 | Business and Administration Associate Professionals except Artistic technicians, tourism and restaurant industries professions |
| 52 | Civil Clerical support workers, except 5216, 5217, 5221, 5222, 5223, 5445 (health and services) |
| 54 | Clerical support workers |

Source: Insee, French classification of occupations, 1982; Autor and Dorn (2013) database of task intensity by occupations; functional specialization from Duranton and Puga (2005).

Table C1-2

Occupations defined as high-skilled

| PCS 1982 | Description |
|----------|--|
| 2244 | Managers of small artistic or cultural businesses (0 to 9 employees) |
| 2246 | Managers of small teaching, health or social businesses (0 to 9 employees) |
| 23 | Higher managerial employees |
| 3 | Managers and Professionals |
| 42 | Primary School Teachers |

Source: Insee, French classification of occupations, 1982; Autor and Dorn (2013) database of task intensity by occupations.

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Table C1-3

Occupations defined as low-skilled service occupations

| PCS 1982 | Description |
|----------|--|
| 2101 | Self-employed bakers, pastry cooks and confectionary makers (0 to 2 employees) |
| 2102 | Self-employed bakers, pastry cooks and confectionary makers (3 to 9 employees) |
| 2103 | Self-employed butchers (0 to 2 employees) |
| 2104 | Self-employed butchers (3 to 9 employees) |
| 2105 | Self-employed pork butchers (0 to 2 employees) |
| 2106 | Self-employed pork butchers (3 to 9 employees) |
| 2107 | Other self-employed food processing workers |
| 2171 | Self-employed taxi drivers |
| 2172 | Self-employed hairdressers, beauticians and related workers |
| 2173 | Self-employed dyers and laundrymen |
| 2174 | Other self-employed personal services workers |
| 2181 | Self-employed heavy truck drivers (0 to 3 employees) |
| 2182 | Self-employed ships' pilots (0 to 9 employees) |
| 2190 | Contributing family worker or craftsperson associates |
| 4311 | Cadres infirmiers et assimilés |
| 4312 | Psychiatry nurses |
| 4313 | Childcare nurses |
| 4314 | Specialized nurses (other than childcare) |
| 4315 | General care nurses |
| 4316 | Self-employed nurses |
| 4321 | Midwife |
| 4322 | Rehabilitation and nutrition specialists |
| 4323 | Self-employed rehabilitation specialists and chiropodists |
| 4324 | Healthcare technicians |
| 4325 | Medical imaging and therapeutic equipment technicians |
| 4326 | Self-employed medical imaging and therapeutic equipment technicians |
| 4327 | Pharmaceutical Technicians and Assistants |
| 4331 | Social work associate professionals |
| 4332 | Education methods specialists |
| 4333 | Youth workers |
| 4334 | Family counselor |
| 4411 | Secular clergy |
| 4412 | Regular clergy |
| 5216 | Schools cleaners and helpers |
| 5217 | Civil service cleaners and helpers (other than schools or hospitals) |
| 5221 | Carers |
| 5222 | Hospital cleaners and helpers |
| 5223 | Ambulance workers |
| 5311 | Police officers |
| 5312 | Gendarmes |
| 5313 | Sergeants |
| 5314 | Enlisted grade soldiers |
| 5315 | Firefighters |
| 5316 | Forestry and water commission workers |
| 5317 | Security guards |
| 5445 | Travel attendants, conductors and guides |
| 5611 | Waiters and bartenders |
| 5614 | Hotel industry workers |
| 5621 | Manicures and beauticians |

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| | |
|------|--|
| 5622 | Hairdressers |
| 5631 | Babysitters and early childhood educators |
| 5632 | Domestic workers and housewives in private households |
| 5633 | Janitors, building managers |
| 5634 | Other services workers |
| 6301 | Gardeners |
| 6351 | Butchers (except industrial activity) |
| 6352 | Pork butchers (except industrial activity) |
| 6353 | Bakers, pastry cooks and confectionary makers (except industrial activity) |
| 6354 | Qualified cooks |
| 6411 | Heavy truck drivers |
| 6412 | Public transport drivers |
| 6413 | Taxi drivers |
| 6414 | Private car drivers |
| 6415 | Delivery drivers, couriers |
| 6851 | Bakers, butchers and pork butchers apprentices |
| 6891 | Cleaners |

Source: Insee, French classification of occupations, 1982; Autor and Dorn (2013) database of task intensity by occupations;

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On-line complement C2 - Import competition and ICT dissemination exposure indices

We compute two other indexes using data from the French National Accounts (insee.fr) over the study period (1982, 1990 and 2011).

We compute an index of import competitions exposure, very similar to Autor et al. (2013a). We do not use China's exports as an instrument as the purpose here is not to estimate the effects of import competition, but only to control for it. Malgouyres (2014) did such instrumentation for the French case. We use data on import in goods and services (chain-linked volumes) and compute the import per employment at a national level for each year and each industry. The finest level common to this data and the Censuses data include 21 industries, of which 11 are in the manufacturing sector (<https://www.insee.fr/fr/statistiques/2832661> (series 5.405) for import data).

For each employment zone, we compute the average across industries of this measure for each year, weighting by the 1982 employment share of each industry in the employment zone. Thus this index measures how much the 1982 employment of a zone was exposed to import competition given national trend of import and the 1982 distribution of employment by industry.

We also compute an index to measure ICT dissemination exposure in an employment zone. We use the end-of the year fixed net capital in ICT (previous year's prices and chain-linked volumes) by industry per year. We compute ICT per worker per year at a national level and then, for each employment zone, we compute the average across industries of this measure for each year, weighting by the 1982 employment share of each industry in the employment zone (<https://www.insee.fr/fr/statistiques/2832673> (series 6.418) for ICT capital). Thus this index measures how much the 1982 employment of a zone was exposed to ICT dissemination given national trends and the 1982 distribution of employment by industry.

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On line complement C3 - Additional table

Table C3-1

Robustness of the effect of initial share of routine occupations on the 1990-2011 change in the share of routine occupations by employment zone

| | 1990-2011 change in the share of routine occupations in employment | | | | |
|--|---|-----------------------|-----------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) | (4) | (5) |
| 1982 share of routine occupations | - 0.340*** (0.022) | - 0.365*** (0.019) | - 0.347*** (0.029) | - 0.348*** (0.016) | - 0.357*** (0.03) |
| 1982 female participation | - 0.03 (0.024) | | | | - 0.060** (0.026) |
| 1982 share of 75 years old | | - 0.059 (0.038) | | | - 0.085** (0.035) |
| 1982 offshorability index | | | 0 (0.001) | | 0.002* (0.001) |
| 1990-2011 change in import exposure | | | | - 0.001 (0.002) | - 0.004** (0.002) |
| Observations | 304 | 304 | 304 | 304 | 304 |
| | 1990-2011 change in the share of support routine occupations in employment | | | | |
| | (1) | (2) | (3) | (4) | (5) |
| 1982 share of support routine occupations | - 0.272*** (0.019) | - 0.298*** (0.017) | - 0.269*** (0.028) | - 0.290*** (0.015) | - 0.278*** (0.033) |
| 1982 female participation | - 0.030* (0.018) | | | | - 0.027 (0.017) |
| 1982 share of 75 years old | | - 0.039 (0.027) | | | - 0.02 (0.032) |
| 1982 offshorability index | | | - 0.001 (0.001) | | 0.00002 (0.001) |
| 1990-2011 change in import exposure | | | | 0.001 (0.001) | 0.0002 (0.001) |
| Observations | 304 | 304 | 304 | 304 | 304 |
| | 1990-2011 change in the share of production routine occupations in employment | | | | |
| | (1) | (2) | (3) | (4) | (5) |
| 1982 share of production routine occupations | - 0.438*** (0.019) | - 0.419*** (0.021) | - 0.435*** (0.02) | - 0.414*** (0.023) | - 0.435*** (0.022) |
| 1982 female participation | - 0.045*** (0.01) | | | | - 0.028* (0.015) |
| 1982 share of 75 years old | | 0.03 (0.024) | | | 0.013 (0.025) |
| 1982 offshorability index | | | - 0.002*** (0.001) | | - 0.001* (0.001) |
| 1990-2011 change in import exposure | | | | - 0.001 (0.002) | -0.0005 (0.002) |
| Observations | 304 | 304 | 304 | 304 | 304 |

Note: OLS regression coefficients. Standard errors in parentheses. Estimations are weighted by 1982 employment zone population. *p<0,10 ** p<0,05 *** p<0,01.

Coverage: employed labor force, metropolitan France. Source: Insee, 1982, 1990 and 2011 *French Censuses*, <https://www.insee.fr/fr/statistiques/2832661> (series 5.405) for import data.