Possible uses of labour demand and supply information to reduce skill mismatches

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Possible uses of labour demand and supply information to reduce skill mismatches[1] [2]

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Abstract

Unemployment and informality are widespread phenomena in the Colombian economy that affect people with different profiles. This working paper discusses how the vacancy database can be used to build a detection system of skill shortages. Also, it elaborates on, for the first time in Colombia, a set of macro indicators within the vacancy database's labour demand and supply information for the identification of possible skill shortages. Finally, it illustrates how detailed information from vacancies (job descriptions) can be used to update occupational classifications (ISCO) and the labour force skills according to employers' requirements. The results suggest low-skilled occupations tend to show more signs of oversupply: a considerably higher informality rate compared to other skill groups. On the other hand, the first quarter of the year for each occupation is characterised by higher unemployment rates and lower vacancy rates. The skill mismatch indicators for Colombia demonstrate that 30 occupations are currently in short supply. Therefore, the evidence suggests that formal labour market opportunities exist for people with different profiles in terms of age, education and work experience, amongst others. Based on these results, policymakers and education and training providers can promote and update policy/curriculums quickly, according to the current occupational labour demand structure and specific skills required, and the job seekers can receive relevant information regarding occupation shortages, and in this way, unemployed and informal people can make better and informed decisions about their training and job search.

Key words: Skill, Skill mismatches, Beveridge curve, online job portals, informality, unemployment.

JEL classification: J23, J24, J31

[1] This working paper is part of the author's PhD thesis at the University of Warwick.
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1. Introduction

Colombia does not have a proper system to identify possible skill mismatches (skill shortages), hence educational and training providers experience difficulties in training people according to current employers' requirements (Cárdenas, 2020a). As a potential solution to this issue, Cárdenas (2020c, 2020d) demonstrated that job portals are rich sources of representative information for the analysis of a significant segment of the Colombian labour demand (job openings). The systematic collection and depuration of this information via the methods of web scraping and text mining, among other techniques, provide (at a low-cost) valuable information about the skill requirements that employers demand, and the structure and trends of this labour demand. Consequently, this novel source of vacancy information is useful for reducing imperfect information issues and tackling two main issues of the Colombian labour market: unemployment and informality. Thus, this paper shows how the vacancy database along with household survey information can be used as tool to address the labour market issues mentioned above.

Given that the occupational structure of the database, as well as seasonal and other vacancy information trends, are broadly consistent with the results from official surveys this indicates three advantages of the vacancy database. First, the vacancy database can be used to describe the main characteristics of unmet labour demand (e.g. occupational structure, wages, educational requirements, etc.) such as its structure and changes that occur over time. Vacancy information combined with labour supply information generates the possibility of describing and comparing the characteristics of Colombian labour demand and supply. While descriptive analysis provides an understanding of the structure of the Colombian labour market and labour market issues; for example, where possible or more remarkable skill shortages problems occur.

Second, and more importantly, with the combined use of the household survey (GEIH) and vacancy database a set of macro indicators are proposed to identify current skill shortages. For instance, the existence of a skill mismatch is suggested when there is an increase in job placements for specific occupations or skills and, in turn, there is an increase in real wages. In addition, when there is an increase in the unemployment rate and a decline of job placements and real wages for a certain occupation, these features also suggest the existence of a skill mismatch.

Third, as shown in Cárdenas (2020c, 2020d), vacancy information provides detailed and updated information regarding employers' requirements at a low-cost and in real-time. Specifically, the vacancy information provides information about new job titles and skills demanded in Colombia; consequently, job portals are, potentially, a valuable source of information to keep occupational classifications updated and monitor composition and skill trends by occupation. With the regular updating of occupational classifications, educational and training providers have useful inputs on which to base their curriculums on (according to employers' requirements), and public policymakers can identify any barriers (or lack of skills) that obstruct the entrance of people into the formal economy.

Given the three advantages of job portal information listed above, this paper discusses how the vacancy database can be used to build a detection system of skill shortages, and to regularly update occupational classifications according to employers' requirements. The second section of this paper characterises the labour market (formal and informally employed, and unemployed) by educational level and occupational level from 2016 to 2018. The third section elaborates on, for the first time in Colombia, a set of macro indicators within the vacancy database's labour demand and supply information for the identification of possible skill shortages. Finally, the fourth section illustrates how detailed information from vacancies (job descriptions) can be used to update occupational classifications (ISCO) and the labour force skills according to employers' requirements.

2. Labour market description

The theoretical framework of this paper has stressed that a considerable proportion of unemployment and the informal economy are explained by a misallocation between the skills possessed by job seekers and the skills demanded by employers (see Cárdenas, 2020a). Moreover, it has been argued that wages in the formal economy tend to be higher than in the informal economy; thus, informal workers have incentives to be part of the formal economy. Indeed, Cárdenas (2020a) has shown that the Colombian labour market is characterised by prolonged and relatively high unemployment and informality rates (in 2017 around 47% of workers were informal, and the unemployment rate was approximately 10%), and informal workers earn between 40% and 60% less than their formal peers. Additionally, the evidence

suggests that one of the leading causes of unemployment in Colombia is due to skill mismatches between labour demand and supply.

This section describes the characteristics of formal and informally employed workers, and those who were unemployed, by occupation from 2016 to 2018[3]. This characterisation of the labour market indicates the structure of the Colombian labour market, and provides an idea of labour market issues; for example, where possible or more remarkable skill mismatches problems occur. One of the most distinctive elements of this characterisation is that it shows—for the first time—a disaggregated occupational analysis with the Colombian household survey using a relatively updated classification such as ISCO-08. As shown in Cárdenas (2020d), one of the most significant advantages of reclassifying the household survey according to ISCO-08 is that this classification allows comparisons with labour demand information—and in further research, it will enable making international comparisons. Perhaps, the reason why researchers did not consider using the occupational variable before for identifying skill mismatches was that this variable was aggregated and outdated due to update all of the household historical survey records according to ISCO-08 via manual codifiers would require a considerable amount of time and money (Cárdenas, 2020d). However, Cárdenas (2020b) has shown that it is possible to overcome these issues with the help of tools such as CASCOT and machine learning techniques.

According Cárdenas (2020d), official labour market information (GEIH) is representative of urban and rural areas, while the vacancy information might not provide accurate results for the rural zones of the country. In this paper, the results from the GEIH are considered for the Colombian urban zones to make adequate comparisons between the labour supply and the labour demand information.

[3] For the employment time series analysis, the data was available from 2010 to 2018.

2.1 Colombian labour force distribution by occupational groups

Tables 1 and 2 describe the occupational composition of formal and informal workers and unemployed people at a four-digit ISCO level[4] from 2016 to 2018 (the full tables can be found in Appendix A:, Tables A.1 and A.2). Most of the formal workers are sales demonstrators, followed by (secondary or university) teachers[5], and security guards, while most of the informal workers are sales demonstrators, domestic cleaners and car, taxi and van drivers.

Table 1: Occupational distribution of the Colombian workers[6]

#	ISCO title	Formal workers	ISCO title	Informal workers
1	Sales demonstrators	4.8%	Sales demonstrators	16.4%
2	(Secondary or university) education teachers	4.5%	Domestic cleaners and helpers	6.0%
3	Security guards	3.7%	Car. taxi and van drivers	6.0%
4	Cleaners and helpers in offices. hotels and other establishments	3.6%	Stall and market salespersons	3.7%
5	Car. taxi and van drivers	3.0%	Cleaners and helpers in offices. hotels and other establishments	3.3%
6	Stock clerks	2.0%	Cooks	2.9%
7	Health care assistants	1.9%	Commercial sales representatives	2.3%
8	Building and related electricians	1.8%	Bricklayers and related workers	2.1%
9	Accounting and bookkeeping clerks	1.7%	Child care workers	2.1%
10	Waiters	1.5%	Building and related electricians	1.9%
11	Welders and flamecutters	1.5%	Beauticians and related workers	1.9%

[4] Given that the GEIH might have representativeness issues when the data are disaggregated at a four-digit ISCO level, the results at a four-digit level are indicative of the general structure of the Colombian labour market but they might not exactly represent the distribution of the labour force by occupational groups.

[5] In most cases information available in the GEIH does not distinguish between primary, secondary and university teachers.

[6] Occupations with the lowest frequency (10% of occupations in the GEIH) were dropped to avoid representativeness issues and outliers.

12	Primary school teachers	1.5%	Sewing machine operators	1.9%
13	Child care workers	1.5%	Services managers not elsewhere classified	1.8%
14	Sewing machine operators	1.4%	Shop keepers	1.8%
15	Mail carriers and sorting clerks	1.3%	Kitchen helpers	1.7%
16	Cooks	1.3%	Motorcycle drivers	1.6%
17	Cashiers and ticket clerks	1.3%	Motor vehicle mechanics and repairers	1.6%
18	Contact centre information clerks	1.1%	Construction supervisors	1.4%
19	Kitchen helpers	1.0%	Freight handlers	1.2%
20	Senior officials of special-interest organizations	1.0%	Waiters	1.2%

Source: DANE-GEIH 2016 - 2018. Own calculations

According to Table 2[7], most unemployed people in Colombia are seeking jobs as "Sales demonstrators", "Cleaners and helpers in offices, hotels and other establishments", and "Domestic cleaners and helpers".

Table 2: Occupational distribution of jobs sought by Colombian unemployed

#	ISCO title	Unemployed
1	Sales demonstrators	13.9%
2	Cleaners and helpers in offices. hotels and other establishments	4.9%
3	Domestic cleaners and helpers	4.4%
4	Building and related electricians	3.2%
5	Waiters	3.1%
6	Security guards	3.1%
7	Stock clerks	2.7%
8	Car. taxi and van drivers	2.7%
9	Health care assistants	2.0%
10	Accounting and bookkeeping clerks	2.0%
11	(Secondary or university) education teachers	2.0%
12	Administrative and executive secretaries	1.7%
13	Kitchen helpers	1.6%
14	Contact centre information clerks	1.6%

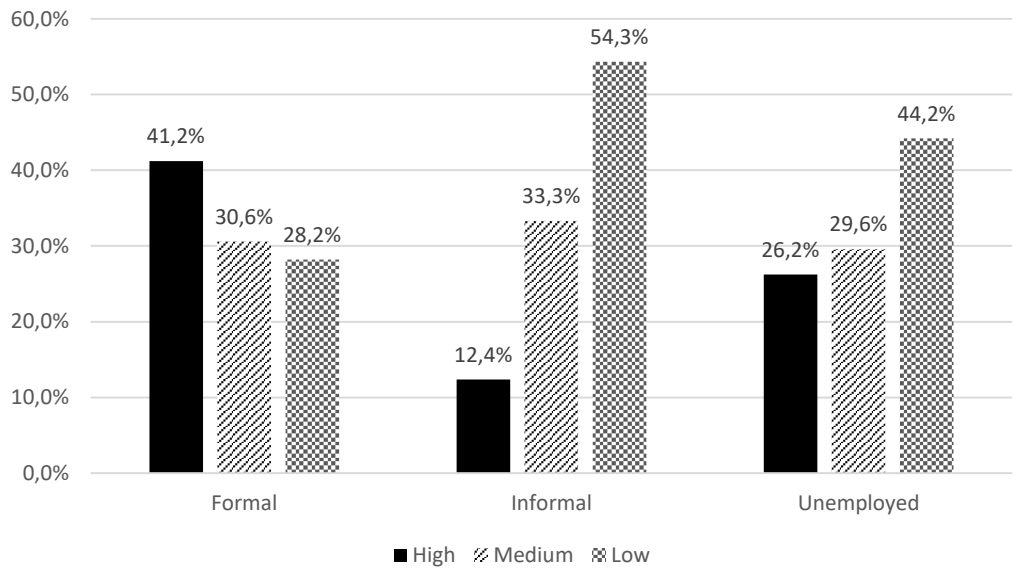
[7] As mentioned in Cárdenas (2020d), the GEIH asks unemployed people: "what kind of job (occupation) are you looking for?". This question identifies what occupations unemployed people are trying to find a job in.

15	Cooks	1.6%
16	Cashiers and ticket clerks	1.5%
17	Bricklayers and related workers	1.5%
18	Sewing machine operators	1.4%
19	Child care workers	1.2%
20	Construction supervisors	1.1%

Source: DANE-GEIH 2016 - 2018. Own calculations

Figure 1 summarises the labour market structure of the Colombian workforce by occupational group: 41.2% of formal workers are in high-skilled occupations, followed by medium and low-skilled occupations at 30.6% and 28.2%, respectively. Conversely, low-skilled occupations represent 54.3% of informal workers and 44.2% of those unemployed. This evidence suggests what was mentioned in Cárdenas (2020a), that a lack of skills is a prevalent problem in Colombia and contributes to high rates of unemployment and informality.

Figure 1: Occupational distribution of the Colombian workforce by skill level



Source: DANE-GEIH 2016 - 2018. Own calculations.

2.2. Unemployment and informality rates

The above results showed the composition of the Colombian workforce by occupational group, and they allow the identification of the general structure and patterns in the workforce by

occupation, skill level and the formal/informal/unemployed workforce. However, the above analysis does not indicate which occupational groups tend to have the highest informality and unemployment rates. For instance, Table 1 shows that 16.4% of informal workers are "Sales demonstrators". The high proportion of this occupation in the informal labour market might be because a considerable number of Colombian workers work in this occupation. It might well be that they have a low informality rate because the number of formal sales demonstrators far exceeds the number of informal sales demonstrators.

It is essential to observe these rates because they demonstrate which occupational groups tend to be more/less exposed to unemployment or informality. Consequently, Table 3 shows that the occupations with higher informality rates are "Domestic cleaners", "Motorcycle drivers" and "Shop keepers" (the full tables can be found in the Appendix A:, Tables A.3 and A.4).

Table 3 Occupations with higher informality rates

#	ISCO title	Informality rate
1	Domestic cleaners and helpers	99.8%
2	Motorcycle drivers	99.0%
3	Shop keepers	97.3%
4	Tailors, dressmakers, furriers and hatters	96.7%
5	Street food salespersons	96.6%
6	Stall and market salespersons	95.3%
7	Sewing, embroidery and related workers	94.1%
8	Drivers of animal-drawn vehicles and machinery	93.6%
9	Potters and related workers	92.3%
10	Clearing and forwarding agents	92.2%
11	Sales workers not elsewhere classified	92.0%
12	Beauticians and related workers	90.7%
13	Handicraft workers in textile, leather and related materials	90.7%
14	Hairdressers	89.2%
15	Bicycle and related repairers	89.0%
16	Fast food preparers	87.6%
17	Laundry machine operators	87.2%
18	Refuse sorters	86.0%
19	Street vendors (excluding food)	84.9%
20	Bricklayers and related workers	83.7%

Source: DANE-GEIH 2016 - 2018. Own calculations

By contrast, Table 4 depicts which occupations tend to have the lowest informality rates: "Computer network professionals", "Dieticians and nutritionists", "Geologists and geophysicists", among others. Additionally, with the vacancy database information it is possible to identify the skills demanded by occupations with low informality rates. For instance, for "Computer network professionals", the most required skills are APL (programming language), customer service, communication, and knowledge in alarm and control systems. Consequently, these low rates, along with the vacancy skills information might suggest what occupations and specific skills, people should possess to improve their probabilities of finding a formal job. However, as will be discussed in the following section, there are other variables to consider before determining a skill shortage in this way.

Table 4: Occupations with lower informality rates

#	ISCO title	Informality rate
1	Computer network professionals	0.0%
2	Dieticians and nutritionists	0.3%
3	Geologists and geophysicists	0.9%
4	Computer network and systems technicians	1.2%
5	Mathematicians, actuaries and statisticians	1.2%
6	Psychologists	1.5%
7	Metal production process controllers	1.6%
8	Mining supervisors	1.8%
9	Travel attendants and travel stewards	1.9%
10	Legislators	1.9%
11	Vocational education teachers	2.0%
12	Software developers	2.1%
13	Sweepers and related labourers	2.4%
14	University and higher education teachers	2.5%
15	Visual artists	2.6%
16	Filing and copying clerks	2.6%
17	Secondary education teachers	2.7%
18	Health services managers	2.7%
19	Statistical, finance and insurance clerks	2.8%
20	Economists	2.8%

Source: DANE-GEIH 2016 - 2018. Own calculations

Based on information about what jobs are being sought by potential workers, Table 5 presents occupations with a higher unemployment rate. "Environmental engineers" have the highest unemployment rate (36.7%), followed by "Geologists and geophysicists" (26.1%) and "Sociologists, anthropologists and related professionals" (25.4%). Additionally, occupations with

higher unemployment rates tend to have a prolonged (above average) duration of employment. These results do not contradict the unemployment rates reported by DANE: according to the office for national statistics, the unemployment rate for undergraduates was relatively high (around 10%) in 2016[8], and the average duration of unemployment for undergraduates is 26 weeks, but 18 weeks for people with only a high school certificate.

Tables 5 and 4 show the importance of analysing unemployment and the informality rates at the same time. Occupations such as "Geologists and geophysicists", "Economists", "Filing and copying clerks", tend to have low informality rates, but high unemployment rates and prolonged unemployment periods. Consequently, increases in labour supply in occupations with relatively low informality rates might significantly increase the unemployment rate. Thus, any public policy that attempts to reorientate labour supply according to employers' requirements should consider unemployment and informality rates.

Table 5: Occupations with higher unemployment rates

#	ISCO title	Unemployment rate	Duration of unemployment (weeks)
1	Environmental engineers	36.7%	29.3
2	Geologists and geophysicists	26.1%	31.7
3	Sociologists, anthropologists and related professionals	25.4%	24.8
4	Economists	22.7%	46.3
5	Philosophers, historians and political scientists	22.7%	40.3
6	Survey and market research interviewers	22.5%	21.0
7	Contact centre information clerks	22.1%	18.1
8	Filing and copying clerks	21.8%	25.9
9	Veterinary technicians and assistants	21.6%	10.8
10	Environmental and occupational health inspectors and associates	20.7%	27.9
11	Enquiry clerks	20.0%	27.9
12	Mining engineers, metallurgists and related professionals	19.9%	33.1
13	Receptionists (general)	19.2%	26.1
14	Stock clerks	18.8%	18.6
15	Mechanical engineers	18.7%	25.9

[8] See: https://www.dane.gov.co/index.php/estadisticas-por-tema/mercado-laboral/fuerza-laboral-y-educacion

16	Sports, recreation and cultural centre managers	18.5%	12.9
17	Business services agents not elsewhere classified	18.4%	20.8
18	Social work and counselling professionals	17.9%	29.3
19	Information and communications technology operations technicians	17.5%	24.9
20	Psychologists	17.1%	29.4

Source: DANE-GEIH 2016 - 2018. Own calculations

By contrast, Table 6 presents occupations with the lowest unemployment rates. "Religious professionals" have the lowest unemployment rate (0.3%), followed by "Motorcycle drivers" (0.5%) and "Shopkeepers" (0.7%). Moreover, occupations with lower unemployment rates tend to have a shorter (below average) duration of employment. Additionally, the results from Table 6 can be complemented with vacancy database information. For instance, for "Motorcycle drivers", the most demanded skills are customer service, sales activities, work in an organised manner, and count money (see Section 4).

Importantly, Tables 6 and 3 also show the importance of analysing unemployment and informality rates at the same time to draw proper public policy advice from the data. Occupations such as "Motorcycle drivers", "Shopkeepers", "Refuse sorters", "Hairdressers", among others, tend to have low unemployment rates and shorter unemployment periods, but high informality rates. Consequently, increases of labour supply in occupations with relatively low unemployment rates might significantly increase the informality rate.

Table 6: Occupations with lower unemployment rates

#	ISCO title	Unemployment rate	Duration of unemployment (weeks)
1	Religious professionals	0.3%	19.3
2	Motorcycle drivers	0.5%	8.6
3	Shop keepers	0.7%	16.9
4	Bicycle and related repairers	0.9%	13.7
5	Legislators	0.9%	16.3
6	Tailors, dressmakers, furriers and hatters	1.0%	23.6
7	Potters and related workers	1.0%	8.5
8	Handicraft workers in textile, leather and related materials	1.1%	24.3

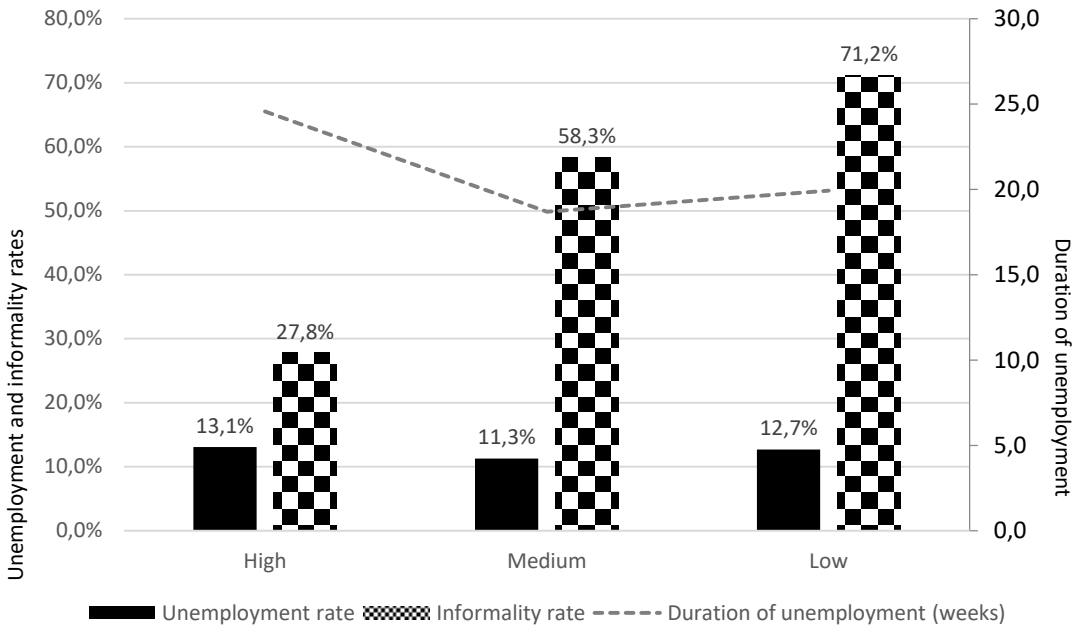
9	Pawnbrokers and money-lenders	1.1%	6.0
10	Dairy-products makers	1.3%	15.2
11	Stall and market salespersons	1.4%	20.7
12	Weaving and knitting machine operators	1.4%	26.0
13	Sewing, embroidery and related workers	1.4%	24.2
14	Debt-collectors and related workers	1.5%	13.1
15	Education managers	1.6%	36.3
16	Refuse sorters	1.6%	3.3
17	Travel consultants and clerks	1.8%	18.0
18	Contact centre salespersons	1.9%	19.0
19	Accounting associate professionals	1.9%	17.8
20	Hairdressers	1.9%	19.4

Source: DANE-GEIH 2016 - 2018. Own calculations

summarises the labour informality and unemployment rates by occupation skill level. Low-skilled occupations have an informality rate of 71.2%, followed by medium- and high-skilled occupations with 58.3% and 27.8%, respectively. In contrast, high- and low-skilled occupations reported the highest unemployment rates, with 13.1% and 12.7%, respectively. Moreover, the duration of unemployment is significantly higher for high-skilled people.

According to the evidence presented in this paper, skill mismatches are widespread in the Colombian economy the consequences of which are reflected in its relatively high unemployment and informality rates (see Cárdenas, 2020a). However, low-skilled occupations tend to present more signs of oversupply (high informality and unemployment rates). Consequently, Colombian public policies should pay specially attention to informing, educating and training people with low skills according to employers' needs.

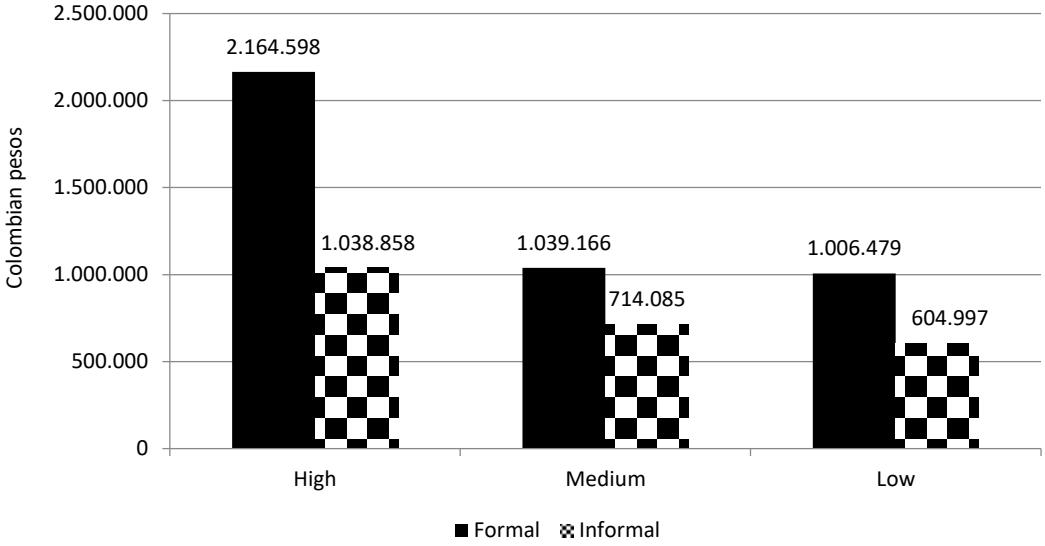
Figure 2: Unemployment and informality rates and duration of unemployment by skill level



Source: DANE-GEIH 2016 - 2018. Own calculations.

As mentioned in Cárdenas (2020a), the informal economy overall tends to pay lower salaries than the formal economy. Figure 3 shows the average wages of formal and informal workers by skill level. As can be observed, there is a considerable wage gap between formal and informal workers across all skill groups. However, the difference between formal and informal high-skilled workers is significantly higher: formal workers in high-skilled occupations earn 52.0% more than their informal peers. Furthermore, formal low- and medium-skilled workers earn 39.9% and 31.3% more than their informal peers, respectively. Thus, as indicated by Cárdenas (2020a), informal workers (in terms of income) have an incentive to be part of the formal economy.

Figure 3: The average wages of formal and informal workers by skill level



Source: DANE-GEIH 2016 - 2018. Own calculations.

In summary, the informality and unemployment rates in Colombia are relatively high. Informal labour (once compared with the formal and unemployed population) is mainly composed of adults (more than 29 years old) with a high school educational level or less (see Cárdenas, 2020a). On the one hand, in concordance with the previous results, people in low-skilled occupations have the highest informality rates. On the other hand, the unemployed population is mainly composed of young adults (less than 29 years old) (see Cárdenas, 2020a). Moreover, people in high and low-skilled occupations have the highest unemployment rates and prolonged unemployment periods. Consequently, the evidence suggests that informality issues tend to occur most frequently for adults with (at most) a high school education, who work in low-skilled occupations, while unemployment issues occur more frequently in groups of people who are less than 29 years old and that work in low- or high-skilled occupations. Thus, regardless of the skill group, the Colombian labour market displays potential signals of skill mismatches.

However, low-skilled occupations tend to express more signs of oversupply: 1) a considerable higher informality rate compared to medium- and high-skilled occupations; 2) a high unemployment rate (slightly lower than the high-skilled unemployment rate). These results suggest that in Colombia skill shortages might be more frequent in medium- and high-skilled occupations (see Section 3).

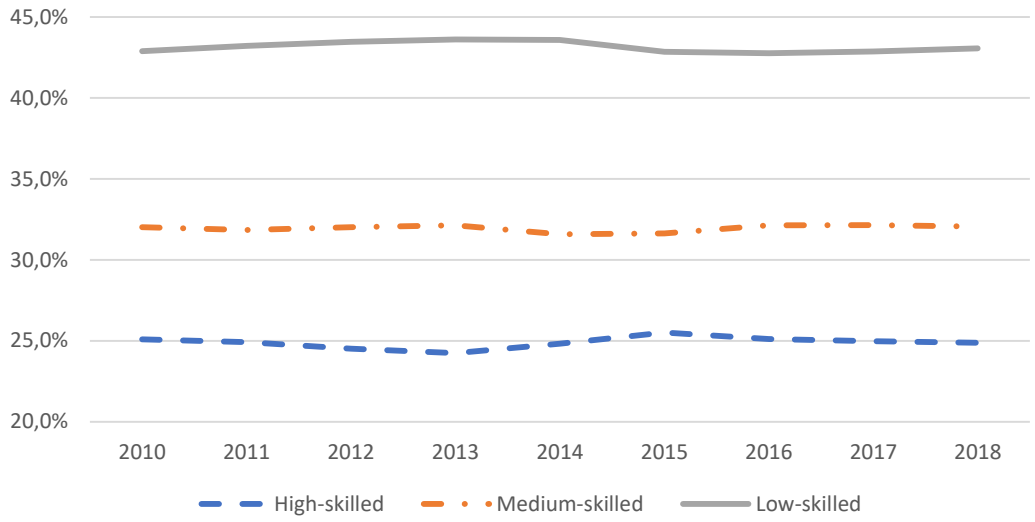
The differences in the average wages of formal and informal workers by skill level show that informal and unemployed workers—independent of their skill level—have a strong incentive to be part of the formal economy. As explained in Cárdenas (2020a), despite this financial incentive to be part of the formal economy, the evidence suggests that the misallocation between the skills possessed by job seekers and the skills demanded by employers makes the formalisation of a considerable part of the Colombian economy a challenge. Thus, policymakers in Colombia need to administer a national and systematic analysis of human resources demand and supply, and act based on reliable data to tackle high unemployment and informality rates, especially, in low-skilled occupations.

Moreover, for a proper human resources analysis to occur, it is necessary to consider and compare occupational unemployment and informality rates. Some occupations with relatively low unemployment rates are characterised by relatively high informality rates (or vice versa); consequently, increases in some occupations, for instance with low informality rates, might significantly increase unemployment rates. Thus, policymakers and training providers should be aware of this duality to provide adequate skills that genuinely improve people's employability.

2.3. Trends in the labour market

The above descriptive analysis shows the current state of the Colombian labour market. Nevertheless, it does not say anything about the dynamics of the labour market. Given possible changes that might occur in the labour market, the conditions for a specific group of occupations might be improving/worsening over time. Consequently, analysing labour market dynamics by occupations or skill levels will reveal if there are favourable/unfavourable changes for a particular segment of the labour force. With this in mind, Figure 4 depicts the labour market composition of Colombian workers by skill level. As can be seen, the distribution of skills has remained approximately consistent over time (2010-2018). Low-skilled workers represent around 43% of the total of Colombian workers, followed by 32% medium-skilled and 25% high-skilled workers.

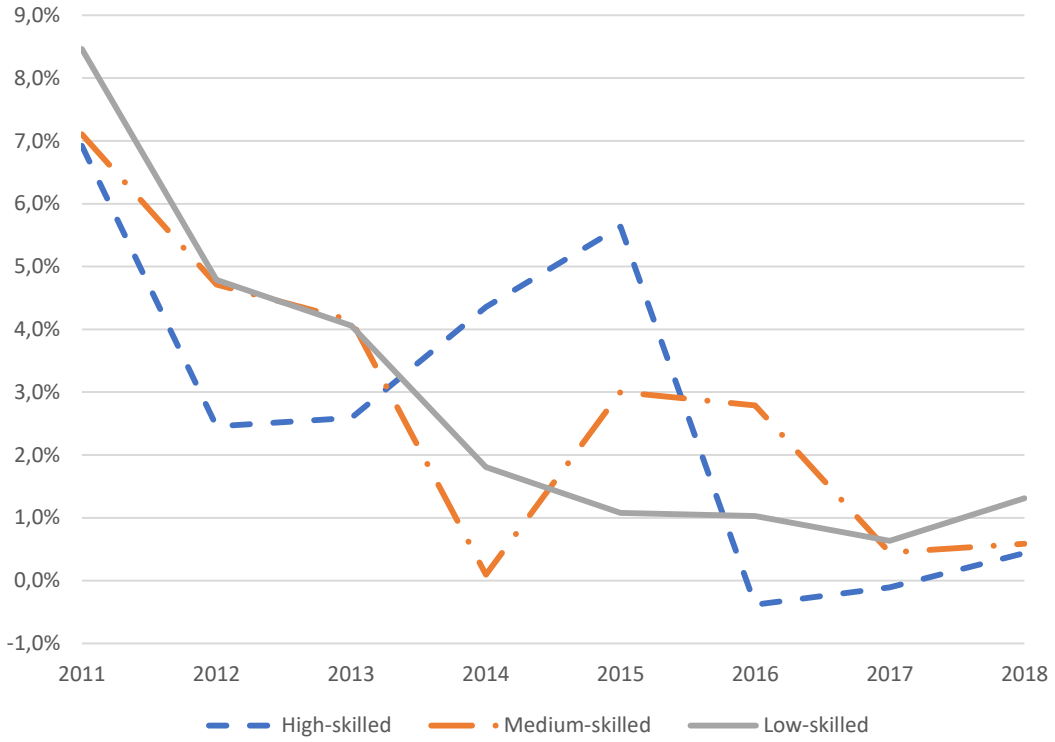
Figure 4: The labour market composition of Colombian workers by skill level (2010–2018)



Source: DANE-GEIH. Own calculations.

As shown above, the overall structure of Colombian employed workers has not significantly changed during the last nine years. However, this composition has not changed because employment growth/decline has been relatively the same across all occupational groups. Figure 5 shows that, in general, employment growth for low-, medium- and high-skilled occupations has decreased during the last decade. The decreasing trend of employment growth might be explained by labour supply and demand factors. It might be the case that the participation rate has declined or the growth in demand has slowed during the last years.

Figure 5: Employment growth by skill level (2010–2018)

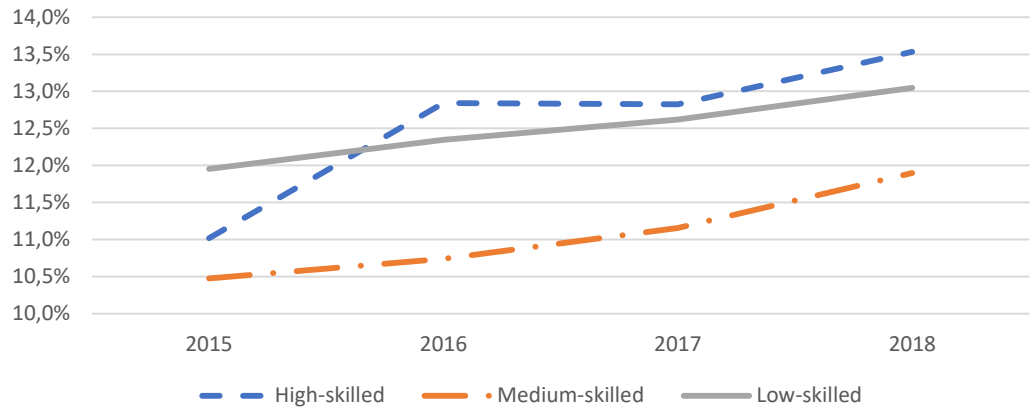


Source: DANE-GEIH. Own calculations.

Cárdenas (2020a) showed that GPR has been relatively consistent over the last nine years (around 64%), while the unemployment rate has started to increase in the last four years. Figure 6 indicates how the unemployment rates for each skill level have increased. This evidence suggests that the imbalances between labour supply and demand have been prevalent for all the skill levels in the last years[9].

[9] Indeed, the Talent Shortage Survey released in 2019 by Manpower indicates that, in Colombia, there has been an increasing trend of talent shortages since 2011 (Manpower, 2019).

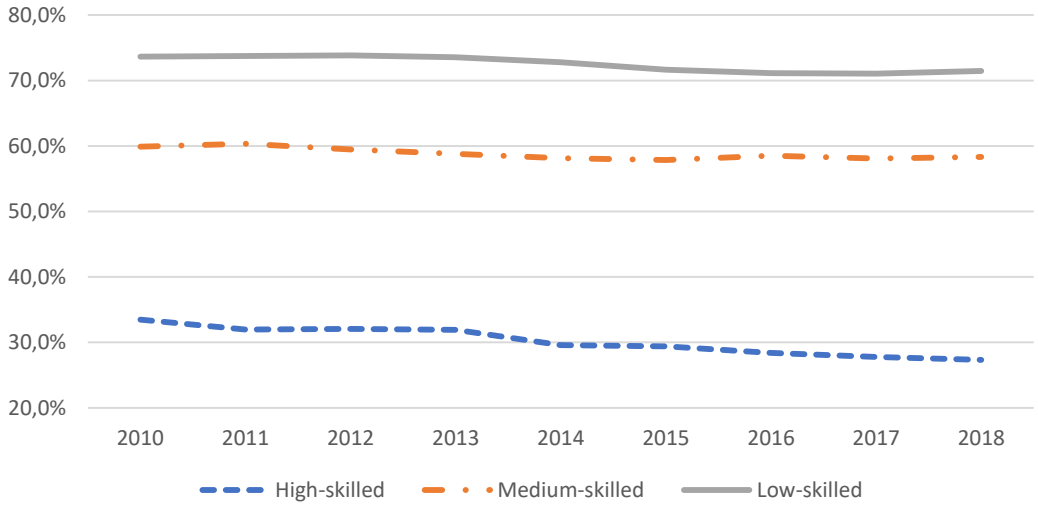
Figure 6: Evolution of the unemployment rate by skill level (2015–2018)



Source: DANE-GEIH. Own calculations.

Moreover, Cárdenas (2020a) showed that informality rates have slightly decreased in the last four years. Figure 7 confirms in more detail how the informality rates have slightly decreased for high- and low-skilled occupations, while for medium-skilled occupations this rate has remained relatively consistent over time. This result suggests that there has been an increase in skill oversupply, especially in low- and medium-skilled occupations over the last years.

Figure 7: Evolution of the informality rate by skill level (2010–2018)



Source: DANE-GEIH. Own calculations.

Thus, by considering the behaviour of the unemployment and informality rates, in general, it can be seen that labour market outcomes have worsened across all skill groups in the last four years. Specifically, the evidence indicates that low-skilled occupations show more signs of oversupply. Moreover, the recent increase of unemployment and informality rates (oversupply) suggest that there has been an increase of skill mismatching problems.

However, a more detailed analysis might reveal that despite the worsening of employment conditions overall, for some occupations there have been improvements in terms of formal employment and real wages. For instance, a complete list of occupations in Appendix A: (Table A.5) demonstrates that the employment growth trend has been positive between 2010 and 2018: around 47.4% of occupations correspond to high-skilled occupations, followed by 37.1% medium-skilled and 15.5% low-skilled occupations.

Importantly, most of the occupations with the highest growth in labour demand (mentioned in Cárdenas, 2020c) are also in the list of occupations for which the employment growth trends are positive (Appendix A:, Table A.5). Such is the case for "computer network professionals", "real estate agents and property managers", "electronics engineering technicians", "Electronics engineers", and "Information and communications technology user support technicians". This evidence suggests that these occupations are in high demand.

Moreover, a complete list of occupations for which the trend in real wages growth is positive between 2010 and 2018 can be found in Appendix A: (Table A.6). Around 42.6% of occupations with a positive trend in wage growth are medium-skilled occupations, followed by 35.7% high-skilled, and 21.6% low-skilled occupations. Most occupations with the highest growth in labour demand (as mentioned in Cárdenas, 2020c) are also found in the list of occupations with a positive trend in wage growth (Appendix A:, Table A.6).

In summary, the evidence suggests that Colombian workers face high rates of unemployment and informality and, overall, their employment conditions have deteriorated in the last four years. However, there are some segments in the labour market where formal employment and real wages have increased. This evidence might suggest that there are some occupations which are in high demand and might be at risk of skill shortages. Moreover, the considerable gap in the average wages of formal and informal workers by skill level indicates that informal workers and

unemployed individuals have incentives to join the formal economy. Potentially, occupations with skill shortages might be filled with the excess of supply from other occupations.

Nevertheless, further examination is required to determine whether there is a skill mismatch or not. For instance, the positive employment trend for some occupations might be due to improvements in labour market efficiency (e.g. reduction of search cost) rather than skill scarcity. Consequently, well-designed indicators of potential skill shortages are required to tackle labour market frictions, especially in Colombia where skill mismatches (due to imperfect information) have been reported as one of the leading causes of relatively high unemployment and informality rates.

3. Measuring possible skill mismatches (macro indicators)

To measure skill mismatches is challenging. As pointed out by Bosworth (1993) "there is no one 'best way' to do it". Indicators that attempt to measure skill shortages might be affected by diverse factors; for instance, increases in the wages of a particular occupation might correspond to skill shortages or institutional and social factors (such as minimum wage increases or lower discrimination) (Shah and Burke, 2003).

Consequently, the labour market literature has proposed different indicators to measure possible skill mismatches (see, for instance, European Commission, 2015; MAC, 2017; Mavromaras et al. 2013). The UK Migration Advisory Committee (MAC) has summarised the skill mismatch indicators in four categories (see Table 7): employer-based, price-based, volume-based indicators and indicators of imbalance. As explained in Cárdenas (2020a), in Colombia, it is not possible to build macro employer-based indicators because there are no sources of information (employer surveys) available. Instead, indicators of imbalance refer to the vacancy to unemployment ratio (Beveridge curve). Briefly, the idea behind this indicator is that a high vacancy/unemployment ratio within an occupation or skill level might suggest that employers have difficulties in filling their vacancies, and vice versa.

Price-based indicators reveal that increases in real wages in a particular occupation is a possible sign of skill shortages. As explained in Cárdenas (2020a), in the basic labour market model when there is an increase in labour demand and labour supply is static the real average wages tend to increase (given the relative labour shortage) to meet demand. Similarly, increases in

employment and a reduction of the unemployment rate, etc. (volume-based indicators), are a sign of possible skill shortages.

Table 7: Skill mismatch indicators

Indicators set	Description
Employer-based indicators	Employer-based indicators are derived from surveys that ask employers direct questions about their demand for workers and their ability to recruit. Rising vacancy rates may suggest that employers are finding it hard to fill jobs. These data provides a valuable employer perspective however is limited by only providing what employers choose to report.
Indicators of imbalance	Indicators of imbalance focus directly on the vacancy levels within an occupation. A high vacancy/unemployment ratio within an occupation suggests that employers are having particular difficulty filling vacancies given the supply of workers available. Similarly an increase in the average vacancy duration also indicates that employers are finding it more difficult to fill vacancies.
Price-based indicators	In the case of a labour shortage, market pressure should increase wages, helping to raise supply and reduce demand, thus restoring labour market equilibrium. On this basis, rising wages within an occupation can be considered to provide an indication of shortage.
Volume-based indicators	Increases in employment or increases in average hours worked may indicate rising demand and greater utilisation of the existing workforce, which could indicate shortage. Low or falling unemployment among people previously employed in, or seeking work in, an occupation may also indicate shortage (conversely high unemployment amongst people seeking work in a particular occupation is an indicator than an occupation is not in shortage).

Source: Migration Advisory Committee (MAC). (2017). Assessing labour market shortages: A methodology update. Migration Advisory Committee, London.

Typically, in Colombia the analysis of possible skill mismatches is conducted by using aggregated labour supply information. However, this labour analysis is incomplete without information about labour demand (see Cárdenas, 2020c). As mentioned by MAC (2017), each set of indicators has advantages and disadvantages in measuring skill mismatches (see the following subsections). Consequently, both labour supply and labour demand information are necessary to determine where possible skills problems exist, and what labour demand requirements might not be fulfilled by the labour supply.

Nevertheless, in Colombia, a comparison between labour supply and labour demand information was impossible because there was no information about the labour demand or labour demand information was not comparable with the labour supply information; for example, not available at an occupational level (see Cárdenas, 2020a). Therefore, one of the contributions of this paper is that it makes Colombian information about labour demand (job portals) and labour supply (household surveys) comparable to identify possible skill shortages.

Recently job portal information has started to be considered as a source to measure possible skill shortages. For instance, recently, the MAC considered the use of job portal information to design and update skill shortage indicators. However, due to the collection of vacancy information provided by Burning Glass[10] (see Cárdenas, 2020b), so far this source of information is considered as a complement of the MAC indicators (MAC, 2017). In contrast, Cedefop which carries out the "Big data analysis from online vacancies" project (see Cárdenas, 2020a) has mentioned the potential of online vacancy information to provide information that reduces skill mismatches (Cedefop, 2018). However, at the time when this paper was written, MAC or Cedefop's skill mismatch indicators based on job portal information have not been released.

Thus, Section 3.3 discusses how labour demand (job portals) and supply (household surveys) information can be used to determine possible skill shortages given the sources of labour market information available in a developing country such as Colombia.

3.1. Beveridge curve (Indicators of imbalance)

Cárdenas (2020a) showed that job portal information provides consistent information, in terms of data representativeness, with the employment and unemployment series to reduce imperfect information issues in the labour market. Thus, it is possible to build indicators to continuously monitor and evaluate the match between labour supply and demand. Perhaps, one of the most well-known indicators for the evaluation of labour market matching is the Beveridge curve.

As mentioned in Cárdenas (2020a), the Beveridge curve relates vacancies to unemployment levels to determine how well, or inadequately, vacancies match unemployed workers. The curve is calculated by dividing the job openings rate (the number of job placements as a per cent of

[10] Burning Glass accounts the number of advertised job postings as vacancies and (so far) does not consider the number of job placements one job advert might include (MAC, 2017).

the numbers of total employment plus job placements) by the unemployment rate (total unemployed people divided by the total of employed and unemployed):

$$\text{Beveridge curve} = \frac{\frac{Job\ placements}{\text{total employment} + \text{job placements}}}{\frac{\text{unemployed}}{labour\ force}}$$

The points on the curve indicate the current business cycle of an economy[11]. Moreover, shifts to the right of the Beveridge curve indicate an increasing inefficiency of the labour market; in this scenario, there is a higher unemployment rate and a higher vacancy rate than before. This phenomenon is explained by an increase of labour market frictions, such as skill mismatches and labour mobility, among others. Shifts to the left of the Beveridge curve might indicate an increasing efficiency of the labour market; in this scenario, there are fewer frictions in the labour market allowing workers to match more easily with a job vacancy (Bleakley and Fuhrer, 1997). Theoretically, this curve slopes downward as the higher the unemployment rate, the lower the vacancy rate and vice versa[12].

Despite the Beveridge curve measuring labour market mismatch rather than skill mismatch, the curve provides a first approach to assess the state of labour market matching. Moreover, it was expected that the Colombian Beveridge curve should be strongly influenced by skill mismatches because the evidence found in Colombia, thus far (see Cárdenas, 2020a), showed that skill mismatch problems are one of the most important causes of unemployment. Additionally, disaggregating the curve into occupational (one-digit) ISCO groups helped to determine which occupations might be experiencing more or fewer skill mismatches problems.

[11] For instance, recession periods are characterised by a low vacancy rate and a relatively high unemployment rate (lower side of the 45° line), while periods of economic expansion are, generally, described by a high vacancy rate and a relatively low unemployment rate (upper side of the 45° line).

[12] Empirically, different authors have demonstrated the downward slope of this curve in the US and other countries (Elsby, 2015). For Colombia, Álvarez and Hofstetter (2014) manually collected job advertisements in newspapers from 1976 to 2012 and estimated the aggregated Colombian Beveridge curve. They found, as expected, a downward slope between vacancy and unemployment rates. Consequently, the quarterly Beveridge curve calculated with the vacancy information for this paper was also expected to show a downward slope.

For the Beveridge curve estimation, the vacancy database has advantages and disadvantages. On one side, the rich information of the vacancy database permits an estimation of the Beveridge curve by groups (i.e. occupational groups). On the other side, however, the sample period of the data only runs from 2016 to 2018; consequently, so far it is not possible to estimate the curve for an extended period and, hence, it is not possible to observe trends over a long time period. Moreover, the GEIH information has representativeness problems when the data are excessively disaggregated (i.e. by quarter, four-digit occupational groups, etc. [see Cárdenas, 2020a]). Given the advantages and disadvantages of the available information, this paper estimates the Beveridge curve at a one-digit occupational group level for the period 2016–2018 (similar to Turrell et al. 2018); potentially, however, the data can be disaggregated at a two-digit ISCO level.

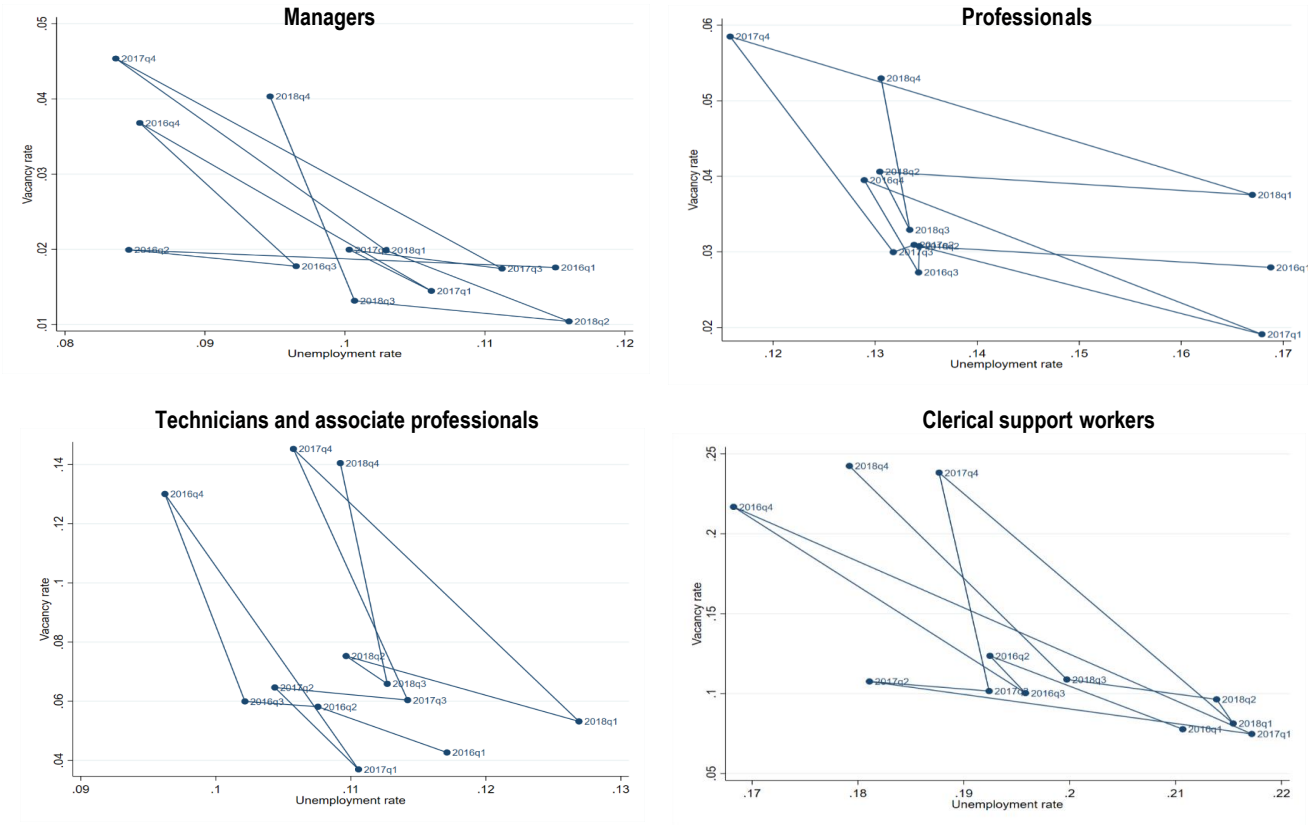
Figure 8 shows the Beveridge curve by occupational (major) groups. As can be noted, the Beveridge curve is downward sloped by occupational groups; however, the occupational group "Skilled agricultural, forestry and fishery workers" have some atypical points. This unexpected behaviour might be due to representativeness problems for the vacancy data within agricultural jobs (see Cárdenas, 2020d). It is also worth considering that the GEIH information for this analysis does not take into account rural areas where most agricultural jobs are located.

In more detail, the Colombian Beveridge curve by occupational group indicates two facts. First, the initial quarter of each year is characterised by higher unemployment rates and lower vacancy rates (in concordance with the evidence given in Cárdenas, 2020c, 2020d), while the last quarter of each year is characterised by lower unemployment rates and higher vacancy rates. This exercise shows that the vacancies have, as expected, a positive relation with employment and a negative association with unemployment rate. Second, on average the Beveridge curve for "Clerical support workers", "Professionals and technicians and associate professionals" are farther from the origin (points [0,0] in Figure 8 compared to the other occupational groups. This evidence suggests that in these occupations there are likely to be higher labour market inefficiencies such as skill mismatches. Alternatively, the Beveridge curve for "Plant and machine

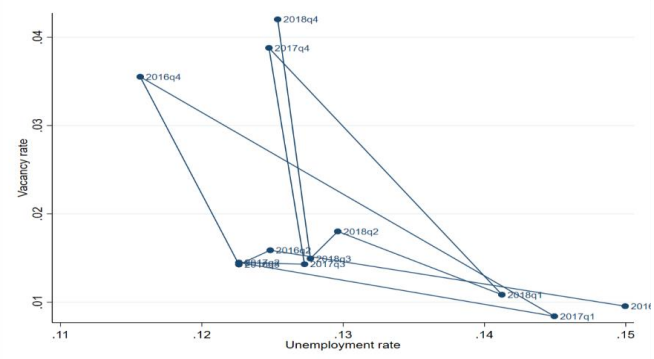
operators, and assemblers", "Craft and related trades workers" and "Managers", suggest fewer labour market frictions for those occupational groups[13].

[13] As mentioned above, at this moment the vacancy data do not allow a long-term analysis of the Beveridge curve. So far, the present study helps to describe the current state of labour market frictions and compare them between occupational groups. However, in the future, when longer vacancy time series are available, it will be possible to calculate clearer shifts for the curve and, thus, observe increasing inefficiency/efficiency of Colombian labour matching.

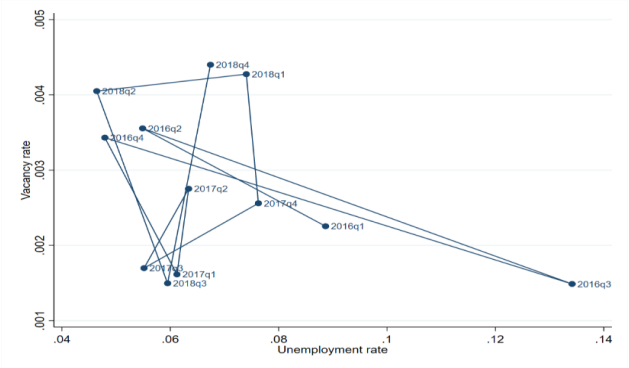
Figure 8: Beveridge curve by occupational (major) groups



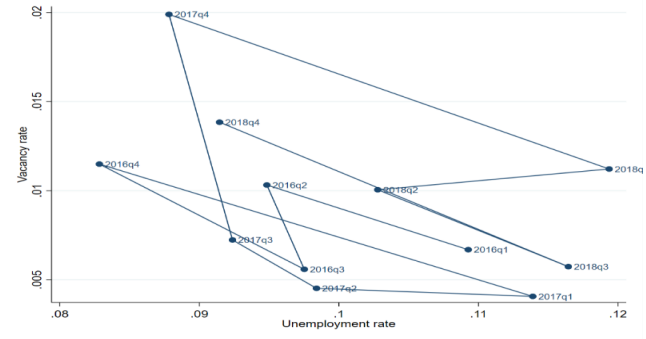
Service and sales workers



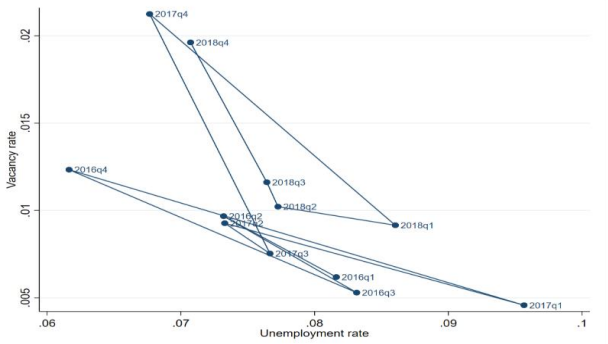
Skilled agricultural, forestry and fishery workers



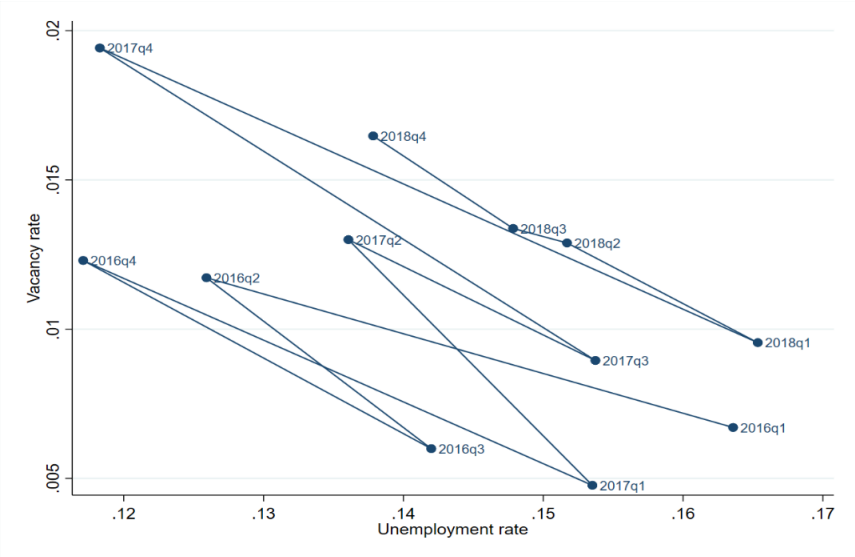
Craft and related trades workers



Plant and machine operators, and assemblers



Elementary occupations



Source: Vacancy database and GEIH 2016 - 2018. Own calculations.

3.2. Volume-based indicators: employment, unemployment and vacancy growth

The Beveridge curve showed that occupational groups such as "Clerical support workers", "Professionals" and "Technicians and associate professionals" exhibit higher labour market frictions. However, the curve is affected by skill mismatches and other labour market issues (e.g. frictional unemployment, search costs, participation rates, etc.); consequently, further labour market indicators are needed to precisely determine possible skill shortages.

As previously shown in Table 7, volume-based and price-based indicators can be built to measure skill mismatches. For instance, the European Commission (2015) used the variation in employment and unemployment rates across skill levels as a measure of skill mismatch in the European Union. Increases or decreases of the employment/unemployment rates are sought as a sign of skill shortages; in other words, of skill shortages.

This subsection focuses on volume-based indicators. As the name "volume-based" implies, these indicators are based on the number of people working, unemployed or the number of hours worked[14]. Given the existing labour supply and new sources of labour demand

[14] Increases in employment level or the average number of hours worked for an occupation might suggest a higher utilisation of a specific occupation and, hence, might indicate a potential skill mismatch. Conversely, a positive

information available in Colombia, it has become possible to estimate volume-based (and price-based) indicators of skill mismatch.

Importantly, due to the occupational reclassification of labour supply information according to ISCO-08 (see Cárdenas, 2020d), this paper uses the GEIH to develop volume-based (and price-based) indicators according to updated occupational classifications. Vacancy information provides reliable information regarding the trends and the economic seasons of the Colombian labour market at an occupational level (see Cárdenas, 2020c, 2020d); thus, it is possible to build labour demand-based indexes compatible with labour supply-based indicators that might determine possible skill shortages.

As mentioned in Cárdenas (2020a), one of the most developed approaches to measure skill mismatches can be found in the UK. Indeed, since 2008 the MAC has developed a conceptual framework and built 12 indicators of shortage using data for both labour demand and supply. Importantly, most of those indicators can now be adopted in Colombia given the updated information of labour demand and supply presented in this paper. Thus, based on the system developed by the MAC and the information available for Colombia, this paper proposes the following volume-based measures to identify possible skill shortages:

3.2.1. Percentage change in unemployment by sought occupation (three years)

As mentioned above, decreases in the number of unemployed individuals are a sign that employers require relatively more people for a certain occupation, hence skill mismatch might arise. The GEIH provides information regarding sought occupations (job titles). However, given data representativeness issues, the annual percentage change in unemployment (and, in general, for most of the indicators that use household survey information) might excessively fluctuate and produce volatility in volume-based indicators, affecting the analysis of occupational changes. As proposed by the MAC (2017), one way to overcome this issue is by calculating skill shortage indicators averaged across three years. This three-year average identifies recent and less volatile occupational changes.

depicts the percentage change in unemployed individuals by sought occupation. Additionally, this and the following figure show the median, the third quartile and the median plus 50 per cent of the median (red lines a, b and c, respectively). As will be discussed in Section 3.4, these

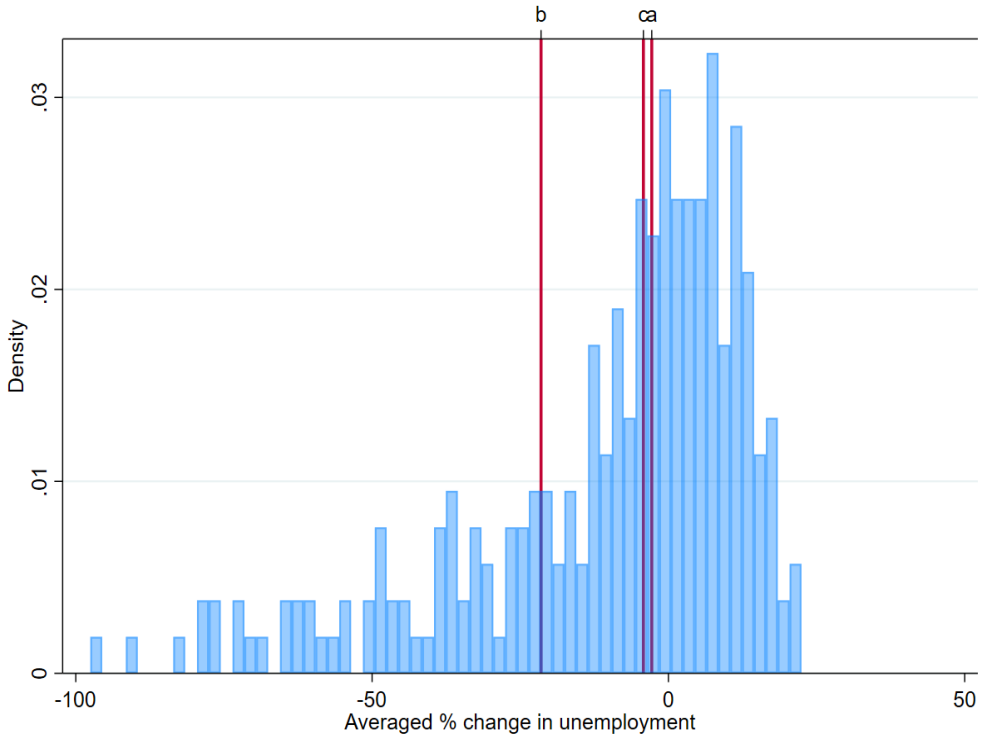
trend of unemployment might represent lower utilisation of a particular occupation; therefore, it might suggest that the occupation is not in shortage.

thresholds help to determine at which point a specific indicator value should be considered as a sign of skill mismatch[15]. The median of this percentage change is -2.8% and the third quartile is -21.4%. Moreover, the median plus 50 per cent of the median is -4.2%. The distribution of this indicator shows that unemployed individuals (by sought occupation) for some occupations has increased, while for other occupation it has decreased. This result suggests that employers have required relatively more people for certain occupations, while for other occupations labour demand shows signs of decline; however, the distribution is left-skewed and the mass of the occupation is concentrated on the right of , around a 0% change in unemployment.

Moreover, the fact that the median is negative (-2.8%) indicates that more than half of occupational groups experienced reductions in the number of unemployed individuals (by sought occupation). It is important to note that this result does not mean that the number of unemployed individuals (by sought occupation) has decreased over time. It might be the case that the reductions in unemployment occurred in occupations with relatively few job seekers, and increases in unemployment in occupations with a relatively high number of job seekers.

[15] The median and the third quartile are the most well-known measures of central tendency and dispersion. The median plus 50 per cent of the median is an alternative measure given that the median and the third quartile might be considered ambiguous or static thresholds to determinate skill mismatches (see Section 9.3.4). The median plus 50 per cent was selected (instead of, for instance, the median plus 10 or 90 per cent) to avoid this indicator from being similar to the median, or higher than the maximum value of a certain an indicator. For instance, a particular variable can have the following values: 10, 30 and 50. The median of this variable is 30. The median plus 10 per cent (33) is similar to the median, while the median plus 90 per cent is 55 which is higher than the maximum value of the variable. Instead, the median plus 50 per cent of the median is 45, and thus this threshold can be used to determine at which point a specific indicator value should be considered as a sign of skill mismatch.

Figure 9: Percentage change in unemployed individuals by sought occupation



Source: DANE-GEIH 2016 - 2018. Own calculations. Median (a), third quartile (b) and the median plus 50 per cent of the median (c).

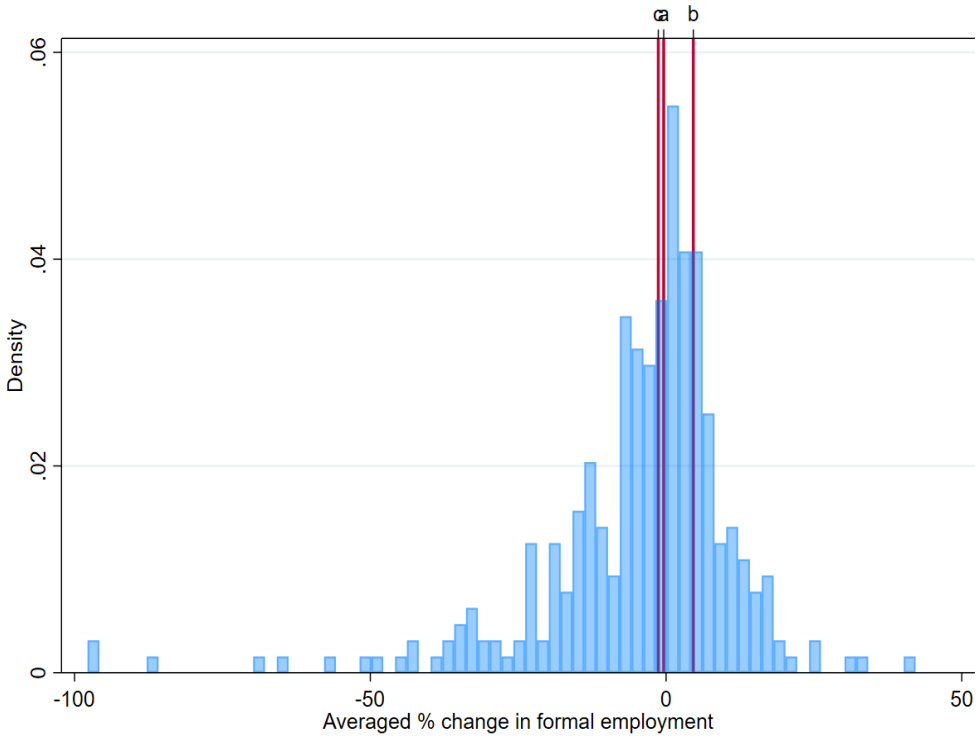
3.2.2. Percentage change in formal employment (three years)

Contrary to the unemployment indicator, increases in the number of employees suggest that employers require relatively more people for a certain occupation and hence, skill mismatch might arise. However, a distinction between formal and informal workers is required as growth in the level of employment might be due to people who could not find a formal job and opted for the informal economy instead. In this case, increases in the number of employees do not correspond to skill shortages (see Cárdenas, 2020a). Instead, such increases would suggest that there is an oversupply for a specific occupation in the formal economy; consequently, given the proportion of informality in Colombia, it is important to calculate this indicator only for formal workers.

As shows, the median of the percentage change in formal employment by occupation is -0.8%, the third quartile is 4.6%, and the median plus 50 per cent of the median is -1.3%. The percentage change in formal employment (controlling for some outliers) has a similar shape of a normal distribution curve centred at 0. This result indicates that a considerable proportion of

occupations do not experience major changes in total formal employment numbers. However, certain occupations experience increases in the number of formal workers, suggesting that formal labour demand might have increased for particular segments of the labour market.

Figure 10: Percentage change in formal employment by occupation



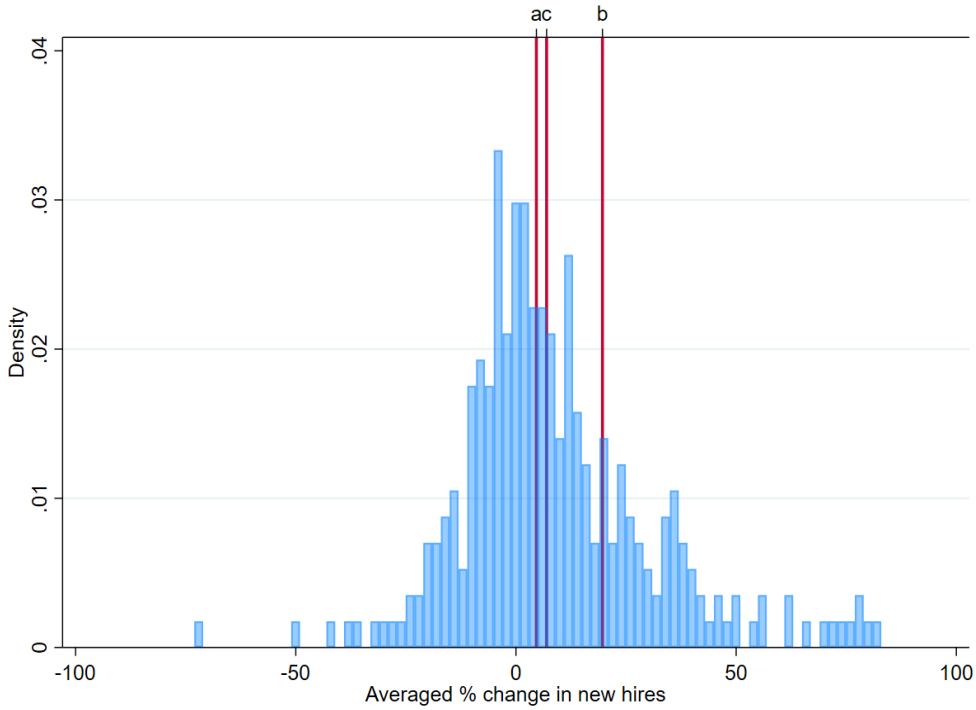
Source: DANE-GEIH 2016 - 2018. Own calculations. Median (a), third quartile (b) and the median plus 50 per cent of the median (c).

3.2.3. Percentage change in the proportion of formal workers in their job for less than a year: new hires (three years)

As discussed by Cárdenas (2020d), unemployment or employment levels might be influenced by different factors such as lower dismissal rates or search costs, among others. The number of new hires, on the other hand, corresponds to vacancies created by economic growth (net growth) and the number of vacancies created because people left their jobs (replacement demand). It is logical to think that when there is an increase of new hires, there is higher utilisation of the workforce for a specific occupation. Indeed, in Colombia, new hires have a strong correlation lag with the number of job openings (see Cárdenas, 2020d). Consequently, new hires can be used as an indicator of possible skill shortages.

As for the previous indicator, a distinction between formal and informal workers is required. Growth in the number of new hires might be due to people opting for the informal economy when they could not find a formal job. Thus, this indicator is calculated by only accounting for the number of new hires in the formal economy. Figure 11 shows that the median, the third quartile and the median plus 50 per cent of the median for this indicator is 4.6%, 19.6% and 6.9%, respectively. The fact that the median is positive indicates that more than half of the occupational groups experienced increases in the number of new formal hires. Indeed, this distribution is slightly left-skewed.

Figure 11: Percentage change in new hires by occupation



Source: DANE-GEIH 2016 - 2018. Own calculations. Median (a), third quartile (b) and the median plus 50 per cent of the median (c).

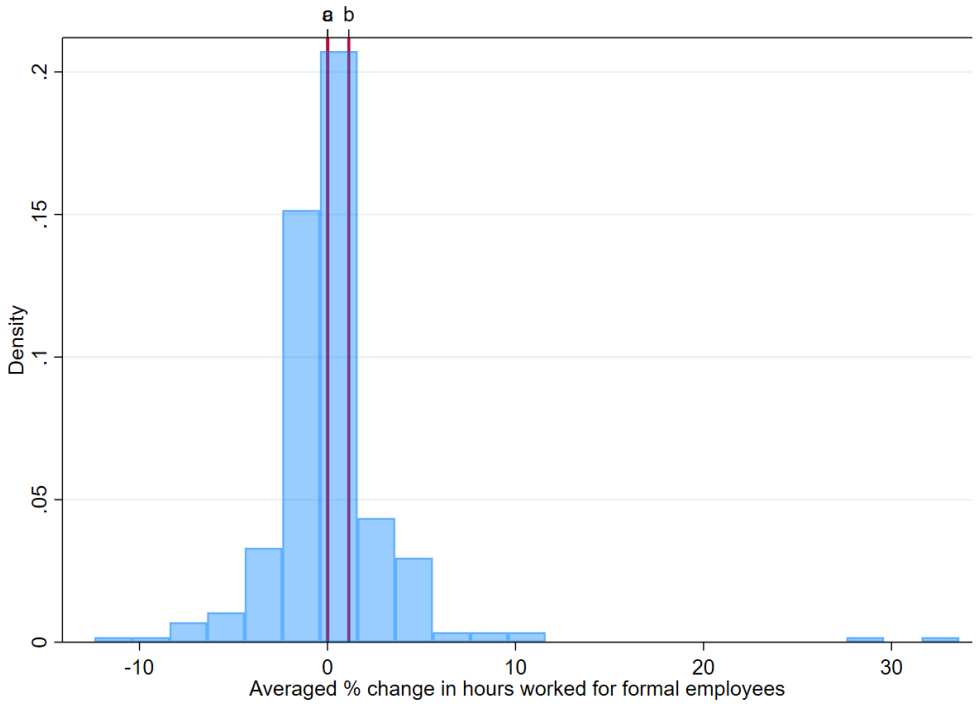
3.2.4. Percentage change in hours worked of formal employees (three years)

Alternatively, higher utilisation of the workforce for a particular occupation can take place through increases in the hours worked. It might be the case that employers do not find proper candidates to fill their vacancies, consequently they might increase the number of hours worked by their current employees. Once again, a distinction between formal and informal workers is required: the number of hours worked in the informal economy might increase, while hours

worked by formal workers might not increase, but decrease. In this case, an increase in the hours worked do not indicate that there is a possible skill mismatch.

Figure 12 illustrates the percentage change in hours worked for informal employees by occupation. The median of this indicator is around 0.00%, and the third quartile is 1.1%. Moreover, the median plus 50 per cent of the median is 0.01%. The percentage change in hours worked for formal employees (controlling for some outliers) has a similar shape to a normal distribution centred at 0. This result indicates that a considerable proportion of occupations do not experience major changes in hours worked. However, some occupations demonstrate increases in the number of hours worked, suggesting that formal labour demand might have increased for particular segments of the labour market.

Figure 12: Percentage change in hours worked for formal employees by occupation



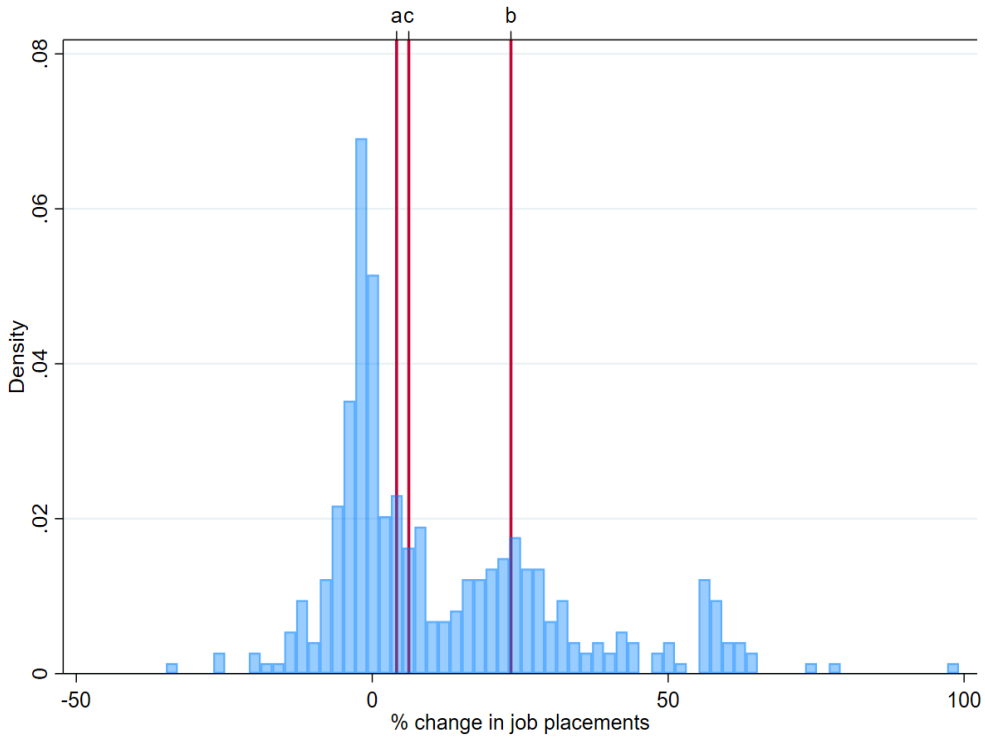
Source: DANE-GEIH 2016 - 2018. Own calculations. Median (a), third quartile (b) and the median plus 50 per cent of the median (c).

3.2.5. Percentage change in job vacancy advertisements by occupation

As mentioned above, labour supply-based indicators might be influenced by other factors (e.g. labour participation) rather than a higher labour demand utilisation. Moreover, Cárdenas (2020a) has shown that job portal information represents the occupational economic seasons and trends of Colombia's labour demand; consequently, increases in the number of online job vacancy advertisements might be a sign of higher demand for a specific occupation and possible skill shortages. Thus, the annual percentage change in job vacancy advertisements might indicate a higher or lower use of the workforce by employers. Given that the vacancy information does not show high volatility in the period of analysis (2016–2018), the percentage change in job vacancy advertisements by occupation is not averaged across the last three years. To some extent, how this vacancy information changes over one-year guarantees that the use of a volume-based indicator is relevant in the short term for the identification of skill shortages.

As Figure 13 shows, the median of the percentage change in job placements by occupation is 4.1%, the third quartile is 23.4%, and the median plus 50 per cent of the median is 6.1%. In accordance with Cárdenas (2020c), the percentage change in job placement distribution indicates that a considerable proportion of occupations do not experience major changes in labour demand (vacancies). However, the job placement distribution is right-skewed; relatively few occupations experienced decreases in the number of vacancies advertised, while a higher number of occupations experienced an increase in job placements.

Figure 13: Percentage change in job placements by occupation



Source: Vacancy database 2016 - 2018. Own calculations. Median (a), third quartile (b) and the median plus 50 per cent of the median (c).

This subsection has discussed how proper volume-based skill mismatch indicators can be built using information sources available in Colombia. However, and in agreement with the MAC (2017) and Mavromaras et al. (2013), the identification of skill mismatches cannot be achieved by relying on just one indicator set. For instance, increases in the volume of employment or vacancies in specific occupations might be due to improvements in the searching process (e.g. lower searching cost) rather than real increases of the labour demand for a particular occupation. Thus, it is necessary to develop another set of indexes that use other labour market dimensions such as prices to complement volume-based indicators and indicators of imbalance.

3.3. Price-based indicators: wages

As explained in Cárdenas (2020a), skill shortages might lead to increases in wages. As the labour demand increases for certain occupations, the current labour supply might not be enough to cover this higher demand; consequently, employers might have more difficulties in

finding workers according to their requirements, and hence the wages of certain occupations might increase given the shortage of labour. Thus, information about wages might provide signs of skill shortages.

As in the case of volume-based indicators, in Colombia the household survey (GEIH) provides information regarding the monthly wages and hourly wages of Colombian workers (prices), while job portal information provides reliable information about vacancy wages (see Cárdenas, 2020c, 2020d). Therefore, it is possible to build labour demand-based price indexes compatible with labour supply-based indicators that might determine possible skill shortages.

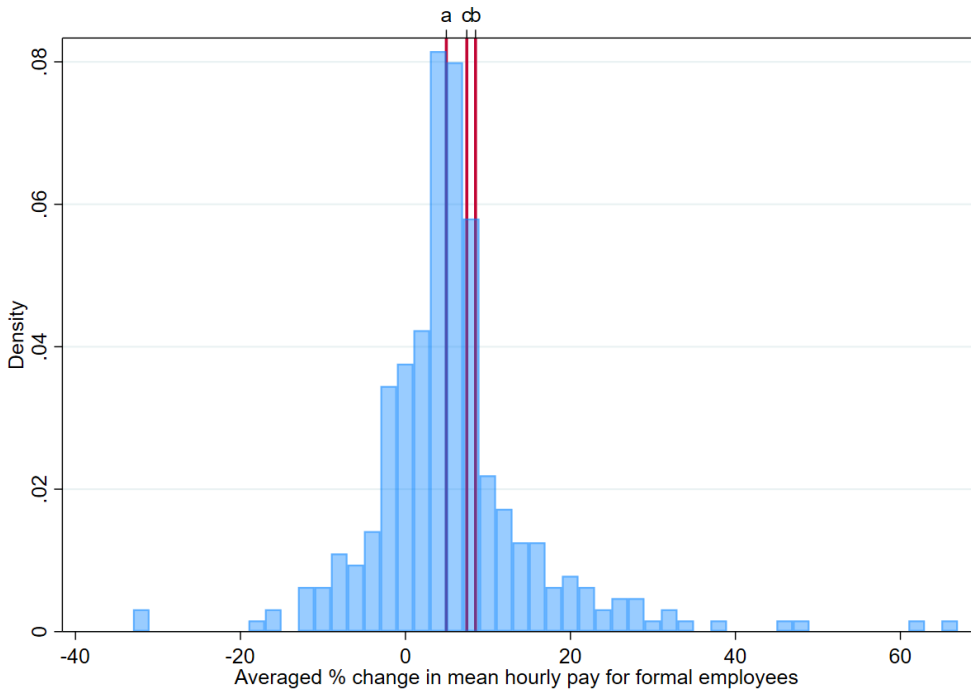
3.3.1. Percentage change in median hourly real pay for formal employees (three years)

Estimating the percentage change in wages might provide evidence regarding possible skill shortages. However, there are a number of points to consider to define this indicator in a way that captures potential increases in labour demand. First, wage levels might increase over the years due to inflation. Second, the level of wages might be affected by the number of hours worked. Moreover, employers might react to skill shortages by increasing hourly salaries to improve a worker's productivity. Third, as discussed above, a distinction between formal and informal workers is required. Growth in wage levels might be due to increases in informal wages (the formal market might show an opposite trend), and, in this case, the percentage change in salaries might not necessarily suggest a skill shortage. Fourth, average wages figures might be affected by outliers. Finally, as is the case for volume-based indicators, household information might excessively fluctuate and produce volatility in price-based indicators, affecting the analysis of real wage changes at the occupational level.

To control for these issues, it is necessary to calculate the median[16] value for the real wages (adjustment for inflation) of formal employees, to divide real salaries by the number of hours worked, and average annual wages changes across the last three years. Figure 14 shows that the median, the third quartile, and the median plus 50 per cent of the median for this indicator are 4.9%, 8.4% and 7.4%, respectively. The distribution of percentage change in mean hourly pay for formal employees indicates that more than half of the occupational groups have experienced increases in real hourly pay. This result suggests that for a considerable number of occupational groups, the labour demand might have increased.

[16] The median is a measure of central tendency that is not affected by outliers.

Figure 14: Percentage change in mean real hourly pay for formal employees by occupation



Source: DANE-GEIH 2016 - 2018. Own calculations. Median (a), third quartile (b) and the median plus 50 per cent of the median (c).

3.3.2. Relative premium for an occupation: controlling for education, region and age

Alternatively, occupational shortages might indicate a relative higher salary premium for those occupations compared with others. As mentioned above, companies tend to pay more to attract people with specific skills that are relatively scarce; therefore, the scarcer the supply in a particular occupation the more likely a higher premium is offered for working in that occupation. Thus, the relative premium for an occupation can be expressed as follows:

$$\ln(w) = \beta_0 + \beta_1 occupation_i + \varepsilon$$

Where w is wages, β_0 is the intercept and $occupation$ is a dummy variable that takes the value of one when the premium is estimated for the occupation i and ε is the error term.

However, the premium of a certain occupation compared to another might be affected by geographical or people's characteristics. For instance, the remuneration for an occupation might be affected by the differences in the cost of living between regions—regions with a higher cost of life tend to pay higher wages, for example. Thus, it necessary to control for labour supply

characteristics so as to estimate more precisely where occupational premium and skill shortages overlap. Nevertheless, there is a limit to the number of control variables because the higher the number of control variables, the more likely that data representativeness issues will arise—given that household surveys might possess representativeness at a four-digit ISCO-08 level.

Thus, it is necessary to select the most relevant control variables to measure the relative premium for an occupation. One well-known approach to estimate a wage premium is Mincer's equation (see Cárdenas, 2020a). This equation states that labour market income is a (linear and quadratic function) return on education and years of experience.

Usually, in the economic literature, the education variable is represented by years of education. This education variable is available in the GEIH and can be used to estimate relative premium for an occupation. In contrast, the GEIH do not provide information regarding years of experience. However, a proxy frequently used for this variable is worker's age. The older the worker, the more likely she/he will have more practical experience. Consequently, the worker's age is a correlated variable with the worker's experience. Moreover, as explained above, the level of prices in a region might significantly affect the level of wages for a specific occupation. therefore, the region is an important variable to estimate relative premium for an occupation

Finally, high-skilled occupations tend to be better paid than low-skilled occupations (see Cárdenas, 2020d); consequently, by definition, high-skilled occupations tend to have a higher premium and show signs of skill mismatch. Thus, to avoid comparisons between high- and low-skilled occupations, the relative premium was estimated by one-digit ISCO groups[17] (nine groups). Thus, the relative premium for an occupation can be expressed as follows:

$$\ln(w) = \beta_0 + \beta_1 occupation_{io} + \beta_2 education_{io} + \beta_3 age_{io} + \beta_4 region_{io} + \varepsilon$$

Where w indicates people's wages, β_0 is the intercept and $occupation$ is a dummy variable that takes the value of one when the premium is estimated for a person in the occupation i and in the one-digit ISCO group o. The $education$ and age variables are the worker's education

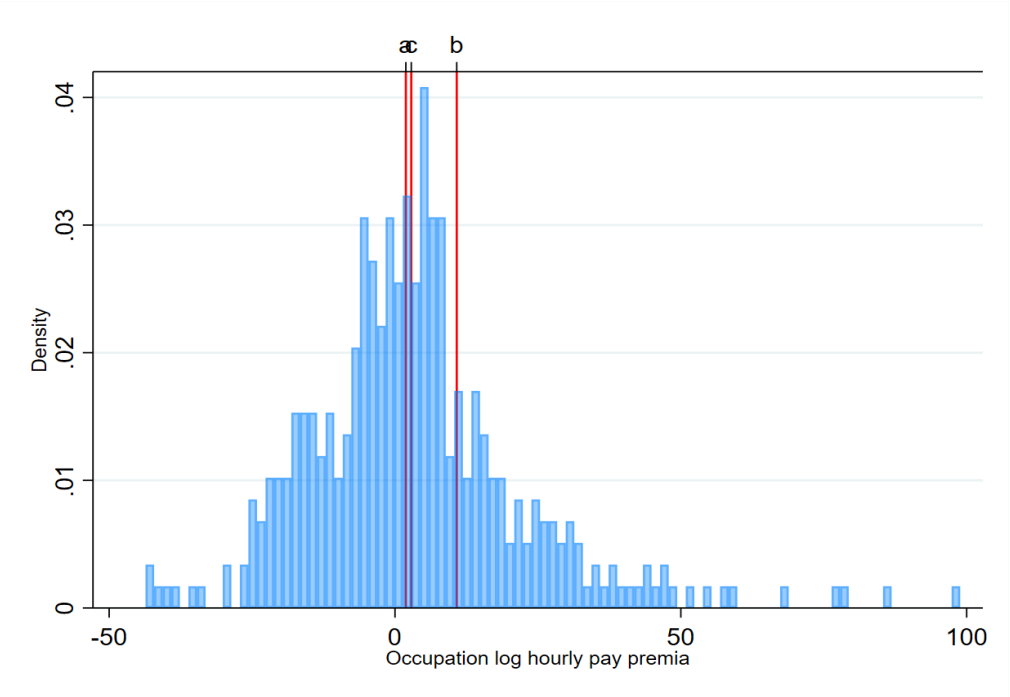
[17] Higher levels of disaggregation can cause representativeness problems.

(measured in years of education) and age, respectively. $region$ is the county[18] where the person works, and ε is the error term.

This equation controls for the most relevant elements while estimating salaries' premiums. Moreover, to estimate the relative premium of an occupation and to avoid representativeness issues and biases from the informal economy, as much as possible, a pooled OLS (Ordinary least squares) was conducted from 2016 to 2018 for formal Colombian workers.

Figure 15 shows that the median, the third quartile and the median plus 50 per cent of the median occupation hourly pay premia are 1.9%, 10.8% and 2.8%, respectively. There are a considerable number of occupational groups with positive hourly pay premia, which might indicate a shortage.

Figure 15: Occupation hourly pay premia



Source: DANE-GEIH 2016 - 2018. Own calculations. Median (a), third quartile (b) and the median plus 50 per cent of the median (c).

[18] Amazonas, Antioquia, Arauca, Atlántico, Bogotá, Bolívar, Boyacá, Caldas, Caquetá, Casanare, Cauca, Cesar, Chocó, Córdoba, Cundinamarca, Guainía, Guaviare, Huila, La Guajira, Magdalena, Meta, Nariño, Norte de Santander, Putumayo, Quindío, Risaralda, San Andrés y Providencia, Santander, Sucre, Tolima, Valle del Cauca, Vaupés and Vichada.

3.3.3. Relative vacancy premium for an occupation: controlling for region and experience

Similarly, with the vacancy database, it is possible to estimate the premium for an occupation. As pointed out above, labour supply-based indicators might be influenced by other factors (e.g. labour participation) rather than a higher labour demand utilisation. Consequently, calculating the relative premium for an occupation using the vacancy database has an advantage because the information comes from employers' sources. Moreover, as showed in Cárdenas (2020d), the vacancy information is annually representative at a four-digit ISCO level for a considerable portion of occupations; thus, it is possible to annually estimate the relative vacancy premium for an occupation. To some extent, this estimation guarantees that the price-based indicator is relevant in the short term for the identification of skill shortages.

However, like any other indicator, the vacancy premium has limitations. Given the frequency of missing values, for instance, it is not possible (so far) to control for required years of experience. At most, it is possible to control whether a vacancy requires labour experience or not. Therefore, the relative vacancy premium for an occupation can be expressed as follows:

$$\ln(w) = \beta_0 + \beta_1 occupation_{io} + +\beta_2 diploma_{io} + \beta_3 experience_{io} + \beta_4 region_{io} + \varepsilon$$

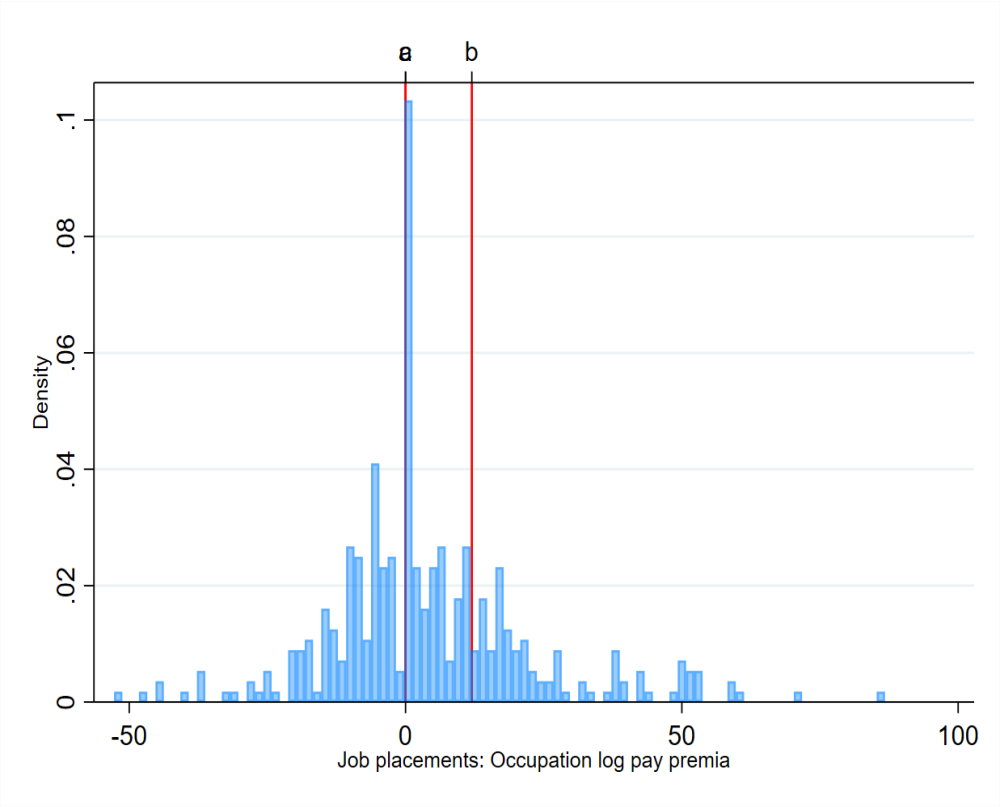
Where w is the vacancy's wages, β_0 is the intercept and $occupation$ is a dummy variable that takes the value of one when the premium is estimated for a vacancy in the occupation i and in the one-digit ISCO group o. "$diploma$" represents a set of dummy variables which indicate educational requirements (six categories, see Cárdenas, 2020b, Table 6.2[19]). The variable $experience$ is a dummy variable that takes the value of one if a vacancy requires experience and zero otherwise, $region$ is the county where the job vacancy is available and ε is the error term.

Figure 16 shows that the median, the third quartile and the median plus 50 per cent of the median occupation pay premia within job placements is 0%, 12% and 0%, respectively. The measures of central tendency tend to be positive in both Figure 15 and Figure 16. However, there are differences in the magnitude of the measures of central tendency for each one as Figure 15 presents a higher hourly pay premium than Figure 16. As mentioned in Cárdenas (2020d), these differences might be explained by several reasons, such as the bargaining

[19] Due to frequency issues, specialisation, master and doctor's degree categories were grouped in one category: "postgraduate".

process or an employer's behaviour when posting wages in job advertisements. Despite their differences, Cárdenas (2020d) shows that there is a considerable number of occupational groups with positive hourly pay premia, which might indicate a skill shortage.

Figure 16: Occupational pay premia within job placements



Source: Vacancy database 2016 - 2018. Own calculations. Median (a), third quartile (b) and the median plus 50 per cent of the median (c).

3.4. Thresholds

Once the basic skill shortage indicators are established, the following step is to determine the threshold at which a specific index value should be considered as a sign of skill mismatch. In this regard, the MAC (2017) has been part of an extended discussion regarding the adaptation of possible thresholds. As this institution has pointed out, there is not an economic rule that fixes indicators' thresholds. Consequently, given the MAC's recommendations and the similarities of the MAC's indicators with Colombia's skill shortages indexes, this paper considers the median, the quartile distribution and median plus 50 per cent thresholds, which have been

proposed by the MAC to determine at which value each indicator provides a sign of skill shortages.

The median and the quartile distribution are one of the most straightforward thresholds to determine at which value an indicator might suggest skill shortages. An occupation with values below or above the median might be considered as an occupation in deficit. However, independent of the economic cycle, quartiles (i.e. third quartile) and median thresholds will always provide the same number of occupations (i.e. 50% or 25% of occupations) at risk of skill shortages (see MAC, 2008). Consequently, even in situations where labour market works under perfect competition (see Cárdenas, 2020a), these thresholds will always suggest occupational deficits.

Alternatively, the advantage of the median plus 50 per cent is that this threshold does not fix a specific number of occupations into skill shortage. Depending on the median value, the median plus 50 per cent threshold suggests a higher or lower number of occupations as being in short supply. However, this threshold might give inconsistent results. For instance, the median and the median plus 50 per cent of the percentage, change in formal employment by occupation is -0.8% and -1.3%, respectively (see). Occupations above these values could be considered at risk of skill shortages. Nevertheless, it is counterintuitive to conclude that those occupations with a negative value (between -1.3 and 0) in formal employment growth are at risk of skill shortages. Moreover, the median and the median plus 50 per cent might coincide when the median value of an indicator is at or closer to zero.

The fact that the median plus 50 per cent does not fix a certain number of occupations in short supply is an advantage that makes this indicator preferable to others. However, in cases where the median plus 50 per cent threshold fails to provide consistent results, other rules will be considered alongside the data to indicate possible skill shortages.

Thus, the distribution of each indicator mentioned above needs to be analysed to select the most appropriate threshold. For the percentage change in unemployed individuals by sought occupation, the median plus 50 per cent is -4.2% (Figure 9). Decreases of more than -4.2% in unemployment by occupation suggest that employers require relatively more people for a specific occupation, hence skill mismatch might arise.

As mentioned above, the median plus 50 per cent of the percentage change in formal employment by occupation does not provide intuitive results because it suggests that occupations with negative formal employment values are experiencing skill shortages. Thus, in

this case, when the third quartile value (4.6%) is selected to classify occupations, increases of more than 4.6% in formal employment by occupation suggests shortages.

For the "new hires" indicator, the median plus 50 per cent provide intuitive results. Increases in more than 6.9% in formal hires by occupation suggests the occurrence of skills shortages (Figure 11). For the percentage change in hours worked for formal employees by occupation the median plus 50 per cent gives the same value as the median (see Figure 12). The median is almost zero, hence the median plus 50 per cent is close to zero. In such a case, the third quartile value (1.1%) is selected to classify occupations, and increases of more than 1.1% of the hours worked of formal employees by occupation suggests skill mismatch.

The median plus 50 per cent threshold for the percentage change in job placements by occupation is 6.1% (see Figure 13); therefore, increases in the percentage of online job vacancy advertisements of more than 6.1% is a sign of skill shortages. Likewise, the median plus 50 per cent threshold for the percentage change in mean hourly pay for formal employees by occupation is positive (Figure 14). Consequently, increases in percentage change of more than 7.4% regarding the mean hourly pay for formal employees suggests occupational deficits.

Regarding the occupational hourly pay premia of formal workers (Figure 15), the median plus 50 per cent threshold is 2.8%. Consequently, occupations with higher premia than 2.8% are potentially considered in short supply. In contrast, the median plus 50 per cent threshold for occupational pay premia in job placements is the same as the median (Figure 16). Thus, in such cases, the third quartile value (12%) is selected to classify occupations and increases of more than 12% in the occupation pay premia for job placements suggests skill shortages. Table 8 summarises the indicators alongside their corresponding threshold values for an occupation to be considered in short supply.

Table 8: Skill shortages indicators and thresholds

Indicator	Threshold type	Threshold value
% change in unemployment by sought occupation	Median plus 50%	-4.2%
% change in formal employment	Top Quartile (75)	4.6%
% change in proportion of formal workers in job less than a year (new hires)	Median plus 50%	6.9%
% change in hours worked of formal employees	Top Quartile (75)	1.1%

% change in job vacancies advertisements by occupation	Median plus 50%	6.1%
% change in median hourly (real) pay for formal employees	Median plus 50%	7.4%
Relative premium to an occupation, controlling for region and age	Median plus 50%	2.8%
Relative vacancy premium to an occupation, controlling for region and experience	Top Quartile (75)	12.0%

Source: Vacancy database and GEIH. Own calculations.

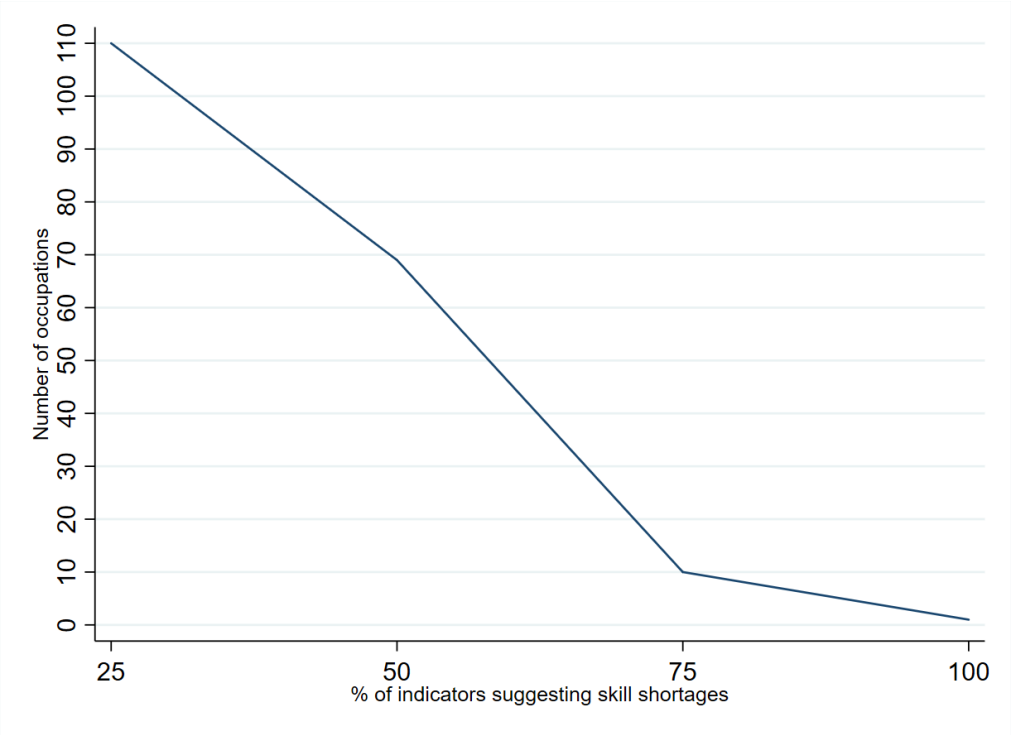
Once the measurement methods and thresholds have been established, the next step is to determine when an occupation shows strong signs of skills mismatch. As mentioned before, there is not an indicator that satisfactory identifies every skill shortage. Instead, it would be excessively restrictive to expect that occupations in short supply will be identified by every indicator.

Figure 17 shows the number of occupations according to the percentage of indicators that suggest skill shortages. For instance, in 110 occupations 25% or more indicators suggest skill shortages, while in 69 groups, at least, 50% of the indicators suggest mismatch issues. Figure 17 helps to determine when an occupation shows strong signs of skills mismatch. As can be seen, for a relatively high number of occupations half of the indices show signs of skill mismatch (69 categories). However, it is ambiguous to consider an occupation in skill mismatch when 50% of its indicators suggest skill shortages as the remaining 50% do not. Moreover, the number of occupations with more than half their indicators signalling skills shortages is considerably lower. This result indicates that thresholds above 50% might be adequate to distinguish skill mismatch occupations from other groups.

Nevertheless, in only 10 of the occupational categories, 75% or more indicators suggest skill shortages. Consequently, a threshold of 75% or more is excessively restrictive to classify occupations as exhibiting skill mismatch. Thus, to determine whether an occupation has shown enough evidence to be considered in short supply, this paper suggests accepting a skill shortage if more than 50% of an occupation's indicators exhibit no missing values[20]. The MAC (2008) uses a similar condition to determine skill shortages in the UK.

[20] For some occupations the data were only available for a subset of indicators.

Figure 17: Number of occupations according to the percentage of indicators that suggest skill shortages



Source: Vacancy database and GEIH 2016 - 2018. Own calculations.

3.5. Skill shortages in the Colombian labour market

Table 9 lists the occupations which exhibit a strong sign of skill shortages. According to this table, 30 occupations are currently in short supply: 46.7% of categories belong to high-skilled occupations, 36.6% to medium-skilled occupations, and 16.7% to low-skilled occupations. This evidence suggests that formal labour market opportunities exist for people at all skill levels.

"Web and multimedia developers", "Financial and investment advisers", and "Management and organization analysts" are occupations with the strongest signs of skill mismatch. It is important to note that occupations related to data, networks and web professionals show clear shortage signs. These results confirm what has been said in Cárdenas (2020a), that labour market changes and new occupations might emerge; cases of occupation related to Big Data technologies (Machine learning engineers, Data sciences, Big data engineers, among others) are representative examples.

The results from Table 9 strongly evidence that formal jobs have the best opportunities to absorb labour supply. Important information for the Colombian government, for educational and training providers, and for people in general in order to make policy decisions, provide training and find employment. Consequently, based on the labour supply and demand model, to tackle informality and unemployment rates, it is necessary to inform informal and unemployed people that jobs in certain occupations (see Table 9) offer the best chance to participate in the formal labour market, and to train people for these jobs. By considering people's characteristics and skill shortages, policymakers can design more precise public policies (e.g. routes of employment). For instance, given an informal or unemployed person's occupation, it is possible to know which is/are the most similar job(s) to that person's current occupation where there is/are skill shortages. Based on this information, a person might decide to start applying for such jobs or (if necessary) to train and obtain the corresponding certification to apply for jobs experiencing skill shortages.

Table 9: Occupations in skill mismatch

Code	ISCO titles	Total indicators available	Total indicators passed	Percentage indicators passed
2513	Web and multimedia developers	8	8	100.0%
2412	Financial and investment advisers	8	7	87.5%
2421	Management and organization analysts	8	7	87.5%
2529	Database and network professionals not elsewhere classified	8	6	75.0%
7234	Bicycle and related repairers	8	6	75.0%
8154	Bleaching, dyeing and fabric cleaning machine operators	8	6	75.0%
2521	Database designers and administrators	8	6	75.0%
7413	Electrical line installers and repairers	8	6	75.0%
2423	Personnel and careers professionals	8	6	75.0%
3118	Draughtspersons	8	6	75.0%
5113	Travel guides	7	5	71.4%
3432	Interior designers and decorators	7	5	71.4%
4313	Payroll clerks	7	5	71.4%
4221	Travel consultants and clerks	7	5	71.4%
4322	Production clerks	8	5	62.5%

5132	Bartenders	8	5	62.5%
4419	Clerical support workers not elsewhere classified	8	5	62.5%
2152	Electronics engineers	8	5	62.5%
8155	Fur and leather preparing machine operators	8	5	62.5%
5141	Hairdressers	8	5	62.5%
3259	Health associate professionals not elsewhere classified	8	5	62.5%
3141	Life science technicians (excluding medical)	8	5	62.5%
8321	Motorcycle drivers	8	5	62.5%
7314	Potters and related workers	8	5	62.5%
7214	Structural-metal preparers and erectors	8	5	62.5%
5312	Teachers' aides	8	5	62.5%
5112	Transport conductors	8	5	62.5%
2631	Economists	8	5	62.5%
2622	Librarians and related information professionals	8	5	62.5%
1342	Health services managers	7	4	57.1%

Source: Vacancy database and GEIH 2016 - 2018. Own calculations.

4. Detailed information about occupations and skill matching

The above section showed that by combining supply (GEIH) and labour demand (vacancy) information, it is possible to describe the structure and dynamics of the Colombian labour market and find convincing signs of skill mismatch issues. However, the advantage of online job portal information is not limited to the provision of skill mismatch (macro) indicators. Vacancy information provides detailed and updated information regarding employers' requirements. Specifically, vacancy information provides detailed information about the job requirements and, hence, this data might function as a way to observe and reduce imperfect information regarding a country's skill needs. By monitoring relevant skills by occupations, the Colombian government and education and training providers might deliver to individuals the proper skills demanded by employers (Cárdenas, 2020a). Moreover, people can make an informed decision regarding their career path. This section presents how detailed vacancy information might serve as a tool to improve labour market skill matching.

4.1. Skills

As demonstrated by Cárdenas (2020c), job descriptions for vacancies provide a rich source of information to analyse what skills are demanded by employers. However, it is important to clarify that employers do not provide a full list of skills needed for a specific occupation in each job vacancy description. First, to provide a complete list of skills required for each vacancy would be a time-consuming task. Second, job descriptions tend to be concise and precise to capture the attention of job applicants. Thus, employers provide the requirements that they consider to be the most essential ones for job applicants in vacancy descriptions. Alternatively, employers might mention in the job description skills that are not easily found in job candidates. In both cases, the job vacancy description is a source that can be used to identify the most important skills in demand for particular occupation, and the candidate who possesses those key skills will have better chances to obtain a job.

Consequently, skills analysis might reveal the key skills an individual needs to apply for a certain job. Importantly, together with macro indicators, job vacancy information can show which occupations are in short in supply and the key skills required to apply for those occupations. For instance, Table 10 shows five illustrative examples of occupations with skill shortages and what skills are frequently demanded for those occupations[21]. As can be observed, the skill most demanded for "Web and multimedia developers" is SQL (Structured Query Language), followed by database (according to ESCO skill definitions, database is "The classification of databases, that includes their purpose, characteristics, terminology, models and use such as XML databases, document-oriented databases and full text databases"), and JavaScript (the programming language of HTML and the web).

As mentioned by Cárdenas (2020a), technical skills are an important element for labour market matching. However, there are other types of skills (e.g. socio-emotional) that play a critical role in the matching process. With the information available from the vacancy data, it is possible to determine the most mentioned transversal skills. For instance, for "Web and multimedia developers" and "Draughtspersons" the most requested skills are for English knowledge and for a person who can work in teams. Moreover, in some cases (such as "Production clerks")

[21] Given the quantity of the information and occupational categories, this subsection focuses on some illustrative cases.

transversal skills such English, work in teams and communication, are the most, or one of the most, frequent skills requested by employers.

Consequently, in general, the vacancy data provides important sector-specific, cross-specific and transversal skills information. However, in some cases (e.g. “Travel guides” or “Bicycle and related repairers”), job portal information provides a limited number of demanded skills. Due to the lack of sufficient observations, it is not possible obtain a more comprehensive skill list for specific occupations.

With the information in Table 10, policymakers can design and induce training and educational programs that provide (at the very least) the skills most frequently demanded by employers. Likewise, with this information educational and training providers can update their curricula according to labour market needs. Furthermore, job seekers can make informed and better decisions in training and job search processes.

Table 10: Skills most demanded for the occupations in skill mismatch

ISCO title	Skill title	Skill type	Skill reusability level
Web and multimedia developers	SQL	knowledge	sector-specific
Web and multimedia developers	database	knowledge	cross-sector
Web and multimedia developers	JavaScript	knowledge	sector-specific
Web and multimedia developers	communication	knowledge	cross-sector
Web and multimedia developers	PHP	knowledge	sector-specific
Web and multimedia developers	web programming	knowledge	sector-specific
Web and multimedia developers	MySQL	knowledge	sector-specific
Web and multimedia developers	telecommunications engineering	knowledge	cross-sector
Web and multimedia developers	English	knowledge	transversal
Web and multimedia developers	work in teams	skill/competence	transversal
Web and multimedia developers	logic	knowledge	cross-sector
Web and multimedia developers	Visual Studio .NET	knowledge	sector-specific
Web and multimedia developers	LESS	knowledge	sector-specific

Web and multimedia developers	ASP.NET	knowledge	sector-specific
Web and multimedia developers	WordPress	knowledge	sector-specific
Web and multimedia developers	telecommunication industry	knowledge	cross-sector
Web and multimedia developers	financial engineering	knowledge	cross-sector
Web and multimedia developers	web analytics	knowledge	cross-sector
Web and multimedia developers	Sass	knowledge	sector-specific
Web and multimedia developers	design process	skill/competence	cross-sector
Web and multimedia developers	customer insight	knowledge	sector-specific
Web and multimedia developers	Spanish	knowledge	transversal
Web and multimedia developers	Drupal	knowledge	sector-specific
Web and multimedia developers	solution deployment	knowledge	sector-specific
Web and multimedia developers	control systems	knowledge	cross-sector
Web and multimedia developers	computer programming	knowledge	transversal
Web and multimedia developers	Oracle WebLogic	knowledge	sector-specific
Web and multimedia developers	business analysis	knowledge	cross-sector
Web and multimedia developers	ICT system integration	knowledge	sector-specific
Web and multimedia developers	Java (computer programming)	knowledge	sector-specific
Web and multimedia developers	create an act	skill/competence	sector-specific
Web and multimedia developers	business model	knowledge	occupation-specific
Web and multimedia developers	data warehouse	knowledge	occupation-specific
Web and multimedia developers	e-learning	knowledge	sector-specific
Web and multimedia developers	DB2	knowledge	sector-specific
Web and multimedia developers	office equipment	knowledge	sector-specific
Web and multimedia developers	information architecture	knowledge	sector-specific

Web and multimedia developers	maintain equipment	skill/competence	cross-sector
Web and multimedia developers	design principles	knowledge	cross-sector
Web and multimedia developers	Xcode	knowledge	sector-specific
Web and multimedia developers	analyse information processes	skill/competence	occupation-specific
Web and multimedia developers	Cisco	knowledge	sector-specific
Web and multimedia developers	create model	skill/competence	occupation-specific
Web and multimedia developers	create base for products	skill/competence	occupation-specific
Web and multimedia developers	engineering principles	knowledge	cross-sector
Web and multimedia developers	electrical engineering	knowledge	cross-sector
Web and multimedia developers	office administration	knowledge	sector-specific
Web and multimedia developers	object-oriented modelling	knowledge	sector-specific
Web and multimedia developers	assess ICT knowledge	skill/competence	sector-specific
Web and multimedia developers	search engines	knowledge	sector-specific
Web and multimedia developers	innovation processes	knowledge	sector-specific
Web and multimedia developers	Microsoft Access	knowledge	sector-specific
Web and multimedia developers	create solutions to problems	skill/competence	cross-sector
Web and multimedia developers	systems development life-cycle	knowledge	cross-sector
Web and multimedia developers	algorithms	knowledge	cross-sector
Web and multimedia developers	Information extraction	knowledge	sector-specific
Web and multimedia developers	screen clients	skill/competence	cross-sector
Web and multimedia developers	create software design	skill/competence	sector-specific
Web and multimedia developers	perform business analysis	skill/competence	cross-sector
Web and multimedia developers	electromechanics	knowledge	cross-sector
Web and multimedia developers	data mining	knowledge	sector-specific

Web and multimedia developers	financial statements	knowledge	cross-sector
Web and multimedia developers	maintain database	skill/competence	cross-sector
Web and multimedia developers	sales activities	knowledge	sector-specific
Web and multimedia developers	assess customers	skill/competence	sector-specific
Web and multimedia developers	Portuguese	knowledge	transversal
Web and multimedia developers	ICT quality policy	knowledge	sector-specific
Web and multimedia developers	information structure	knowledge	sector-specific
Web and multimedia developers	write English	skill/competence	transversal
Web and multimedia developers	perform data analysis	skill/competence	cross-sector
Web and multimedia developers	SQL Server Integration Services	knowledge	sector-specific
Web and multimedia developers	Apache Tomcat	knowledge	sector-specific
Web and multimedia developers	perform system analysis	skill/competence	occupation-specific
Web and multimedia developers	photography	knowledge	cross-sector
Web and multimedia developers	show responsibility	skill/competence	cross-sector
Web and multimedia developers	develop new products	skill/competence	sector-specific
Web and multimedia developers	carry out sales analysis	skill/competence	sector-specific
Web and multimedia developers	Adobe Photoshop	knowledge	sector-specific
Web and multimedia developers	Lead a team	skill/competence	cross-sector
Web and multimedia developers	assess object condition	skill/competence	sector-specific
Draughtspersons	design drawings	knowledge	cross-sector
Draughtspersons	communication	knowledge	cross-sector
Draughtspersons	design process	skill/competence	cross-sector
Draughtspersons	customer service	knowledge	sector-specific
Draughtspersons	office equipment	knowledge	sector-specific
Draughtspersons	customer insight	knowledge	sector-specific
Draughtspersons	work in teams	skill/competence	transversal
Draughtspersons	English	knowledge	transversal
Draughtspersons	trademarks	knowledge	cross-sector

Draughtspersons	Adobe Photoshop	knowledge	sector-specific
Draughtspersons	information architecture	knowledge	sector-specific
Draughtspersons	Spanish	knowledge	transversal
Draughtspersons	technical drawings	knowledge	cross-sector
Draughtspersons	carpentry	knowledge	cross-sector
Draughtspersons	give advice to others	skill/competence	transversal
Draughtspersons	material mechanics	knowledge	cross-sector
Draughtspersons	entertainment industry	knowledge	occupation-specific
Draughtspersons	show responsibility	skill/competence	cross-sector
Draughtspersons	geometry	knowledge	cross-sector
Draughtspersons	innovation processes	knowledge	sector-specific
Draughtspersons	Adobe Illustrator	knowledge	sector-specific
Draughtspersons	manage ICT project	skill/competence	sector-specific
Draughtspersons	lead a team	skill/competence	cross-sector
Draughtspersons	monitor activities	skill/competence	cross-sector
Draughtspersons	industrial software	knowledge	cross-sector
Draughtspersons	instrumentation equipment	knowledge	cross-sector
Draughtspersons	engineering principles	knowledge	cross-sector
Draughtspersons	principles of mechanical engineering	knowledge	cross-sector
Draughtspersons	design principles	knowledge	cross-sector
Draughtspersons	algebra	knowledge	cross-sector
Draughtspersons	maintenance and repair	knowledge	cross-sector
Draughtspersons	manage personnel	skill/competence	cross-sector
Draughtspersons	production processes	knowledge	cross-sector
Draughtspersons	geographic information systems	knowledge	sector-specific
Draughtspersons	digital printing	knowledge	sector-specific
Draughtspersons	create model	skill/competence	occupation-specific
Draughtspersons	create floor plan template	skill/competence	sector-specific
Draughtspersons	publishing industry	knowledge	cross-sector
Draughtspersons	food engineering	knowledge	sector-specific
Draughtspersons	bridge engineering	knowledge	sector-specific
Draughtspersons	Visual Studio .NET	knowledge	sector-specific
Draughtspersons	develop new products	skill/competence	sector-specific
Draughtspersons	mathematics	knowledge	cross-sector

Draughtspersons	design job analysis tools	skill/competence	occupation-specific
Draughtspersons	information structure	knowledge	sector-specific
Travel guides	customer service	knowledge	sector-specific
Travel guides	English	knowledge	transversal
Travel guides	Portuguese	knowledge	transversal
Bicycle and related repairers	customer service	knowledge	sector-specific
Bicycle and related repairers	maintenance and repair	knowledge	cross-sector
Production clerks	work in teams	skill/competence	transversal
Production clerks	English	knowledge	transversal
Production clerks	customer insight	knowledge	sector-specific
Production clerks	textile industry	knowledge	cross-sector
Production clerks	office equipment	knowledge	sector-specific
Production clerks	customer service	knowledge	sector-specific
Production clerks	characteristics of products	knowledge	sector-specific
Production clerks	communication	knowledge	cross-sector
Production clerks	production processes	knowledge	cross-sector
Production clerks	medicines	knowledge	cross-sector
Production clerks	maintain equipment	skill/competence	cross-sector
Production clerks	pharmaceutical products	knowledge	sector-specific
Production clerks	maintain machinery	skill/competence	cross-sector
Production clerks	chemical products	knowledge	sector-specific
Production clerks	construction products	knowledge	sector-specific
Production clerks	e-learning	knowledge	sector-specific
Production clerks	mechanical tools	knowledge	cross-sector
Production clerks	inspect quality of products	skill/competence	cross-sector
Production clerks	maintenance and repair	knowledge	cross-sector
Production clerks	footwear industry	knowledge	cross-sector
Production clerks	machinery products	knowledge	sector-specific
Production clerks	grade foods	skill/competence	occupation-specific
Production clerks	trademarks	knowledge	cross-sector
Production clerks	ICT quality policy	knowledge	sector-specific
Production clerks	perform business analysis	skill/competence	cross-sector
Production clerks	flexography	knowledge	sector-specific
Production clerks	data warehouse	knowledge	occupation-specific
Production clerks	sales activities	knowledge	sector-specific

Production clerks	give instructions to staff	skill/competence	cross-sector
Production clerks	digital printing	knowledge	sector-specific
Production clerks	exercise stewardship	skill/competence	cross-sector
Production clerks	good manufacturing practices	knowledge	sector-specific
Production clerks	dairy products	knowledge	sector-specific
Production clerks	financial engineering	knowledge	cross-sector
Production clerks	milk production process	knowledge	sector-specific
Production clerks	mathematics	knowledge	cross-sector
Production clerks	implement instructions	skill/competence	cross-sector
Production clerks	carry out products preparation	skill/competence	sector-specific
Production clerks	integrate ICT data	skill/competence	sector-specific
Production clerks	design process	skill/competence	cross-sector
Production clerks	identify customer requirements	skill/competence	cross-sector
Production clerks	collect samples	skill/competence	sector-specific
Production clerks	check the production schedule	skill/competence	sector-specific
Production clerks	ICT security standards	knowledge	sector-specific
Production clerks	guarantee customer satisfaction	skill/competence	sector-specific
Production clerks	perform system analysis	skill/competence	occupation-specific
Production clerks	manipulate wood	skill/competence	cross-sector
Production clerks	audit techniques	knowledge	cross-sector
Production clerks	ensure information security	skill/competence	cross-sector
Production clerks	animal food products	knowledge	sector-specific
Production clerks	manage quality	skill/competence	transversal
Production clerks	manage system security	skill/competence	sector-specific
Production clerks	good laboratory practice	knowledge	cross-sector
Production clerks	perform interviews	skill/competence	cross-sector
Production clerks	operate video equipment	skill/competence	cross-sector
Production clerks	liaise with government officials	skill/competence	cross-sector
Production clerks	comply with schedule	skill/competence	cross-sector
Production clerks	label foodstuffs	skill/competence	sector-specific
Production clerks	compose condition reports	skill/competence	sector-specific

Production clerks	weigh materials	skill/competence	sector-specific
Production clerks	water pressure	knowledge	cross-sector
Production clerks	database	knowledge	cross-sector
Production clerks	present a cause	skill/competence	sector-specific
Production clerks	order products	skill/competence	sector-specific
Production clerks	upsell products	skill/competence	cross-sector
Production clerks	develop new products	skill/competence	sector-specific

Source: Vacancy database and GEIH 2016 - 2018. Own calculations.

4.2. Skill trends

The results from Table 10 are essential to improve labour market skill matching. However, the utilisation of skills might vary over time. Especially, given rapid labour market changes (such as technological changes), some attributes might become more/less relevant than others to obtain a job. Increases in the demand for a particular skill for an occupation mean that employers consider that characteristic more critical than others, or they are unable to find people with those requirements. Thus, to analyse skill trends means identifying among the skills being demanded the ones that are becoming more/less important for the labour market.

For illustrative purposes, Table 11 shows skills in demand with a positive trend for "Web and multimedia developers" from 2016 to 2018. Skills such as object-oriented modelling, create software design, Apache Tomcat, among other skills, exhibit a positive trend. Thus, particular emphasis must be placed on providing those skills to "Web and multimedia developers". Moreover, the results from Table 11 can be extended to other occupations. Consequently, the Colombian system of education and training—for example, career advisers, among others—can eventually improve the efficiency of addressing labour supply according to labour demand trends.

Table 11: Skills with a positive trend for web and multimedia developers

Skill title	Skill type	Skill reusability level
Object-oriented modelling	knowledge	sector-specific
Create software design	skill/competence	sector-specific
Apache Tomcat	knowledge	sector-specific
Perform data analysis	skill/competence	cross-sector
Lead a team	skill/competence	cross-sector
Develop new products	skill/competence	sector-specific
Systems development life-cycle	knowledge	cross-sector
Perform system analysis	skill/competence	occupation-specific
Assess customers	skill/competence	sector-specific
ICT system integration	knowledge	sector-specific

Maintain database	skill/competence	cross-sector
ICT system integration	knowledge	sector-specific
Information extraction	knowledge	sector-specific

Source: Vacancy database and GEIH 2016 - 2018. Own calculations.

5. Conclusions

Unemployment and informality are widespread phenomena in the Colombian economy that affect people with different profiles. For instance, informality issues tend to be more prevalent in adults with a high school education (at most) that work in low-skilled occupations, while unemployment problem occurs with relatively more in people younger than 29-years-old, that work in low- or high-skilled occupations. Furthermore, the considerable gap in the average wages of formal and informal workers by skill level indicates that informal workers and those who are unemployed (regardless of skill level) have incentives to join the formal economy. Thus, the Colombian labour market shows potential signals of skill mismatches at each skill level. However, low-skilled occupations tend to show more signs of oversupply: 1) a considerably higher informality rate compared to other skill groups; 2) a high unemployment rate (slightly below than the high-skilled unemployment rate). Consequently, skill shortages might be more frequent in medium- and high-skilled occupations.

Despite the high incidence of these phenomena, Colombia does not have a proper system (macro indicators and monitoring skills) to reduce imperfect information issues by identifying possible skill shortages. Thus, this paper has demonstrated that a system for the identification of skill mismatch based on online vacancy information and household surveys can be developed in countries such as Colombia.

Despite the relatively short period covered by the data, a Colombian Beveridge curve by occupational group was estimated from 2016 to 2018. This curve provides a macroeconomic context and indicates two facts: 1) the first quarter of the year for each occupation is characterised by higher unemployment rates and lower vacancy rates, while in the last quarter of the year is characterised by lower unemployment rates and higher vacancy rates; 2) on average, the labour market for “Clerical support workers”, “Professionals”, and “Technicians and associate professionals”, has higher mismatches.

Moreover, the vacancy database, along with household surveys, can provide updated and precise indicators for the identification of skill shortages. However, it is important to no note that “there is no one ‘best way’ to do it” (Bosworth, 1993). Indeed, different approaches can be

adapted from the literature (see Section 3). Given the relatively long experience of the MAC on designing skill mismatch indicators, and the vacancy and household survey information available for Colombia, this paper concludes that the MAC's indicators are a suitable framework the Colombian context.

One of the most relevant elements for the adaptation of the MAC's indicators to the Colombian context is the difference between the formal and the informal economy in Colombia. Increases in the level of employment might be due to increases in the numbers of informal workers. In this scenario, growth in the number of employees do not correspond to skill shortages. On the contrary, this outcome indicates that oversupply exists for a particular occupation. Thus, given the size of the informal economy in Colombia, skill indicators should be estimated by only considering formal workers.

The skill mismatch indicators for Colombia demonstrate that 30 occupations are currently in short supply. This list is composed of high-skilled occupations (46.7%), followed by medium- (36.6%) and low-skilled occupations (16.7%). Therefore, the evidence suggests that formal labour market opportunities exist for people with different profiles in terms of age, education and work experience, amongst others.

These results have a high relevancy for Colombia because they allow continuously and consistently monitoring skill shortages at relatively low cost and over a short time period. However, the scope of job vacancy information is not limited to the estimation and improvements of skill mismatch indicators at an occupational level: one of the greatest advantages of using job portal data for a system of skill mismatch identification is that these sources enable the analysis of skills demanded over time for a certain occupation. For instance, for "Web and multimedia developers", there is an increasing demand for object-oriented modelling, create software design, and Apache Tomcat, among other skills.

Based on these results, 1) policymakers and educational and training providers can promote and update policy/curriculums quickly, according to the current occupational labour demand structure and specific skills required; 2) the government and career advisers, among other related professionals, can design better routes to employment based on people's profiles and employers' requirements; 3) job seekers can receive relevant information regarding occupation shortages and, more importantly, the corresponding skills in demand. In this way, unemployed and informal people can make better and informed decisions about their training and job search processes.

In summary, vacancy information is a valuable resource that provides consistent and unique (unmet) labour demand data for a considerable set of non-agricultural, non-governmental, non-military and non-self-employed ("business owners") occupations in the urban and formal economy. With the systematic analysis of this information, economic agents can reduce unemployment and informality rates by taking informed and better decisions according to up-to-date labour market needs.

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Appendix A: Additional tables

Table A.1: Occupational distribution of the Colombian workers

#	ISCO title	Formal workers	ISCO title	Informal workers
1	Sales demonstrators	4.8%	Sales demonstrators	16.4%
2	Secondary education teachers	4.5%	Domestic cleaners and helpers	6.0%
3	Security guards	3.7%	Car, taxi and van drivers	6.0%
4	Cleaners and helpers in offices, hotels and other establishments	3.6%	Stall and market salespersons	3.7%
5	Car, taxi and van drivers	3.0%	Cleaners and helpers in offices, hotels and other establishments	3.3%
6	Stock clerks	2.0%	Cooks	2.9%
7	Health care assistants	1.9%	Commercial sales representatives	2.3%
8	Building and related electricians	1.8%	Bricklayers and related workers	2.1%
9	Accounting and bookkeeping clerks	1.7%	Child care workers	2.1%
10	Waiters	1.5%	Building and related electricians	1.9%
11	Welders and flamecutters	1.5%	Beauticians and related workers	1.9%
12	Primary school teachers	1.5%	Sewing machine operators	1.9%
13	Child care workers	1.5%	Services managers not elsewhere classified	1.8%
14	Sewing machine operators	1.4%	Shop keepers	1.8%
15	Mail carriers and sorting clerks	1.3%	Crop farm labourers	1.7%
16	Cooks	1.3%	Motorcycle drivers	1.6%
17	Cashiers and ticket clerks	1.3%	Motor vehicle mechanics and repairers	1.6%
18	Contact centre information clerks	1.1%	Construction supervisors	1.4%
19	Kitchen helpers	1.0%	Freight handlers	1.2%
20	Senior officials of special-interest organizations	1.0%	Waiters	1.2%
21	Lawyers	1.0%	Kitchen helpers	1.2%

22	Services managers not elsewhere classified	1.0%	Tailors, dressmakers, furriers and hatters	1.1%
23	Heavy truck and lorry drivers	1.0%	Painters and related workers	1.1%
24	Commercial sales representatives	1.0%	Heavy truck and lorry drivers	1.0%
25	Policy administration professionals	1.0%	Bakers, pastry-cooks and confectionery makers	0.9%
26	Police inspectors and detectives	0.9%	House builders	0.9%
27	Generalist medical practitioners	0.8%	Door to door salespersons	0.9%
28	Agricultural and industrial machinery mechanics and repairers	0.8%	Real estate agents and property managers	0.8%
29	Administrative and executive secretaries	0.8%	Security guards	0.7%
30	Office supervisors	0.8%	Shop sales assistants	0.7%
31	Human resource managers	0.7%	Cabinet-makers and related workers	0.7%
32	Financial and insurance services branch managers	0.7%	Fast food preparers	0.7%
33	Transport clerks	0.7%	Butchers, fishmongers and related food preparers	0.7%
34	Nursing professionals	0.7%	Hairdressers	0.7%
35	Supply, distribution and related managers	0.7%	Messengers, package deliverers and luggage porters	0.6%
36	House builders	0.6%	Shoemakers and related workers	0.6%
37	Physical and engineering science technicians not elsewhere classified	0.6%	Handicraft workers in textile, leather and related materials	0.6%
38	Retail and wholesale trade managers	0.6%	Welders and flamecutters	0.6%
39	Civil engineers	0.6%	Carpenters and joiners	0.6%
40	Freight handlers	0.6%	Gardeners, horticultural and nursery growers	0.6%
41	Shop sales assistants	0.6%	Mail carriers and sorting clerks	0.6%
42	Secretaries (general)	0.6%	Livestock and dairy producers	0.6%

43	Construction supervisors	0.6%	Food service counter attendants	0.5%
44	Graphic and multimedia designers	0.6%	Food and related products machine operators	0.5%
45	Butchers, fishmongers and related food preparers	0.6%	Retail and wholesale trade managers	0.5%
46	Bakers, pastry-cooks and confectionery makers	0.6%	Field crop and vegetable growers	0.4%
47	Systems analysts	0.6%	Stonemasons, stone cutters, splitters and carvers	0.4%
48	Motor vehicle mechanics and repairers	0.5%	Contact centre salespersons	0.4%
49	Crop farm labourers	0.5%	Mobile farm and forestry plant operators	0.4%
50	Bricklayers and related workers	0.5%	Miners and quarriers	0.4%
51	Crane, hoist and related plant operators	0.5%	Sewing, embroidery and related workers	0.4%
52	Messengers, package deliverers and luggage porters	0.5%	Hand launderers and pressers	0.4%
53	Information and communications technology installers and servicers	0.5%	Fruit, vegetable and related preservers	0.4%
54	Legal professionals not elsewhere classified	0.5%	Cashiers and ticket clerks	0.3%
55	Industrial and production engineers	0.5%	Database and network professionals not elsewhere classified	0.3%
56	Driving instructors	0.5%	Restaurant managers	0.3%
57	Psychologists	0.5%	Electrical mechanics and fitters	0.3%
58	Specialist medical practitioners	0.4%	Tree and shrub crop growers	0.3%
59	Real estate agents and property managers	0.4%	Bookmakers, croupiers and related gaming workers	0.3%
60	Musicians, singers and composers	0.4%	Building caretakers	0.3%

61	Teaching professionals not elsewhere classified	0.4%	Home-based personal care workers	0.3%
62	Business services agents not elsewhere classified	0.4%	Bartenders	0.3%
63	Accountants	0.4%	Stock clerks	0.2%
64	Electrical mechanics and fitters	0.4%	Senior officials of special-interest organizations	0.2%
65	Filing and copying clerks	0.4%	Packing, bottling and labelling machine operators	0.2%
66	Painters and related workers	0.4%	Sheet-metal workers	0.2%
67	University and higher education teachers	0.4%	Agricultural and industrial machinery mechanics and repairers	0.2%
68	Door to door salespersons	0.4%	Laundry machine operators	0.2%
69	Mathematicians, actuaries and statisticians	0.4%	Garbage and recycling collectors	0.2%
70	Securities and finance dealers and brokers	0.4%	Transport clerks	0.2%
71	Plastic products machine operators	0.4%	Other artistic and cultural associate professionals	0.2%
72	Other language teachers	0.3%	Manufacturing supervisors	0.2%
73	Packing, bottling and labelling machine operators	0.3%	Fumigators and other pest and weed controllers	0.2%
74	Insurance representatives	0.3%	Spray painters and varnishers	0.2%
75	Paper products machine operators	0.3%	Potters and related workers	0.2%
76	Building architects	0.3%	Street vendors (excluding food)	0.2%
77	Civil engineering technicians	0.3%	Accounting and bookkeeping clerks	0.2%
78	Dentists	0.3%	Buyers	0.2%
79	Receptionists (general)	0.3%	Jewellery and precious-metal workers	0.2%
80	Religious professionals	0.3%	Product and garment designers	0.2%
81	Sales and marketing managers	0.3%	Shoemaking and related machine operators	0.2%
82	Buyers	0.3%	Street food salespersons	0.2%

83	Manufacturing managers	0.3%	Assemblers not elsewhere classified	0.1%
84	Food and related products machine operators	0.3%	Refuse sorters	0.1%
85	Social work and counselling professionals	0.3%	Upholsterers and related workers	0.1%
86	Restaurant managers	0.3%	Civil engineers	0.1%
87	Construction managers	0.3%	Credit and loans officers	0.1%
88	Environmental and occupational health inspectors and associates	0.3%	Teachers' aides	0.1%
89	Electrical engineers	0.3%	Toolmakers and related workers	0.1%
90	Carpenters and joiners	0.3%	Translators, interpreters and other linguists	0.1%
91	Information and communications technology sales professionals	0.3%	Administrative and executive secretaries	0.1%
92	Translators, interpreters and other linguists	0.3%	Garment and related pattern-makers and cutters	0.1%
93	Bus and tram drivers	0.3%	Policy administration professionals	0.1%
94	Pharmaceutical technicians and assistants	0.3%	Glass and ceramics plant operators	0.1%
95	Beauticians and related workers	0.3%	Information and communications technology installers and servicers	0.1%
96	Police officers	0.3%	Aquaculture workers	0.1%
97	Cabinet-makers and related workers	0.2%	Civil engineering technicians	0.1%
98	Gardeners, horticultural and nursery growers	0.2%	Physical and engineering science technicians not elsewhere classified	0.1%
99	Electrical engineering technicians	0.2%	Bus and tram drivers	0.1%
100	Advertising and marketing professionals	0.2%	Crane, hoist and related plant operators	0.1%

101	Statistical, finance and insurance clerks	0.2%	Electronics mechanics and servicers	0.1%
102	Meter readers and vending-machine collectors	0.2%	Building construction labourers	0.1%
103	Stall and market salespersons	0.2%	Secretaries (general)	0.1%
104	Glass and ceramics plant operators	0.2%	Poultry producers	0.1%
105	Manufacturing supervisors	0.2%	Pawnbrokers and money-lenders	0.1%
106	Enquiry clerks	0.2%	Pet groomers and animal care workers	0.1%
107	Financial analysts	0.2%	Primary school teachers	0.1%
108	Information and communications technology user support technicians	0.2%	Secondary education teachers	0.1%
109	Other artistic and cultural associate professionals	0.2%	Dairy-products makers	0.1%
110	Personal care workers in health services not elsewhere classified	0.2%	Vehicle cleaners	0.1%
111	Broadcasting and audio-visual technicians	0.2%	Sales workers not elsewhere classified	0.1%
112	Food service counter attendants	0.2%	Personal care workers in health services not elsewhere classified	0.1%
113	Biologists, botanists, zoologists and related professionals	0.2%	Health care assistants	0.1%
114	Telecommunications engineers	0.2%	Debt-collectors and related workers	0.1%
115	Toolmakers and related workers	0.2%	Handicraft workers in wood, basketry and related materials	0.1%
116	Chefs	0.2%	Bicycle and related repairers	0.1%
117	Early childhood educators	0.2%	Clearing and forwarding agents	0.1%
118	Information and communications technology service managers	0.2%	Companions and valets	0.1%

119	Bank tellers and related clerks	0.2%	Biologists, botanists, zoologists and related professionals	0.1%
120	Fitness and recreation instructors and program leaders	0.2%	Air conditioning and refrigeration mechanics	0.1%
121	Assemblers not elsewhere classified	0.2%	Hotel receptionists	0.1%
122	Management and organization analysts	0.2%	Graphic and multimedia designers	0.1%
123	Photographers	0.2%	Dentists	0.1%
124	Armed forces occupations, other ranks	0.2%	Insurance representatives	0.1%
125	Electronics mechanics and servicers	0.2%	Livestock farm labourers	0.1%
126	Stonemasons, stone cutters, splitters and carvers	0.2%	Industrial and production engineers	0.1%
127	Physiotherapists	0.2%	Concrete placers, concrete finishers and related workers	0.1%
128	Shoemakers and related workers	0.2%	Business services agents not elsewhere classified	0.1%
129	Medical and pathology laboratory technicians	0.2%	Fishery and aquaculture labourers	0.1%
130	Archivists and curators	0.2%	Receptionists (general)	0.1%
131	Mechanical engineering technicians	0.2%	Fitness and recreation instructors and program leaders	0.1%
132	Fruit, vegetable and related preservers	0.2%	Broadcasting and audio-visual technicians	0.1%
133	Agricultural technicians	0.2%	Floor layers and tile setters	0.1%
134	Air conditioning and refrigeration mechanics	0.2%	Print finishing and binding workers	0.1%
135	Chemical and physical science technicians	0.2%	Chefs	0.1%
136	Shoemaking and related machine operators	0.2%	Medical and dental prosthetic technicians	0.1%

137	Engineering professionals not elsewhere classified	0.2%	Religious professionals	0.1%
138	Product and garment designers	0.2%	Sports coaches, instructors and officials	0.1%
139	Sports coaches, instructors and officials	0.2%	Paper products machine operators	0.1%
140	Sweepers and related labourers	0.2%	Supply, distribution and related managers	0.1%
141	Electronics engineers	0.2%	Printers	0.1%
142	Financial and investment advisers	0.2%	Lawyers	0.1%
143	Bartenders	0.2%	Plastic products machine operators	0.1%
144	Information and communications technology operations technicians	0.2%	Managing directors and chief executives	0.1%
145	Education methods specialists	0.2%	Bleaching, dyeing and fabric cleaning machine operators	0.1%
146	Electronics engineering technicians	0.2%	Drivers of animal-drawn vehicles and machinery	0.1%
147	Managing directors and chief executives	0.1%	Enquiry clerks	0.1%
148	Survey and market research interviewers	0.1%	Conference and event planners	0.1%
149	Legislators	0.1%	Advertising and marketing professionals	0.1%
150	Mechanical engineers	0.1%	Legal professionals not elsewhere classified	0.1%
151	Debt-collectors and related workers	0.1%	Lifting truck operators	0.1%
152	Building construction labourers	0.1%	Medical and pathology laboratory technicians	0.0%
153	Metal working machine tool setters and operators	0.1%	Electrical engineering technicians	0.0%
154	Journalists	0.1%	Metal working machine tool setters and operators	0.0%
155	Hand packers	0.1%	Electrical engineers	0.0%
156	Bookmakers, croupiers and	0.1%	Elementary workers not elsewhere classified	0.0%

	related gaming workers			
157	Building caretakers	0.1%	Musicians, singers and composers	0.0%
158	Payroll clerks	0.1%	Metal processing plant operators	0.0%
159	Personnel and careers professionals	0.1%	Manufacturing managers	0.0%
160	Database and network professionals not elsewhere classified	0.1%	Precision-instrument makers and repairers	0.0%
161	Plumbers and pipe fitters	0.1%	Pre-press technicians	0.0%
162	Fast food preparers	0.1%	Police inspectors and detectives	0.0%
163	Contact centre salespersons	0.1%	Hotel managers	0.0%
164	Miners and quarriers	0.1%	Mechanical engineering technicians	0.0%
165	Chemists	0.1%	Forestry and related workers	0.0%
166	Special needs teachers	0.1%	Photographers	0.0%
167	Earthmoving and related plant operators	0.1%	Agricultural and forestry production managers	0.0%
168	Fumigators and other pest and weed controllers	0.1%	Armed forces occupations, other ranks	0.0%
169	Technical and medical sales professionals (excluding ICT)	0.1%	Meteorologists	0.0%
170	Hand launderers and pressers	0.1%	Sales and marketing managers	0.0%
171	Veterinarians	0.1%	Generalist medical practitioners	0.0%
172	Hotel receptionists	0.1%	Driving instructors	0.0%
173	Accounting associate professionals	0.1%	Personal services workers not elsewhere classified	0.0%
174	Health services managers	0.1%	Tobacco preparers and tobacco products makers	0.0%
175	Teachers' aides	0.1%	Veterinarians	0.0%
176	Personal services workers not elsewhere classified	0.1%	Construction managers	0.0%

177	Finance managers	0.1%	Technical and medical sales professionals (excluding ICT)	0.0%
178	Hairdressers	0.1%	Weaving and knitting machine operators	0.0%
179	Bleaching, dyeing and fabric cleaning machine operators	0.1%	Deep-sea fishery workers	0.0%
180	Telephone switchboard operators	0.1%	Financial and insurance services branch managers	0.0%
181	Librarians and related information professionals	0.1%	Mineral and stone processing plant operators	0.0%
182	Spray painters and varnishers	0.1%	Inland and coastal waters fishery workers	0.0%
183	Fire-fighters	0.1%	Structural-metal preparers and erectors	0.0%
184	Elementary workers not elsewhere classified	0.1%	Cement, stone and other mineral products machine operators	0.0%
185	Incinerator and water treatment plant operators	0.1%	Plumbers and pipe fitters	0.0%
186	Field crop and vegetable growers	0.1%	Chemical products plant and machine operators	0.0%
187	Garbage and recycling collectors	0.1%	Pharmaceutical technicians and assistants	0.0%
188	Telecommunications engineering technicians	0.1%	Sign writers, decorative painters, engravers and etchers	0.0%
189	Metal processing plant operators	0.1%	Telephone switchboard operators	0.0%
190	Home-based personal care workers	0.1%	Contact centre information clerks	0.0%
191	Database designers and administrators	0.1%	Specialist medical practitioners	0.0%
192	Cartographers and surveyors	0.1%	Incinerator and water treatment plant operators	0.0%
193	Handicraft workers in textile, leather and related materials	0.1%	Wood processing plant operators	0.0%
194	Chemical engineering technicians	0.1%	Blacksmiths, hammersmiths and forging press workers	0.0%
195	Service station attendants	0.1%	Securities and finance dealers and brokers	0.0%

196	Travel consultants and clerks	0.1%	Steam engine and boiler operators	0.0%
197	Mining and metallurgical technicians	0.1%	Transport conductors	0.0%
198	Medical imaging and therapeutic equipment technicians	0.1%	Teaching professionals not elsewhere classified	0.0%
199	Social work associate professionals	0.1%	Other arts teachers	0.0%
200	Mining supervisors	0.1%	Metal polishers, wheel grinders and tool sharpeners	0.0%
201	Structural-metal preparers and erectors	0.1%	Building architects	0.0%
202	Farming, forestry and fisheries advisers	0.1%	Aged care services managers	0.0%
203	Building frame and related trades workers not elsewhere classified	0.1%	Physiotherapy technicians and assistants	0.0%
204	Conference and event planners	0.1%	Fur and leather preparing machine operators	0.0%
205	Sheet-metal workers	0.1%	Metal finishing, plating and coating machine operators	0.0%
206	Upholsterers and related workers	0.1%	Sports, recreation and cultural centre managers	0.0%
207	Credit and loans officers	0.1%	Early childhood educators	0.0%
208	Precision-instrument makers and repairers	0.1%	Fire-fighters	0.0%
209	Judges	0.1%	Hand packers	0.0%
210	Print finishing and binding workers	0.1%	Travel guides	0.0%
211	Livestock and dairy producers	0.1%	Office supervisors	0.0%
212	Environmental engineers	0.1%	Service station attendants	0.0%
213	Garment and related pattern-makers and cutters	0.1%	Chemical and physical science technicians	0.0%
214	Mining engineers, metallurgists and	0.1%	Building frame and related trades workers not elsewhere classified	0.0%

	related professionals			
215	Authors and related writers	0.1%	Meter readers and vending-machine collectors	0.0%
216	Shop keepers	0.1%	Accountants	0.0%
217	Livestock farm labourers	0.1%	Agricultural technicians	0.0%
218	Draughtspersons	0.1%	Domestic housekeepers	0.0%
219	Non-commissioned armed forces officers	0.1%	Information and communications technology sales professionals	0.0%
220	Electrical line installers and repairers	0.1%	Nursing professionals	0.0%
221	Professional services managers not elsewhere classified	0.1%	Chemical engineers	0.0%
222	Pharmacists	0.1%	Chemists	0.0%
223	Jewellery and precious-metal workers	0.1%	Manufacturing labourers not elsewhere classified	0.0%
224	Aircraft pilots and related associate professionals	0.1%	Human resource managers	0.0%
225	Mineral and stone processing plant operators	0.1%	Electrical line installers and repairers	0.0%
226	Dental assistants and therapists	0.1%	Glaziers	0.0%
227	Client information workers not elsewhere classified	0.1%	Pharmacists	0.0%
228	Medical and dental prosthetic technicians	0.1%	Roofers	0.0%
229	Cleaning and housekeeping supervisors in offices, hotels and other establishments	0.1%	Social work and counselling professionals	0.0%
230	Vehicle cleaners	0.1%	Interior designers and decorators	0.0%
231	Civil engineering labourers	0.1%	Environmental and occupational health inspectors and associates	0.0%

232	Business services and administration managers not elsewhere classified	0.1%	Financial and investment advisers	0.0%
233	Chemical products plant and machine operators	0.1%	Fibre preparing, spinning and winding machine operators	0.0%
234	Economists	0.1%	Electronics engineering technicians	0.0%
235	Tailors, dressmakers, furriers and hatters	0.1%	Education methods specialists	0.0%
236	Education managers	0.0%	Textile, fur and leather products machine operators not elsewhere classified	0.0%
237	Pre-press technicians	0.0%	Civil engineering labourers	0.0%
238	Interior designers and decorators	0.0%	Street and related service workers	0.0%
239	Printers	0.0%	Social work associate professionals	0.0%
240	Health professionals not elsewhere classified	0.0%	Engineering professionals not elsewhere classified	0.0%
241	Chemical engineers	0.0%	Systems analysts	0.0%
242	Employment agents and contractors	0.0%	Travel consultants and clerks	0.0%
243	Commissioned armed forces officers	0.0%	Insulation workers	0.0%
244	Riggers and cable splicers	0.0%	Dispensing opticians	0.0%
245	Wood processing plant operators	0.0%	Mechanical engineers	0.0%
246	Poultry producers	0.0%	Forestry labourers	0.0%
247	Metal finishing, plating and coating machine operators	0.0%	Archivists and curators	0.0%
248	Aquaculture and fisheries production managers	0.0%	Glass makers, cutters, grinders and finishers	0.0%
249	Weaving and knitting machine operators	0.0%	Cleaning and housekeeping supervisors in offices, hotels and other establishments	0.0%
250	Floor layers and tile setters	0.0%	Plasterers	0.0%

251	Companions and valets	0.0%	Chemical engineering technicians	0.0%
252	Laundry machine operators	0.0%	Creative and performing artists not elsewhere classified	0.0%
253	Railway brake, signal and switch operators	0.0%	Aircraft pilots and related associate professionals	0.0%
254	Street vendors (excluding food)	0.0%	Cartographers and surveyors	0.0%
255	Environmental protection professionals	0.0%	Advertising and public relations managers	0.0%
256	Transport conductors	0.0%	Pelt dressers, tanners and fellmongers	0.0%
257	Announcers on radio, television and other media	0.0%	Payroll clerks	0.0%
258	Mobile farm and forestry plant operators	0.0%	Dental assistants and therapists	0.0%
259	Process control technicians not elsewhere classified	0.0%	Web and multimedia developers	0.0%
260	Aircraft engine mechanics and repairers	0.0%	Draughtspersons	0.0%
261	Library clerks	0.0%	Financial analysts	0.0%
262	Hotel managers	0.0%	Petroleum and natural gas refining plant operators	0.0%
263	Film, stage and related directors and producers	0.0%	Information and communications technology operations technicians	0.0%
264	Pet groomers and animal care workers	0.0%	Information and communications technology user support technicians	0.0%
265	Protective services workers not elsewhere classified	0.0%	Other language teachers	0.0%
266	Dieticians and nutritionists	0.0%	Musical instrument makers and tuners	0.0%
267	Other arts teachers	0.0%	Veterinary technicians and assistants	0.0%
268	Research and development managers	0.0%	Photographic products machine operators	0.0%

269	Garden and horticultural labourers	0.0%	Information and communications technology service managers	0.0%
270	Concrete placers, concrete finishers and related workers	0.0%	Filing and copying clerks	0.0%
271	Petroleum and natural gas refining plant operators	0.0%	Mechanical machinery assemblers	0.0%
272	Cement, stone and other mineral products machine operators	0.0%	Telecommunications engineering technicians	0.0%
273	Sociologists, anthropologists and related professionals	0.0%	Earthmoving and related plant operators	0.0%
274	Training and staff development professionals	0.0%	Rubber products machine operators	0.0%
275	Web and multimedia developers	0.0%	Journalists	0.0%
276	Refuse sorters	0.0%	University and higher education teachers	0.0%
277	Sewing, embroidery and related workers	0.0%	Electronics engineers	0.0%
278	Handicraft workers in wood, basketry and related materials	0.0%	Special needs teachers	0.0%
279	Travel attendants and travel stewards	0.0%	Aircraft engine mechanics and repairers	0.0%
280	Government tax and excise officials	0.0%	Telecommunications engineers	0.0%
281	Dairy-products makers	0.0%	Personnel and careers professionals	0.0%
282	Aged care services managers	0.0%	Client information workers not elsewhere classified	0.0%
283	Pawnbrokers and money-lenders	0.0%	Mining and metallurgical technicians	0.0%
284	Advertising and public relations managers	0.0%	Medical imaging and therapeutic equipment technicians	0.0%
285	Fibre preparing, spinning and winding machine operators	0.0%	Clerical support workers not elsewhere classified	0.0%

286	Sports, recreation and cultural centre managers	0.0%	Judges	0.0%
287	Dispensing opticians	0.0%	Optometrists and ophthalmic opticians	0.0%
288	Blacksmiths, hammersmiths and forging press workers	0.0%	Life science technicians (excluding medical)	0.0%
289	Vocational education teachers	0.0%	Railway brake, signal and switch operators	0.0%
290	Photographic products machine operators	0.0%	Craft and related workers not elsewhere classified	0.0%
291	Shop supervisors	0.0%	Business services and administration managers not elsewhere classified	0.0%
292	Manufacturing labourers not elsewhere classified	0.0%	Mixed crop and livestock farm labourers	0.0%
293	Well drillers and borers and related workers	0.0%	Physiotherapists	0.0%
294	Visual artists	0.0%	Survey and market research interviewers	0.0%
295	Personnel clerks	0.0%	Psychologists	0.0%
296	Computer network and systems technicians	0.0%	Religious associate professionals	0.0%
297	Life science technicians (excluding medical)	0.0%	Animal producers not elsewhere classified	0.0%
298	Software developers	0.0%	Ships' deck crews and related workers	0.0%
299	Data entry clerks	0.0%	Statistical, finance and insurance clerks	0.0%
300	Agricultural and forestry production managers	0.0%	Bank tellers and related clerks	0.0%
301	Craft and related workers not elsewhere classified	0.0%	Health professionals not elsewhere classified	0.0%
302	Production clerks	0.0%	Apiarists and sericulturists	0.0%
303	Lifting truck operators	0.0%	Ships' deck officers and pilots	0.0%
304	Textile, fur and leather products machine operators	0.0%	Aquaculture and fisheries production managers	0.0%

	not elsewhere classified			
305	Dancers and choreographers	0.0%	Ambulance workers	0.0%
306	Ships' deck officers and pilots	0.0%	Riggers and cable splicers	0.0%
307	Systems administrators	0.0%	Management and organization analysts	0.0%
308	Environmental and occupational health and hygiene professionals	0.0%	Protective services workers not elsewhere classified	0.0%
309	Motorcycle drivers	0.0%	Employment agents and contractors	0.0%
310	Musical instrument makers and tuners	0.0%	Building structure cleaners	0.0%
311	Potters and related workers	0.0%	Electrical and electronic equipment assemblers	0.0%
312	Optometrists and ophthalmic opticians	0.0%	Handicraft workers not elsewhere classified	0.0%
313	Public relations professionals	0.0%	Education managers	0.0%
314	Sign writers, decorative painters, engravers and etchers	0.0%	Announcers on radio, television and other media	0.0%
315	Geologists and geophysicists	0.0%	Personnel clerks	0.0%
316	Metal polishers, wheel grinders and tool sharpeners	0.0%	Legal secretaries	0.0%
317	Travel guides	0.0%	Environmental protection professionals	0.0%
318	Creative and performing artists not elsewhere classified	0.0%	Mathematicians, actuaries and statisticians	0.0%
319	Metal production process controllers	0.0%	Accounting associate professionals	0.0%
320	Insulation workers	0.0%	Garden and horticultural labourers	0.0%
321	Forestry and related workers	0.0%	Wood treaters	0.0%
322	Religious associate professionals	0.0%	Research and development managers	0.0%
323	Pulp and papermaking plant operators	0.0%	Finance managers	0.0%

324	Statistical, mathematical and related associate professionals	0.0%	Sweepers and related labourers	0.0%
325	Glass makers, cutters, grinders and finishers	0.0%	Other music teachers	0.0%
326	Child care services managers	0.0%	Authors and related writers	0.0%
327	Steam engine and boiler operators	0.0%	Mining engineers, metallurgists and related professionals	0.0%
328	Philosophers, historians and political scientists	0.0%	Data entry clerks	0.0%
329	Fur and leather preparing machine operators	0.0%	Commissioned armed forces officers	0.0%
330	Glaziers	0.0%	Chemical processing plant controllers	0.0%
331	Bicycle and related repairers	0.0%	Philosophers, historians and political scientists	0.0%
332	Mechanical machinery assemblers	0.0%	Database designers and administrators	0.0%
333	Domestic cleaners and helpers	0.0%	Health services managers	0.0%
334	Meteorologists	0.0%	Child care services managers	0.0%
335	Clerical support workers not elsewhere classified	0.0%	Sociologists, anthropologists and related professionals	0.0%
336	Rubber products machine operators	0.0%	Well drillers and borers and related workers	0.0%
337	Tobacco preparers and tobacco products makers	0.0%	Legislators	0.0%
338	Fishery and aquaculture labourers	0.0%	Environmental and occupational health and hygiene professionals	0.0%
339	Inland and coastal waters fishery workers	0.0%	Other cleaning workers	0.0%
340	Underwater divers	0.0%	Environmental engineers	0.0%
341	Mining managers	0.0%	Professional services managers not elsewhere classified	0.0%
342	Computer network professionals	0.0%	Government tax and excise officials	0.0%

343	Sales workers not elsewhere classified	0.0%	Shop supervisors	0.0%
344	Health associate professionals not elsewhere classified	0.0%	Librarians and related information professionals	0.0%
345	Roofers	0.0%	Film, stage and related directors and producers	0.0%
346	Stationary plant and machine operators not elsewhere classified	0.0%	Training and staff development professionals	0.0%
347	Physiotherapy technicians and assistants	0.0%	Systems administrators	0.0%
348	General office clerks	0.0%	Mixed crop and animal producers	0.0%
349	Clearing and forwarding agents	0.0%	Ships' engineers	0.0%
350	Domestic housekeepers	0.0%	Window cleaners	0.0%
351	Other music teachers	0.0%	Farming, forestry and fisheries advisers	0.0%
352	Pelt dressers, tanners and fellmongers	0.0%	Medical secretaries	0.0%
353	Ships' deck crews and related workers	0.0%	Economists	0.0%
354	Plasterers	0.0%	Mining supervisors	0.0%
355	Legal secretaries	0.0%	Pulp and papermaking plant operators	0.0%
356	Veterinary technicians and assistants	0.0%	Metal moulders and coremakers	0.0%
357	Aquaculture workers	0.0%	Actors	0.0%
358	Air traffic controllers	0.0%	Public relations professionals	0.0%
359	Street food salespersons	0.0%	Social welfare managers	0.0%
360	Undertakers and embalmers	0.0%	Process control technicians not elsewhere classified	0.0%
361	Street and related service workers	0.0%	Health associate professionals not elsewhere classified	0.0%
362	Software and applications developers and analysts not elsewhere classified	0.0%	Stationary plant and machine operators not elsewhere classified	0.0%

363	Electrical and electronic equipment assemblers	0.0%	Astrologers, fortune-tellers and related workers	0.0%
364	Forestry labourers	0.0%	Production clerks	0.0%
365	Locomotive engine drivers	0.0%	Library clerks	0.0%
366	Chemical processing plant controllers	0.0%	Underwater divers	0.0%
367	Forestry technicians	0.0%	Statistical, mathematical and related associate professionals	0.0%
368	Drivers of animal-drawn vehicles and machinery	0.0%	Trade brokers	0.0%
369	Information technology trainers	0.0%	Visual artists	0.0%
370	Tree and shrub crop growers	0.0%	Travel attendants and travel stewards	0.0%
371	Ships' engineers	0.0%	Dancers and choreographers	0.0%
372	Metal moulders and coremakers	0.0%	Vocational education teachers	0.0%
373	Actors	0.0%	Police officers	0.0%
374	Air traffic safety electronics technicians	0.0%	Software developers	0.0%
375	Building structure cleaners	0.0%	Undertakers and embalmers	0.0%
376	Ambulance workers	0.0%	Regulatory government associate professionals not elsewhere classified	0.0%
377	Customs and border inspectors	0.0%	Typists and word processing operators	0.0%
378	Animal producers not elsewhere classified	0.0%	Web technicians	0.0%
379	Coding, proof-reading and related clerks	0.0%	Computer network and systems technicians	0.0%
380	Other cleaning workers	0.0%	Metal production process controllers	0.0%
381	Deep-sea fishery workers	0.0%	Town and traffic planners	0.0%
382	Government licensing officials	0.0%	Geologists and geophysicists	0.0%
383	Web technicians	0.0%	Forestry technicians	0.0%

384	Government social benefits officials	0.0%	Government licensing officials	0.0%
385	Gallery, museum and library technicians	0.0%	Software and applications developers and analysts not elsewhere classified	0.0%
386	Mixed crop and livestock farm labourers	0.0%	Government social benefits officials	0.0%
387	Medical secretaries	0.0%	Locomotive engine drivers	0.0%
388	Audiologists and speech therapists	0.0%	Dieticians and nutritionists	0.0%
389	Shelf fillers	0.0%	Non-commissioned armed forces officers	0.0%
390	Policy and planning managers	0.0%	Mining managers	0.0%
391	Town and traffic planners	0.0%		
392	Social welfare managers	0.0%		
393	Wood treaters	0.0%		
394	Astrologers, fortune-tellers and related workers	0.0%		
395	Apiarists and sericulturists	0.0%		
396	Regulatory government associate professionals not elsewhere classified	0.0%		
397	Trade brokers	0.0%		
398	Typists and word processing operators	0.0%		
399	Mixed crop and animal producers	0.0%		
400	Medical records and health information technicians	0.0%		
401	Odd job persons	0.0%		
402	Window cleaners	0.0%		

Source: DANE-GEIH. Own calculations

Table A.2: Occupational distribution of the Colombian unemployed

#	ISCO title	Unemployed
1	Sales demonstrators	13.9%
2	Cleaners and helpers in offices, hotels and other establishments	4.9%
3	Domestic cleaners and helpers	4.4%
4	Building and related electricians	3.2%
5	Waiters	3.1%
6	Security guards	3.1%
7	Stock clerks	2.7%
8	Car, taxi and van drivers	2.7%
9	Health care assistants	2.0%
10	Accounting and bookkeeping clerks	2.0%
11	Secondary education teachers	2.0%
12	Policy administration professionals	1.7%
13	Kitchen helpers	1.6%
14	Contact centre information clerks	1.6%
15	Cooks	1.6%
16	Cashiers and ticket clerks	1.5%
17	Bricklayers and related workers	1.5%
18	Sewing machine operators	1.4%
19	Child care workers	1.2%
20	Construction supervisors	1.1%
21	House builders	1.0%
22	Senior officials of special-interest organizations	1.0%
23	Real estate agents and property managers	0.9%
24	Mail carriers and sorting clerks	0.8%
25	Heavy truck and lorry drivers	0.7%
26	Painters and related workers	0.7%
27	Restaurant managers	0.7%
28	Commercial sales representatives	0.7%
29	Bakers, pastry-cooks and confectionery makers	0.6%
30	Welders and flamecutters	0.6%
31	Motor vehicle mechanics and repairers	0.6%
32	Filing and copying clerks	0.6%
33	Primary school teachers	0.6%
34	Business services agents not elsewhere classified	0.6%
35	Civil engineers	0.6%
36	Stonemasons, stone cutters, splitters and carvers	0.6%
37	Shop sales assistants	0.6%
38	Crop farm labourers	0.5%
39	Psychologists	0.5%
40	Administrative and executive secretaries	0.5%
41	Receptionists (general)	0.5%
42	Driving instructors	0.5%
43	Freight handlers	0.5%

44	Human resource managers	0.5%
45	Agricultural and industrial machinery mechanics and repairers	0.4%
46	Graphic and multimedia designers	0.4%
47	Packing, bottling and labelling machine operators	0.4%
48	Butchers, fishmongers and related food preparers	0.4%
49	Beauticians and related workers	0.4%
50	Secretaries (general)	0.4%
51	Nursing professionals	0.4%
52	Industrial and production engineers	0.4%
53	Environmental and occupational health inspectors and associates	0.4%
54	Enquiry clerks	0.4%
55	Physical and engineering science technicians not elsewhere classified	0.4%
56	Stall and market salespersons	0.4%
57	Services managers not elsewhere classified	0.3%
58	Civil engineering technicians	0.3%
59	Legal professionals not elsewhere classified	0.3%
60	Lawyers	0.3%
61	Social work and counselling professionals	0.3%
62	Information and communications technology sales professionals	0.3%
63	Systems analysts	0.3%
64	Financial and insurance services branch managers	0.3%
65	Manufacturing supervisors	0.3%
66	Bartenders	0.3%
67	Fast food preparers	0.3%
68	Pharmaceutical technicians and assistants	0.3%
69	Building construction labourers	0.3%
70	Building architects	0.3%
71	Shoemakers and related workers	0.3%
72	Personal care workers in health services not elsewhere classified	0.3%
73	Information and communications technology installers and servicers	0.3%
74	Messengers, package deliverers and luggage porters	0.3%
75	Archivists and curators	0.2%
76	Carpenters and joiners	0.2%
77	Crane, hoist and related plant operators	0.2%
78	Supply, distribution and related managers	0.2%
79	Survey and market research interviewers	0.2%
80	Hand launderers and pressers	0.2%
81	Buyers	0.2%
82	Statistical, finance and insurance clerks	0.2%
83	Gardeners, horticultural and nursery growers	0.2%
84	Retail and wholesale trade managers	0.2%

85	Transport clerks	0.2%
86	Environmental engineers	0.2%
87	Translators, interpreters and other linguists	0.2%
88	Securities and finance dealers and brokers	0.2%
89	Product and garment designers	0.2%
90	Agricultural technicians	0.2%
91	Mechanical engineers	0.2%
92	Fruit, vegetable and related preservers	0.2%
93	Miners and quarriers	0.2%
94	Information and communications technology operations technicians	0.2%
95	Bank tellers and related clerks	0.2%
96	Electronics engineers	0.2%
97	Database and network professionals not elsewhere classified	0.2%
98	Paper products machine operators	0.2%
99	Sweepers and related labourers	0.2%
100	Hotel receptionists	0.2%
101	Teaching professionals not elsewhere classified	0.2%
102	Food and related products machine operators	0.2%
103	Electrical mechanics and fitters	0.2%
104	Hand packers	0.2%
105	Police inspectors and detectives	0.2%
106	Office supervisors	0.2%
107	Door to door salespersons	0.2%
108	Farming, forestry and fisheries advisers	0.2%
109	Information and communications technology user support technicians	0.1%
110	Early childhood educators	0.1%
111	Generalist medical practitioners	0.1%
112	Cabinet-makers and related workers	0.1%
113	Biologists, botanists, zoologists and related professionals	0.1%
114	Chefs	0.1%
115	Construction managers	0.1%
116	Electronics mechanics and servicers	0.1%
117	Specialist medical practitioners	0.1%
118	Dentists	0.1%
119	Electrical engineers	0.1%
120	Engineering professionals not elsewhere classified	0.1%
121	Field crop and vegetable growers	0.1%
122	Journalists	0.1%
123	Home-based personal care workers	0.1%
124	Musicians, singers and composers	0.1%
125	Telecommunications engineers	0.1%
126	Accountants	0.1%
127	Electrical engineering technicians	0.1%

128	Advertising and marketing professionals	0.1%
129	Armed forces occupations, other ranks	0.1%
130	Manufacturing managers	0.1%
131	Other language teachers	0.1%
132	Bus and tram drivers	0.1%
133	Food service counter attendants	0.1%
134	Building caretakers	0.1%
135	Sports coaches, instructors and officials	0.1%
136	Insurance representatives	0.1%
137	Fitness and recreation instructors and program leaders	0.1%
138	Assemblers not elsewhere classified	0.1%
139	Hairdressers	0.1%
140	Financial and investment advisers	0.1%
141	Teachers' aides	0.1%
142	Financial analysts	0.1%
143	Chemists	0.1%
144	Sales and marketing managers	0.1%
145	University and higher education teachers	0.1%
146	Mechanical engineering technicians	0.1%
147	Mining engineers, metallurgists and related professionals	0.1%
148	Managing directors and chief executives	0.1%
149	Physiotherapists	0.1%
150	Plastic products machine operators	0.1%
151	Telephone switchboard operators	0.1%
152	Personnel and careers professionals	0.1%
153	Shop keepers	0.1%
154	Livestock and dairy producers	0.1%
155	Economists	0.1%
156	Tailors, dressmakers, furriers and hatters	0.1%
157	Other artistic and cultural associate professionals	0.1%
158	Conference and event planners	0.1%
159	Veterinarians	0.1%
160	Draughtspersons	0.1%
161	Personal services workers not elsewhere classified	0.1%
162	Mathematicians, actuaries and statisticians	0.1%
163	Sheet-metal workers	0.1%
164	Information and communications technology service managers	0.1%
165	Chemical engineers	0.1%
166	Cartographers and surveyors	0.1%
167	Bookmakers, croupiers and related gaming workers	0.1%
168	Broadcasting and audio-visual technicians	0.1%
169	Toolmakers and related workers	0.1%
170	Shoemaking and related machine operators	0.1%
171	Sports, recreation and cultural centre managers	0.1%
172	Medical and pathology laboratory technicians	0.1%

173	Upholsterers and related workers	0.1%
174	Meter readers and vending-machine collectors	0.1%
175	Glass and ceramics plant operators	0.1%
176	Contact centre salespersons	0.1%
177	Management and organization analysts	0.1%
178	Concrete placers, concrete finishers and related workers	0.1%
179	Sociologists, anthropologists and related professionals	0.1%
180	Special needs teachers	0.1%
181	Electronics engineering technicians	0.1%
182	Health services managers	0.1%
183	Aquaculture and fisheries production managers	0.1%
184	Electrical line installers and repairers	0.1%
185	Vehicle cleaners	0.1%
186	Aircraft pilots and related associate professionals	0.1%
187	Payroll clerks	0.1%
188	Air conditioning and refrigeration mechanics	0.1%
189	Metal working machine tool setters and operators	0.1%
190	Police officers	0.1%
191	Handicraft workers in textile, leather and related materials	0.1%
192	Motorcycle drivers	0.1%
193	Garbage and recycling collectors	0.1%
194	Fumigators and other pest and weed controllers	0.0%
195	Laundry machine operators	0.0%
196	Spray painters and varnishers	0.0%
197	Mobile farm and forestry plant operators	0.0%
198	Dental assistants and therapists	0.0%
199	Education methods specialists	0.0%
200	Travel guides	0.0%
201	Cleaning and housekeeping supervisors in offices, hotels and other establishments	0.0%
202	Photographers	0.0%
203	Garment and related pattern-makers and cutters	0.0%
204	Plumbers and pipe fitters	0.0%
205	Elementary workers not elsewhere classified	0.0%
206	Service station attendants	0.0%
207	Sewing, embroidery and related workers	0.0%
208	Technical and medical sales professionals (excluding ICT)	0.0%
209	Chemical engineering technicians	0.0%
210	Finance managers	0.0%
211	Meteorologists	0.0%
212	Railway brake, signal and switch operators	0.0%
213	Agricultural and forestry production managers	0.0%
214	Database designers and administrators	0.0%
215	Geologists and geophysicists	0.0%
216	Street vendors (excluding food)	0.0%

217	Poultry producers	0.0%
218	Chemical and physical science technicians	0.0%
219	Film, stage and related directors and producers	0.0%
220	Building frame and related trades workers not elsewhere classified	0.0%
221	Credit and loans officers	0.0%
222	Travel attendants and travel stewards	0.0%
223	Interior designers and decorators	0.0%
224	Precision-instrument makers and repairers	0.0%
225	Fire-fighters	0.0%
226	Craft and related workers not elsewhere classified	0.0%
227	Jewellery and precious-metal workers	0.0%
228	Librarians and related information professionals	0.0%
229	Sales workers not elsewhere classified	0.0%
230	Veterinary technicians and assistants	0.0%
231	Earthmoving and related plant operators	0.0%
232	Philosophers, historians and political scientists	0.0%
233	Mining and metallurgical technicians	0.0%
234	Announcers on radio, television and other media	0.0%
235	Companions and valets	0.0%
236	Structural-metal preparers and erectors	0.0%
237	Data entry clerks	0.0%
238	Client information workers not elsewhere classified	0.0%
239	Print finishing and binding workers	0.0%
240	Wood processing plant operators	0.0%
241	Medical imaging and therapeutic equipment technicians	0.0%
242	Handicraft workers in wood, basketry and related materials	0.0%
243	Medical and dental prosthetic technicians	0.0%
244	Incinerator and water treatment plant operators	0.0%
245	Metal processing plant operators	0.0%
246	Telecommunications engineering technicians	0.0%
247	Debt-collectors and related workers	0.0%
248	Aircraft engine mechanics and repairers	0.0%
249	Pet groomers and animal care workers	0.0%
250	Refuse sorters	0.0%
251	Bleaching, dyeing and fabric cleaning machine operators	0.0%
252	Health professionals not elsewhere classified	0.0%
253	Chemical products plant and machine operators	0.0%
254	Hotel managers	0.0%
255	Clearing and forwarding agents	0.0%
256	Social work associate professionals	0.0%
257	Mining supervisors	0.0%
258	Livestock farm labourers	0.0%
259	Civil engineering labourers	0.0%
260	Environmental protection professionals	0.0%
261	Floor layers and tile setters	0.0%

262	Research and development managers	0.0%
263	Non-commissioned armed forces officers	0.0%
264	Manufacturing labourers not elsewhere classified	0.0%
265	Metal production process controllers	0.0%
266	Production clerks	0.0%
267	Musical instrument makers and tuners	0.0%
268	Potters and related workers	0.0%
269	Life science technicians (excluding medical)	0.0%
270	Shelf fillers	0.0%
271	Other arts teachers	0.0%
272	Computer network professionals	0.0%
273	Printers	0.0%
274	Software developers	0.0%
275	Blacksmiths, hammersmiths and forging press workers	0.0%
276	Cement, stone and other mineral products machine operators	0.0%
277	Professional services managers not elsewhere classified	0.0%
278	Street and related service workers	0.0%
279	Accounting associate professionals	0.0%
280	Fishery and aquaculture labourers	0.0%
281	Library clerks	0.0%
282	Computer network and systems technicians	0.0%
283	Pharmacists	0.0%
284	Pre-press technicians	0.0%
285	Business services and administration managers not elsewhere classified	0.0%
286	Vocational education teachers	0.0%
287	Tobacco preparers and tobacco products makers	0.0%
288	Authors and related writers	0.0%
289	Dairy-products makers	0.0%
290	Dieticians and nutritionists	0.0%
291	Well drillers and borers and related workers	0.0%
292	Legal secretaries	0.0%
293	Metal finishing, plating and coating machine operators	0.0%
294	Environmental and occupational health and hygiene professionals	0.0%
295	Physiotherapy technicians and assistants	0.0%
296	Domestic housekeepers	0.0%
297	Pawnbrokers and money-lenders	0.0%
298	Personnel clerks	0.0%
299	Roofers	0.0%
300	Travel consultants and clerks	0.0%
301	Ships' deck crews and related workers	0.0%
302	Plasterers	0.0%
303	Electrical and electronic equipment assemblers	0.0%
304	Legislators	0.0%
305	Tree and shrub crop growers	0.0%

306	Riggers and cable splicers	0.0%
307	Public relations professionals	0.0%
308	Forestry and related workers	0.0%
309	Religious professionals	0.0%
310	Underwater divers	0.0%
311	Process control technicians not elsewhere classified	0.0%
312	Insulation workers	0.0%
313	Photographic products machine operators	0.0%
314	Training and staff development professionals	0.0%
315	Weaving and knitting machine operators	0.0%
316	Glaziers	0.0%
317	Advertising and public relations managers	0.0%
318	Bicycle and related repairers	0.0%
319	Rubber products machine operators	0.0%
320	Clerical support workers not elsewhere classified	0.0%
321	Forestry labourers	0.0%
322	Aquaculture workers	0.0%
323	Education managers	0.0%
324	Air traffic controllers	0.0%
325	Deep-sea fishery workers	0.0%
326	Systems administrators	0.0%
327	Shop supervisors	0.0%
328	Creative and performing artists not elsewhere classified	0.0%
329	Forestry technicians	0.0%
330	Chemical processing plant controllers	0.0%
331	Government tax and excise officials	0.0%
332	Visual artists	0.0%
333	Other music teachers	0.0%
334	Glass makers, cutters, grinders and finishers	0.0%
335	Apiarists and sericulturists	0.0%
336	Mineral and stone processing plant operators	0.0%
337	Town and traffic planners	0.0%
338	Dancers and choreographers	0.0%
339	Aged care services managers	0.0%
340	Sign writers, decorative painters, engravers and etchers	0.0%
341	Software and applications developers and analysts not elsewhere classified	0.0%
342	Lifting truck operators	0.0%
343	Garden and horticultural labourers	0.0%
344	Ambulance workers	0.0%
345	Fur and leather preparing machine operators	0.0%
346	Street food salespersons	0.0%
347	General office clerks	0.0%
348	Protective services workers not elsewhere classified	0.0%
349	Web and multimedia developers	0.0%
350	Steam engine and boiler operators	0.0%

351	Dispensing opticians	0.0%
352	Transport conductors	0.0%
353	Commissioned armed forces officers	0.0%
354	Ships' deck officers and pilots	0.0%
355	Judges	0.0%
356	Undertakers and embalmers	0.0%
357	Fibre preparing, spinning and winding machine operators	0.0%
358	Inland and coastal waters fishery workers	0.0%
359	Petroleum and natural gas refining plant operators	0.0%
360	Health associate professionals not elsewhere classified	0.0%
361	Optometrists and ophthalmic opticians	0.0%
362	Textile, fur and leather products machine operators not elsewhere classified	0.0%
363	Employment agents and contractors	0.0%
364	Child care services managers	0.0%
365	Gallery, museum and library technicians	0.0%
366	Handicraft workers not elsewhere classified	0.0%
367	Mining and quarrying labourers	0.0%
368	Government social benefits officials	0.0%
369	Air traffic safety electronics technicians	0.0%
370	Animal producers not elsewhere classified	0.0%
371	Mining managers	0.0%

Source: DANE-GEIH. Own calculations

Table A.3: Informality rate by occupation

#	ISCO title	Informality rate
1	Domestic cleaners and helpers	99.8%
2	Motorcycle drivers	99.0%
3	Shop keepers	97.3%
4	Tailors, dressmakers, furriers and hatters	96.7%
5	Street food salespersons	96.6%
6	Stall and market salespersons	95.3%
7	Sewing, embroidery and related workers	94.1%
8	Drivers of animal-drawn vehicles and machinery	93.6%
9	Potters and related workers	92.3%
10	Clearing and forwarding agents	92.2%
11	Sales workers not elsewhere classified	92.0%
12	Beauticians and related workers	90.7%
13	Handicraft workers in textile, leather and related materials	90.7%
14	Hairdressers	89.2%
15	Bicycle and related repairers	89.0%
16	Fast food preparers	87.6%
17	Laundry machine operators	87.2%
18	Refuse sorters	86.0%
19	Street vendors (excluding food)	84.9%
20	Bricklayers and related workers	83.7%
21	Pawnbrokers and money-lenders	81.7%
22	Sales demonstrators	81.5%
23	Shoemakers and related workers	81.5%
24	Hand launderers and pressers	80.7%
25	Dairy-products makers	80.7%
26	Sheet-metal workers	80.5%
27	Miners and quarriers	80.4%
28	Contact centre salespersons	80.2%
29	Crop farm labourers	79.8%
30	Meteorologists	79.3%
31	Handicraft workers in wood, basketry and related materials	78.7%
32	Tobacco preparers and tobacco products makers	78.7%
33	Motor vehicle mechanics and repairers	78.6%
34	Home-based personal care workers	78.6%
35	Cabinet-makers and related workers	78.5%
36	Painters and related workers	78.5%
37	Jewellery and precious-metal workers	77.7%
38	Street and related service workers	77.5%
39	Pet groomers and animal care workers	76.9%
40	Inland and coastal waters fishery workers	76.6%
41	Database and network professionals not elsewhere classified	76.5%
42	Forestry and related workers	76.5%
43	Gardeners, horticultural and nursery growers	76.1%
44	Physiotherapy technicians and assistants	76.0%
45	Food service counter attendants	75.8%

46	Forestry labourers	75.7%
47	Carpenters and joiners	75.4%
48	Construction supervisors	75.4%
49	Commercial sales representatives	75.2%
50	Garbage and recycling collectors	75.1%
51	Door to door salespersons	75.0%
52	Stonemasons, stone cutters, splitters and carvers	75.0%
53	Poultry producers	74.6%
54	Lifting truck operators	74.4%
55	Domestic housekeepers	74.2%
56	Cooks	74.0%
57	Concrete placers, concrete finishers and related workers	73.0%
58	Upholsterers and related workers	72.6%
59	Fruit, vegetable and related preservers	72.5%
60	Car, taxi and van drivers	71.9%
61	Building caretakers	71.8%
62	Bookmakers, croupiers and related gaming workers	71.6%
63	Credit and loans officers	71.6%
64	Companions and valets	71.4%
65	Garment and related pattern-makers and cutters	71.3%
66	Spray painters and varnishers	71.2%
67	Freight handlers	71.1%
68	Roofers	69.9%
69	Real estate agents and property managers	69.9%
70	Services managers not elsewhere classified	69.7%
71	Steam engine and boiler operators	69.3%
72	Vehicle cleaners	69.1%
73	Agricultural and forestry production managers	69.0%
74	Food and related products machine operators	68.2%
75	Bakers, pastry-cooks and confectionery makers	68.1%
76	Bartenders	67.9%
77	Fur and leather preparing machine operators	67.6%
78	Fumigators and other pest and weed controllers	66.9%
79	Plasterers	66.8%
80	Sign writers, decorative painters, engravers and etchers	65.6%
81	Floor layers and tile setters	65.1%
82	House builders	64.9%
83	Child care workers	64.2%
84	Metal polishers, wheel grinders and tool sharpeners	63.8%
85	Glaziers	63.4%
86	Pelt dressers, tanners and fellmongers	63.3%
87	Sewing machine operators	62.7%
88	Travel guides	62.2%
89	Livestock farm labourers	61.6%
90	Messengers, package deliverers and luggage porters	61.5%
91	Butchers, fishmongers and related food preparers	61.1%
92	Shop sales assistants	60.9%
93	Veterinary technicians and assistants	60.8%

94	Printers	59.8%
95	Teachers' aides	59.7%
96	Restaurant managers	59.0%
97	Kitchen helpers	59.0%
98	Hotel managers	58.6%
99	Building and related electricians	58.3%
100	Medical and dental prosthetic technicians	57.4%
101	Heavy truck and lorry drivers	56.3%
102	Blacksmiths, hammersmiths and forging press workers	56.0%
103	Cement, stone and other mineral products machine operators	54.5%
104	Other artistic and cultural associate professionals	54.2%
105	Cleaners and helpers in offices, hotels and other establishments	54.1%
106	Product and garment designers	54.1%
107	Pre-press technicians	53.6%
108	Shoemaking and related machine operators	53.6%
109	Print finishing and binding workers	53.5%
110	Glass makers, cutters, grinders and finishers	53.2%
111	Manufacturing supervisors	52.1%
112	Aged care services managers	51.6%
113	Insulation workers	51.6%
114	Sports, recreation and cultural centre managers	51.5%
115	Weaving and knitting machine operators	51.3%
116	Waiters	50.1%
117	Assemblers not elsewhere classified	49.6%
118	Manufacturing labourers not elsewhere classified	49.0%
119	Electrical and electronic equipment assemblers	48.9%
120	Textile, fur and leather products machine operators not elsewhere classified	48.8%
121	Electrical mechanics and fitters	48.5%
122	Conference and event planners	48.0%
123	Building construction labourers	47.9%
124	Retail and wholesale trade managers	47.8%
125	Creative and performing artists not elsewhere classified	47.6%
126	Hotel receptionists	47.3%
127	Other arts teachers	46.9%
128	Precision-instrument makers and repairers	45.8%
129	Ships' deck crews and related workers	45.6%
130	Transport conductors	45.4%
131	Packing, bottling and labelling machine operators	45.4%
132	Rubber products machine operators	45.2%
133	Toolmakers and related workers	45.1%
134	Mechanical machinery assemblers	44.9%
135	Wood processing plant operators	44.4%
136	Fibre preparing, spinning and winding machine operators	44.0%
137	Debt-collectors and related workers	43.3%
138	Chemical products plant and machine operators	42.8%
139	Electronics mechanics and servicers	41.4%
140	Mineral and stone processing plant operators	41.4%

141	Buyers	41.1%
142	Metal finishing, plating and coating machine operators	41.0%
143	Clerical support workers not elsewhere classified	39.8%
144	Metal processing plant operators	39.8%
145	Elementary workers not elsewhere classified	39.3%
146	Bleaching, dyeing and fabric cleaning machine operators	39.1%
147	Dispensing opticians	39.1%
148	Translators, interpreters and other linguists	38.9%
149	Glass and ceramics plant operators	38.6%
150	Musical instrument makers and tuners	37.5%
151	Air conditioning and refrigeration mechanics	36.7%
152	Mail carriers and sorting clerks	36.6%
153	Legal secretaries	36.0%
154	Structural-metal preparers and erectors	35.7%
155	Personal care workers in health services not elsewhere classified	35.4%
156	Chemical engineers	35.3%
157	Bus and tram drivers	34.9%
158	Welders and flamecutters	34.8%
159	Advertising and public relations managers	34.8%
160	Biologists, botanists, zoologists and related professionals	33.1%
161	Interior designers and decorators	32.2%
162	Religious associate professionals	31.8%
163	Web and multimedia developers	31.2%
164	Managing directors and chief executives	31.0%
165	Civil engineering technicians	30.9%
166	Sports coaches, instructors and officials	30.7%
167	Metal working machine tool setters and operators	30.4%
168	Other music teachers	30.3%
169	Personal services workers not elsewhere classified	29.7%
170	Photographic products machine operators	29.6%
171	Optometrists and ophthalmic opticians	29.4%
172	Fitness and recreation instructors and program leaders	29.0%
173	Electrical line installers and repairers	29.0%
174	Transport clerks	28.8%
175	Pharmacists	28.5%
176	Veterinarians	28.4%
177	Building frame and related trades workers not elsewhere classified	28.2%
178	Chefs	27.8%
179	Technical and medical sales professionals (excluding ICT)	27.7%
180	Civil engineering labourers	27.5%
181	Broadcasting and audio-visual technicians	27.5%
182	Petroleum and natural gas refining plant operators	27.4%
183	Incinerator and water treatment plant operators	27.3%
184	Agricultural and industrial machinery mechanics and repairers	26.6%
185	Service station attendants	26.1%
186	Telephone switchboard operators	26.1%
187	Craft and related workers not elsewhere classified	25.7%

188	Cashiers and ticket clerks	25.7%
189	Medical and pathology laboratory technicians	25.6%
190	Life science technicians (excluding medical)	25.2%
191	Ships' deck officers and pilots	24.7%
192	Dentists	23.9%
193	Cleaning and housekeeping supervisors in offices, hotels and other establishments	23.6%
194	Plumbers and pipe fitters	23.1%
195	Fire-fighters	23.0%
196	Insurance representatives	22.6%
197	Enquiry clerks	22.6%
198	Information and communications technology installers and servicers	22.5%
199	Mechanical engineering technicians	22.2%
200	Civil engineers	22.0%
201	Senior officials of special-interest organizations	22.0%
202	Advertising and marketing professionals	21.1%
203	Photographers	21.1%
204	Armed forces occupations, other ranks	21.0%
205	Aircraft pilots and related associate professionals	21.0%
206	Crane, hoist and related plant operators	20.8%
207	Social work associate professionals	20.6%
208	Dental assistants and therapists	20.5%
209	Receptionists (general)	20.5%
210	Security guards	20.4%
211	Electrical engineering technicians	20.3%
212	Aircraft engine mechanics and repairers	19.7%
213	Religious professionals	19.4%
214	Electrical engineers	19.2%
215	Travel consultants and clerks	18.7%
216	Draughtspersons	18.6%
217	Philosophers, historians and political scientists	18.4%
218	Paper products machine operators	18.0%
219	Physical and engineering science technicians not elsewhere classified	17.9%
220	Administrative and executive secretaries	17.8%
221	Business services agents not elsewhere classified	17.7%
222	Secretaries (general)	17.4%
223	Manufacturing managers	17.3%
224	Child care services managers	17.1%
225	Hand packers	17.0%
226	Chemists	16.9%
227	Personnel clerks	16.6%
228	Railway brake, signal and switch operators	16.6%
229	Industrial and production engineers	16.5%
230	Chemical engineering technicians	16.3%
231	Plastic products machine operators	16.1%
232	Graphic and multimedia designers	14.9%

233	Cartographers and surveyors	14.8%
234	Construction managers	14.8%
235	Policy administration professionals	14.3%
236	Aquaculture and fisheries production managers	13.8%
237	Chemical and physical science technicians	13.8%
238	Stock clerks	13.8%
239	Client information workers not elsewhere classified	13.7%
240	Sales and marketing managers	13.7%
241	Data entry clerks	13.2%
242	Business services and administration managers not elsewhere classified	13.1%
243	Agricultural technicians	13.0%
244	Protective services workers not elsewhere classified	13.0%
245	Pharmaceutical technicians and assistants	13.0%
246	Health professionals not elsewhere classified	12.9%
247	Early childhood educators	12.6%
248	Electronics engineering technicians	12.6%
249	Education methods specialists	12.5%
250	Financial and investment advisers	12.5%
251	Musicians, singers and composers	12.2%
252	Riggers and cable splicers	11.8%
253	Environmental and occupational health and hygiene professionals	11.7%
254	Legal professionals not elsewhere classified	11.6%
255	Accounting and bookkeeping clerks	11.4%
256	Announcers on radio, television and other media	11.3%
257	Garden and horticultural labourers	11.0%
258	Judges	10.8%
259	Employment agents and contractors	10.8%
260	Mechanical engineers	10.6%
261	Telecommunications engineering technicians	10.5%
262	Environmental protection professionals	10.4%
263	Research and development managers	10.2%
264	Meter readers and vending-machine collectors	10.2%
265	Well drillers and borers and related workers	10.2%
266	Mining and metallurgical technicians	10.1%
267	Medical imaging and therapeutic equipment technicians	10.0%
268	Stationary plant and machine operators not elsewhere classified	10.0%
269	Supply, distribution and related managers	9.8%
270	Payroll clerks	9.7%
271	Engineering professionals not elsewhere classified	9.7%
272	Health associate professionals not elsewhere classified	9.6%
273	Education managers	9.2%
274	Driving instructors	9.0%
275	Information and communications technology sales professionals	8.9%
276	Securities and finance dealers and brokers	8.8%
277	Sociologists, anthropologists and related professionals	8.8%
278	Archivists and curators	8.7%

279	Building architects	8.7%
280	Systems administrators	8.7%
281	Pulp and papermaking plant operators	8.1%
282	Earthmoving and related plant operators	8.0%
283	Environmental and occupational health inspectors and associates	7.9%
284	Shop supervisors	7.8%
285	Social work and counselling professionals	7.8%
286	Information and communications technology operations technicians	7.7%
287	Primary school teachers	7.6%
288	Specialist medical practitioners	7.5%
289	Special needs teachers	7.3%
290	Commissioned armed forces officers	7.2%
291	Government tax and excise officials	7.2%
292	Teaching professionals not elsewhere classified	7.1%
293	Journalists	6.9%
294	Underwater divers	6.5%
295	Personnel and careers professionals	6.3%
296	Lawyers	6.2%
297	Public relations professionals	6.0%
298	Training and staff development professionals	5.9%
299	Accountants	5.9%
300	Police inspectors and detectives	5.8%
301	Health care assistants	5.7%
302	Electronics engineers	5.7%
303	Authors and related writers	5.7%
304	Financial analysts	5.7%
305	Financial and insurance services branch managers	5.7%
306	Generalist medical practitioners	5.6%
307	Film, stage and related directors and producers	5.5%
308	Mining engineers, metallurgists and related professionals	5.4%
309	Information and communications technology user support technicians	5.4%
310	Information and communications technology service managers	5.3%
311	Survey and market research interviewers	4.7%
312	Telecommunications engineers	4.4%
313	Statistical, mathematical and related associate professionals	4.4%
314	Physiotherapists	3.9%
315	Accounting associate professionals	3.8%
316	Professional services managers not elsewhere classified	3.8%
317	Environmental engineers	3.7%
318	Nursing professionals	3.7%
319	Production clerks	3.7%
320	Finance managers	3.7%
321	Office supervisors	3.6%
322	Database designers and administrators	3.5%
323	Human resource managers	3.5%

324	Bank tellers and related clerks	3.4%
325	Other language teachers	3.4%
326	Contact centre information clerks	3.2%
327	Systems analysts	3.1%
328	Process control technicians not elsewhere classified	3.0%
329	Management and organization analysts	2.9%
330	Economists	2.8%
331	Statistical, finance and insurance clerks	2.8%
332	Health services managers	2.7%
333	Secondary education teachers	2.7%
334	Filing and copying clerks	2.6%
335	Visual artists	2.6%
336	University and higher education teachers	2.5%
337	Sweepers and related labourers	2.4%
338	Software developers	2.1%
339	Vocational education teachers	2.0%
340	Legislators	1.9%
341	Travel attendants and travel stewards	1.9%
342	Mining supervisors	1.8%
343	Metal production process controllers	1.6%
344	Psychologists	1.5%
345	Mathematicians, actuaries and statisticians	1.2%
346	Computer network and systems technicians	1.2%
347	Geologists and geophysicists	0.9%
348	Dieticians and nutritionists	0.3%
349	Computer network professionals	0.0%

Source: DANE-GEIH. Own calculations

Table A.4: Unemployment rate by occupation

#	ISCO title	Unemployment rate	Duration of unemployment (weeks)
1	Environmental engineers	36.7%	29.3
2	Geologists and geophysicists	26.1%	31.7
3	Sociologists, anthropologists and related professionals	25.4%	24.8
4	Economists	22.7%	46.3
5	Philosophers, historians and political scientists	22.7%	40.3
6	Survey and market research interviewers	22.5%	21.0
7	Contact centre information clerks	22.1%	18.1
8	Filing and copying clerks	21.8%	25.9
9	Veterinary technicians and assistants	21.6%	10.8
10	Environmental and occupational health inspectors and associates	20.7%	27.9
11	Enquiry clerks	20.0%	27.9
12	Mining engineers, metallurgists and related professionals	19.9%	33.1
13	Receptionists (general)	19.2%	26.1
14	Stock clerks	18.8%	18.6
15	Mechanical engineers	18.7%	25.9
16	Sports, recreation and cultural centre managers	18.5%	12.9
17	Business services agents not elsewhere classified	18.4%	20.8
18	Social work and counselling professionals	17.9%	29.3
19	Information and communications technology operations technicians	17.5%	24.9
20	Psychologists	17.1%	29.4
21	Electronics engineers	16.9%	38.1
22	Accounting and bookkeeping clerks	16.8%	28.4
23	Travel attendants and travel stewards	16.8%	31.7
24	Information and communications technology sales professionals	16.7%	20.4
25	Draughtspersons	16.7%	28.8
26	Sweepers and related labourers	16.6%	23.6
27	Waiters	16.4%	16.9
28	Health care assistants	16.2%	25.0
29	Restaurant managers	16.2%	16.3
30	Agricultural technicians	16.1%	28.9
31	Travel guides	16.0%	24.4
32	Chemical engineers	15.9%	27.4
33	Hand packers	15.7%	28.7
34	Building construction labourers	15.6%	13.4
35	Craft and related workers not elsewhere classified	15.2%	12.0

36	Driving instructors	15.1%	26.6
37	Pharmaceutical technicians and assistants	15.0%	21.9
38	Data entry clerks	14.7%	29.2
39	Bank tellers and related clerks	14.4%	24.2
40	Cashiers and ticket clerks	14.4%	22.5
41	Statistical, finance and insurance clerks	14.3%	27.1
42	Metal production process controllers	14.3%	20.5
43	Journalists	13.9%	28.7
44	Film, stage and related directors and producers	13.7%	35.2
45	Personal care workers in health services not elsewhere classified	13.0%	21.8
46	Stonemasons, stone cutters, splitters and carvers	13.0%	11.8
47	Legal secretaries	13.0%	17.6
48	Aircraft pilots and related associate professionals	12.9%	33.4
49	Hotel receptionists	12.9%	25.9
50	Railway brake, signal and switch operators	12.7%	25.1
51	Building and related electricians	12.7%	15.9
52	Senior officials of special-interest organizations	12.6%	32.6
53	Building architects	12.4%	27.4
54	Civil engineering technicians	12.4%	19.4
55	Civil engineers	12.3%	23.4
56	Electrical and electronic equipment assemblers	12.1%	16.0
57	Cartographers and surveyors	11.8%	23.6
58	Electrical line installers and repairers	11.7%	16.0
59	Packing, bottling and labelling machine operators	11.5%	18.2
60	Industrial and production engineers	11.4%	30.5
61	Engineering professionals not elsewhere classified	11.3%	27.0
62	Dental assistants and therapists	11.3%	30.0
63	Security guards	11.2%	23.6
64	Graphic and multimedia designers	11.2%	28.9
65	Kitchen helpers	11.2%	20.4
66	Human resource managers	11.1%	26.2
67	Early childhood educators	11.0%	21.6
68	Information and communications technology user support technicians	11.0%	23.5
69	Chemists	11.0%	24.8
70	Production clerks	10.9%	34.1
71	Cleaners and helpers in offices, hotels and other establishments	10.8%	24.3
72	Real estate agents and property managers	10.5%	24.3
73	Cleaning and housekeeping supervisors in offices, hotels and other establishments	10.4%	27.5

74	Legal professionals not elsewhere classified	10.4%	27.1
75	Manufacturing supervisors	10.3%	21.4
76	Telephone switchboard operators	10.3%	17.8
77	Bartenders	10.2%	19.2
78	Meteorologists	10.1%	8.5
79	Announcers on radio, television and other media	10.1%	23.4
80	Telecommunications engineers	10.0%	21.5
81	Nursing professionals	9.9%	25.5
82	Conference and event planners	9.9%	24.5
83	Secretaries (general)	9.8%	27.7
84	House builders	9.8%	11.1
85	Domestic cleaners and helpers	9.8%	18.8
86	Personnel and careers professionals	9.7%	20.0
87	Underwater divers	9.7%	4.0
88	Ships' deck crews and related workers	9.6%	8.3
89	Financial and investment advisers	9.6%	29.0
90	Product and garment designers	9.5%	21.8
91	Administrative and executive secretaries	9.3%	28.5
92	Sales demonstrators	9.3%	20.1
93	Securities and finance dealers and brokers	9.1%	27.7
94	Systems analysts	9.0%	29.5
95	Chefs	8.9%	27.6
96	Health services managers	8.9%	20.2
97	Software developers	8.8%	24.6
98	Armed forces occupations, other ranks	8.7%	13.1
99	Concrete placers, concrete finishers and related workers	8.5%	12.6
100	Veterinarians	8.5%	31.8
101	Agricultural and forestry production managers	8.5%	40.8
102	Translators, interpreters and other linguists	8.5%	21.1
103	Personal services workers not elsewhere classified	8.4%	19.3
104	Physical and engineering science technicians not elsewhere classified	8.4%	18.2
105	Special needs teachers	8.3%	25.6
106	Construction supervisors	8.3%	15.2
107	Street and related service workers	8.2%	23.6
108	Computer network and systems technicians	8.2%	43.1
109	Bricklayers and related workers	8.1%	12.9
110	Sports coaches, instructors and officials	8.1%	26.6
111	Biologists, botanists, zoologists and related professionals	8.1%	31.7
112	Musical instrument makers and tuners	8.0%	34.3
113	Physiotherapists	7.9%	27.5
114	Construction managers	7.8%	14.1
115	Buyers	7.8%	21.6
116	Interior designers and decorators	7.7%	21.4

117	Secondary education teachers	7.7%	27.6
118	Agricultural and industrial machinery mechanics and repairers	7.5%	23.2
119	Life science technicians (excluding medical)	7.5%	26.4
120	Paper products machine operators	7.5%	20.7
121	Electronics mechanics and servicers	7.3%	17.9
122	Environmental and occupational health and hygiene professionals	7.3%	42.3
123	Managing directors and chief executives	7.3%	22.4
124	Painters and related workers	7.2%	15.8
125	Chemical engineering technicians	7.2%	18.8
126	Aircraft engine mechanics and repairers	7.1%	18.6
127	Financial and insurance services branch managers	7.1%	23.3
128	Financial analysts	7.1%	21.8
129	Electrical engineers	7.1%	25.0
130	Research and development managers	7.0%	29.0
131	Electrical engineering technicians	7.0%	25.3
132	Mechanical engineering technicians	7.0%	20.1
133	Information and communications technology installers and servicers	7.0%	19.5
134	Database designers and administrators	6.9%	28.5
135	Hand launderers and pressers	6.9%	21.1
136	Fitness and recreation instructors and program leaders	6.9%	23.5
137	Advertising and marketing professionals	6.9%	26.1
138	Vocational education teachers	6.8%	15.9
139	Environmental protection professionals	6.8%	60.8
140	Crane, hoist and related plant operators	6.8%	14.5
141	Service station attendants	6.8%	19.3
142	Primary school teachers	6.7%	30.6
143	Payroll clerks	6.7%	39.1
144	Mail carriers and sorting clerks	6.6%	23.3
145	Client information workers not elsewhere classified	6.6%	16.3
146	Bakers, pastry-cooks and confectionery makers	6.5%	17.5
147	Sewing machine operators	6.5%	19.6
148	Shop sales assistants	6.5%	19.6
149	Teaching professionals not elsewhere classified	6.4%	24.0
150	Manufacturing managers	6.3%	14.9
151	Electronics engineering technicians	6.3%	21.8
152	Well drillers and borers and related workers	6.3%	38.4
153	Health professionals not elsewhere classified	6.3%	30.4
154	Finance managers	6.2%	28.0
155	Teachers' aides	6.2%	24.9

156	Information and communications technology service managers	6.2%	22.0
157	Public relations professionals	6.0%	15.7
158	Plasterers	6.0%	20.1
159	Building frame and related trades workers not elsewhere classified	6.0%	23.7
160	Supply, distribution and related managers	6.0%	20.2
161	Heavy truck and lorry drivers	5.9%	23.7
162	Vehicle cleaners	5.9%	17.1
163	Mining and metallurgical technicians	5.8%	26.3
164	Cooks	5.7%	21.4
165	Dentists	5.7%	32.5
166	Management and organization analysts	5.7%	26.1
167	Other language teachers	5.6%	19.4
168	Lawyers	5.6%	31.2
169	Database and network professionals not elsewhere classified	5.6%	20.6
170	Manufacturing labourers not elsewhere classified	5.5%	22.3
171	Personnel clerks	5.5%	27.7
172	Home-based personal care workers	5.4%	26.0
173	Wood processing plant operators	5.4%	9.4
174	Child care workers	5.4%	22.0
175	Library clerks	5.3%	4.3
176	Miners and quarriers	5.3%	22.8
177	Butchers, fishmongers and related food preparers	5.2%	18.9
178	Fruit, vegetable and related preservers	5.2%	16.7
179	Bus and tram drivers	5.2%	20.3
180	Specialist medical practitioners	5.1%	29.2
181	Welders and flamecutters	5.0%	20.0
182	Librarians and related information professionals	5.0%	42.0
183	Dieticians and nutritionists	5.0%	9.8
184	Medical imaging and therapeutic equipment technicians	5.0%	16.2
185	Clerical support workers not elsewhere classified	5.0%	4.0
186	Accountants	5.0%	29.8
187	Education methods specialists	4.9%	20.1
188	Fast food preparers	4.9%	15.3
189	Domestic housekeepers	4.9%	24.5
190	Roofers	4.9%	8.2
191	Medical and pathology laboratory technicians	4.8%	23.5
192	Elementary workers not elsewhere classified	4.8%	25.8
193	Sales and marketing managers	4.8%	22.8
194	Assemblers not elsewhere classified	4.8%	15.2
195	Non-commissioned armed forces officers	4.8%	10.8

196	Rubber products machine operators	4.8%	12.0
197	Shoemakers and related workers	4.8%	13.4
198	Upholsterers and related workers	4.7%	19.7
199	Metal working machine tool setters and operators	4.6%	15.4
200	Musicians, singers and composers	4.6%	19.3
201	Car, taxi and van drivers	4.6%	24.2
202	Plumbers and pipe fitters	4.6%	21.2
203	Insurance representatives	4.6%	26.7
204	Forestry labourers	4.5%	4.0
205	Motor vehicle mechanics and repairers	4.5%	17.7
206	Technical and medical sales professionals (excluding ICT)	4.5%	15.7
207	Meter readers and vending-machine collectors	4.4%	24.8
208	Physiotherapy technicians and assistants	4.4%	24.7
209	Broadcasting and audio-visual technicians	4.4%	18.2
210	University and higher education teachers	4.4%	26.1
211	Carpenters and joiners	4.3%	12.7
212	Fire-fighters	4.3%	18.2
213	Precision-instrument makers and repairers	4.3%	28.5
214	Mining supervisors	4.2%	18.0
215	Building caretakers	4.2%	20.9
216	Civil engineering labourers	4.1%	9.3
217	Transport clerks	4.1%	23.8
218	Freight handlers	4.1%	17.6
219	Structural-metal preparers and erectors	4.1%	8.5
220	Sales workers not elsewhere classified	3.9%	15.1
221	Earthmoving and related plant operators	3.9%	43.0
222	Chemical products plant and machine operators	3.9%	33.6
223	Sheet-metal workers	3.8%	16.6
224	Telecommunications engineering technicians	3.8%	20.5
225	Gardeners, horticultural and nursery growers	3.8%	17.3
226	Crop farm labourers	3.8%	14.0
227	Police officers	3.8%	17.5
228	Plastic products machine operators	3.7%	21.6
229	Mathematicians, actuaries and statisticians	3.7%	24.9
230	Poultry producers	3.7%	10.2
231	Office supervisors	3.7%	20.9
232	Electrical mechanics and fitters	3.7%	23.0
233	Hotel managers	3.7%	26.6
234	Blacksmiths, hammersmiths and forging press workers	3.7%	19.0
235	Professional services managers not elsewhere classified	3.6%	27.3
236	Systems administrators	3.6%	12.0

237	Social work associate professionals	3.5%	30.1
238	Air conditioning and refrigeration mechanics	3.5%	18.1
239	Training and staff development professionals	3.5%	7.0
240	Messengers, package deliverers and luggage porters	3.5%	20.3
241	Toolmakers and related workers	3.5%	16.1
242	Field crop and vegetable growers	3.5%	14.1
243	Insulation workers	3.5%	10.3
244	Food and related products machine operators	3.5%	18.4
245	Garment and related pattern-makers and cutters	3.5%	16.6
246	Other arts teachers	3.5%	8.1
247	Shoemaking and related machine operators	3.4%	15.5
248	Photographers	3.3%	20.0
249	Companions and valets	3.2%	17.3
250	Retail and wholesale trade managers	3.2%	23.4
251	Tobacco preparers and tobacco products makers	3.2%	9.3
252	Generalist medical practitioners	3.2%	18.9
253	Cement, stone and other mineral products machine operators	3.2%	22.0
254	Police inspectors and detectives	3.2%	20.1
255	Business services and administration managers not elsewhere classified	3.2%	20.7
256	Photographic products machine operators	3.1%	8.7
257	Commercial sales representatives	3.1%	21.1
258	Incinerator and water treatment plant operators	3.1%	10.1
259	Process control technicians not elsewhere classified	3.1%	15.6
260	Other artistic and cultural associate professionals	3.1%	24.5
261	Glass and ceramics plant operators	3.1%	9.6
262	Medical and dental prosthetic technicians	3.1%	11.5
263	Chemical and physical science technicians	3.1%	27.0
264	Glaziers	3.1%	1.0
265	Print finishing and binding workers	3.0%	19.7
266	Handicraft workers in wood, basketry and related materials	3.0%	21.2
267	Clearing and forwarding agents	2.9%	20.1
268	Laundry machine operators	2.9%	12.6
269	Beauticians and related workers	2.9%	19.0
270	Shop supervisors	2.8%	39.4
271	Authors and related writers	2.8%	19.8
272	Bookmakers, croupiers and related gaming workers	2.7%	15.3
273	Spray painters and varnishers	2.7%	10.5

274	Metal processing plant operators	2.7%	6.0
275	Riggers and cable splicers	2.6%	44.0
276	Advertising and public relations managers	2.6%	46.4
277	Garbage and recycling collectors	2.6%	18.9
278	Metal finishing, plating and coating machine operators	2.5%	8.8
279	Credit and loans officers	2.5%	23.7
280	Pharmacists	2.5%	23.9
281	Floor layers and tile setters	2.5%	12.0
282	Fumigators and other pest and weed controllers	2.5%	15.4
283	Street vendors (excluding food)	2.4%	17.6
284	Food service counter attendants	2.4%	17.7
285	Cabinet-makers and related workers	2.3%	17.4
286	Creative and performing artists not elsewhere classified	2.3%	17.0
287	Pet groomers and animal care workers	2.2%	25.7
288	Fishery and aquaculture labourers	2.1%	13.7
289	Bleaching, dyeing and fabric cleaning machine operators	2.1%	21.1
290	Jewellery and precious-metal workers	2.0%	12.6
291	Livestock farm labourers	2.0%	17.4
292	Services managers not elsewhere classified	2.0%	22.9
293	Printers	2.0%	9.3
294	Door to door salespersons	2.0%	20.4
295	Hairdressers	1.9%	19.4
296	Accounting associate professionals	1.9%	17.8
297	Contact centre salespersons	1.9%	19.0
298	Travel consultants and clerks	1.8%	18.0
299	Refuse sorters	1.6%	3.3
300	Education managers	1.6%	36.3
301	Debt-collectors and related workers	1.5%	13.1
302	Sewing, embroidery and related workers	1.4%	24.2
303	Weaving and knitting machine operators	1.4%	26.0
304	Stall and market salespersons	1.4%	20.7
305	Dairy-products makers	1.3%	15.2
306	Pawnbrokers and money-lenders	1.1%	6.0
307	Handicraft workers in textile, leather and related materials	1.1%	24.3
308	Potters and related workers	1.0%	8.5
309	Tailors, dressmakers, furriers and hatters	1.0%	23.6
310	Legislators	0.9%	16.3
311	Bicycle and related repairers	0.9%	13.7
312	Shop keepers	0.7%	16.9
313	Motorcycle drivers	0.5%	8.6

Source: DANE-GEIH. Own calculations

Table A.5: Occupations with positive employment growth (2010 - 2018)

ISCO code	ISCO title	Skill level
3313	Accounting associate professionals	High
7127	Air conditioning and refrigeration mechanics	Medium
7232	Aircraft engine mechanics and repairers	Medium
6221	Aquaculture workers	Low
2621	Archivists and curators	High
5142	Beauticians and related workers	Low
7234	Bicycle and related repairers	Medium
8331	Bus and tram drivers	Medium
7511	Butchers, fishmongers and related food preparers	Medium
8322	Car, taxi and van drivers	Medium
3116	Chemical engineering technicians	High
9112	Cleaners and helpers in offices, hotels and other establishments	Low
3331	Clearing and forwarding agents	High
4229	Client information workers not elsewhere classified	Medium
3322	Commercial sales representatives	High
2523	Computer network professionals	High
7114	Concrete placers, concrete finishers and related workers	Medium
7549	Craft and related workers not elsewhere classified	Medium
7513	Dairy-products makers	Medium
2521	Database designers and administrators	High
3251	Dental assistants and therapists	High
5152	Domestic housekeepers	Low
3118	Draughtspersons	High
8342	Earthmoving and related plant operators	Medium
1345	Education managers	High
7413	Electrical line installers and repairers	Medium
3114	Electronics engineering technicians	High
2152	Electronics engineers	High
2263	Environmental and occupational health and hygiene professionals	High
3257	Environmental and occupational health inspectors and associates	High
9411	Fast food preparers	Low
8151	Fibre preparing, spinning and winding machine operators	Medium
1346	Financial and insurance services branch managers	High
7122	Floor layers and tile setters	Medium
8155	Fur and leather preparing machine operators	Medium
6113	Gardeners, horticultural and nursery growers	Low
7532	Garment and related pattern-makers and cutters	Medium
7315	Glass makers, cutters, grinders and finishers	Medium

7125	Glaziers	Medium
5141	Hairdressers	Low
9121	Hand launderers and pressers	Low
3259	Health associate professionals not elsewhere classified	High
1342	Health services managers	High
1330	Information and communications technology service managers	High
3512	Information and communications technology user support technicians	High
6222	Inland and coastal waters fishery workers	Low
7124	Insulation workers	Medium
3321	Insurance representatives	High
7313	Jewellery and precious-metal workers	Medium
3141	Life science technicians (excluding medical)	High
2421	Management and organization analysts	High
1120	Managing directors and chief executives	High
1321	Manufacturing managers	High
3122	Manufacturing supervisors	High
2120	Mathematicians, actuaries and statisticians	High
3115	Mechanical engineering technicians	High
8211	Mechanical machinery assemblers	Medium
3214	Medical and dental prosthetic technicians	High
9623	Meter readers and vending-machine collectors	Low
8111	Miners and quarriers	Medium
3117	Mining and metallurgical technicians	High
2146	Mining engineers, metallurgists and related professionals	High
7231	Motor vehicle mechanics and repairers	Medium
8321	Motorcycle drivers	Medium
2221	Nursing professionals	High
2267	Optometrists and ophthalmic opticians	High
3435	Other artistic and cultural associate professionals	High
8183	Packing, bottling and labelling machine operators	Medium
5329	Personal care workers in health services not elsewhere classified	Low
2423	Personnel and careers professionals	High
5164	Pet groomers and animal care workers	Low
3213	Pharmaceutical technicians and assistants	High
2262	Pharmacists	High
2633	Philosophers, historians and political scientists	High
8132	Photographic products machine operators	Medium
2264	Physiotherapists	High
3255	Physiotherapy technicians and assistants	High
7123	Plasterers	Medium
3139	Process control technicians not elsewhere classified	High
4322	Production clerks	Medium
5419	Protective services workers not elsewhere classified	Low
2634	Psychologists	High

8171	Pulp and papermaking plant operators	Medium
3334	Real estate agents and property managers	High
4226	Receptionists (general)	Medium
9612	Refuse sorters	Low
1223	Research and development managers	High
7121	Roofers	Medium
1221	Sales and marketing managers	High
7533	Sewing, embroidery and related workers	Medium
7213	Sheet-metal workers	Medium
5221	Shop keepers	Low
2632	Sociologists, anthropologists and related professionals	High
2352	Special needs teachers	High
3422	Sports coaches, instructors and officials	High
4312	Statistical, finance and insurance clerks	Medium
3314	Statistical, mathematical and related associate professionals	High
8182	Steam engine and boiler operators	Medium
4321	Stock clerks	Medium
9520	Street vendors (excluding food)	Low
1324	Supply, distribution and related managers	High
7531	Tailors, dressmakers, furriers and hatters	Medium
5312	Teachers' aides	Low
2153	Telecommunications engineers	High
8159	Textile, fur and leather products machine operators not elsewhere classified	Medium
7222	Toolmakers and related workers	Medium
2424	Training and staff development professionals	High
4221	Travel consultants and clerks	Medium
5113	Travel guides	Low
7541	Underwater divers	Medium
7534	Upholsterers and related workers	Medium
2250	Veterinarians	High
3240	Veterinary technicians and assistants	High
2320	Vocational education teachers	High
2513	Web and multimedia developers	High
8113	Well drillers and borers and related workers	Medium

Source: DANE-GEIH. Own calculations

Table A.6: Occupations with a positive real wage trend (2010 - 2018)

ISCO code	ISCO title	Skill level
1114	Senior officials of special-interest organizations	High
1213	Policy and planning managers	High
1222	Advertising and public relations managers	High
1311	Agricultural and forestry production managers	High
1330	Information and communications technology service managers	High
1342	Health services managers	High
1343	Aged care services managers	High
1345	Education managers	High
1412	Restaurant managers	High
1439	Services managers not elsewhere classified	High
2113	Chemists	High
2114	Geologists and geophysicists	High
2120	Mathematicians, actuaries and statisticians	High
2131	Biologists, botanists, zoologists and related professionals	High
2141	Industrial and production engineers	High
2143	Environmental engineers	High
2146	Mining engineers, metallurgists and related professionals	High
2149	Engineering professionals not elsewhere classified	High
2152	Electronics engineers	High
2153	Telecommunications engineers	High
2166	Graphic and multimedia designers	High
2262	Pharmacists	High
2264	Physiotherapists	High
2265	Dieticians and nutritionists	High
2266	Audiologists and speech therapists	High
2330	Secondary education teachers	High
2341	Primary school teachers	High
2352	Special needs teachers	High
2353	Other language teachers	High
2354	Other music teachers	High
2356	Information technology trainers	High
2359	Teaching professionals not elsewhere classified	High
2423	Personnel and careers professionals	High

2432	Public relations professionals	High
2433	Technical and medical sales professionals (excluding ICT)	High
2513	Web and multimedia developers	High
2522	Systems administrators	High
2523	Computer network professionals	High
2611	Lawyers	High
2612	Judges	High
2619	Legal professionals not elsewhere classified	High
2621	Archivists and curators	High
2622	Librarians and related information professionals	High
2632	Sociologists, anthropologists and related professionals	High
2635	Social work and counselling professionals	High
2642	Journalists	High
2643	Translators, interpreters and other linguists	High
2652	Musicians, singers and composers	High
2654	Film, stage and related directors and producers	High
3111	Chemical and physical science technicians	High
3112	Civil engineering technicians	High
3114	Electronics engineering technicians	High
3115	Mechanical engineering technicians	High
3118	Draughtspersons	High
3121	Mining supervisors	High
3123	Construction supervisors	High
3134	Petroleum and natural gas refining plant operators	High
3139	Process control technicians not elsewhere classified	High
3151	Ships' engineers	High
3154	Air traffic controllers	High
3155	Air traffic safety electronics technicians	High
3211	Medical imaging and therapeutic equipment technicians	High
3213	Pharmaceutical technicians and assistants	High
3240	Veterinary technicians and assistants	High
3254	Dispensing opticians	High
3314	Statistical, mathematical and related associate professionals	High
3324	Trade brokers	High
3333	Employment agents and contractors	High
3339	Business services agents not elsewhere classified	High
3341	Office supervisors	High
3343	Administrative and executive secretaries	High
3344	Medical secretaries	High
3351	Customs and border inspectors	High
3353	Government social benefits officials	High
3355	Police inspectors and detectives	High
3422	Sports coaches, instructors and officials	High
3423	Fitness and recreation instructors and program leaders	High

3431	Photographers	High
3435	Other artistic and cultural associate professionals	High
3511	Information and communications technology operations technicians	High
3513	Computer network and systems technicians	High
4110	General office clerks	Medium
4120	Secretaries (general)	Medium
4131	Typists and word processing operators	Medium
4132	Data entry clerks	Medium
4211	Bank tellers and related clerks	Medium
4214	Debt-collectors and related workers	Medium
4222	Contact centre information clerks	Medium
4223	Telephone switchboard operators	Medium
4226	Receptionists (general)	Medium
4227	Survey and market research interviewers	Medium
4229	Client information workers not elsewhere classified	Medium
4312	Statistical, finance and insurance clerks	Medium
4313	Payroll clerks	Medium
4321	Stock clerks	Medium
4412	Mail carriers and sorting clerks	Medium
4413	Coding, proof-reading and related clerks	Medium
4415	Filing and copying clerks	Medium
4416	Personnel clerks	Medium
4419	Clerical support workers not elsewhere classified	Medium
5111	Travel attendants and travel stewards	Low
5113	Travel guides	Low
5131	Waiters	Low
5132	Bartenders	Low
5141	Hairdressers	Low
5152	Domestic housekeepers	Low
5153	Building caretakers	Low
5161	Astrologers, fortune-tellers and related workers	Low
5163	Undertakers and embalmers	Low
5164	Pet groomers and animal care workers	Low
5169	Personal services workers not elsewhere classified	Low
5242	Sales demonstrators	Low
5244	Contact centre salespersons	Low
5245	Service station attendants	Low
5246	Food service counter attendants	Low
5249	Sales workers not elsewhere classified	Low
5311	Child care workers	Low
5312	Teachers' aides	Low
5322	Home-based personal care workers	Low
5329	Personal care workers in health services not elsewhere classified	Low
5411	Fire-fighters	Low
5414	Security guards	Low
5419	Protective services workers not elsewhere classified	Low

6111	Field crop and vegetable growers	Low
6112	Tree and shrub crop growers	Low
6113	Gardeners, horticultural and nursery growers	Low
6122	Poultry producers	Low
6130	Mixed crop and animal producers	Low
6221	Aquaculture workers	Low
6222	Inland and coastal waters fishery workers	Low
7111	House builders	Medium
7112	Bricklayers and related workers	Medium
7113	Stonemasons, stone cutters, splitters and carvers	Medium
7114	Concrete placers, concrete finishers and related workers	Medium
7115	Carpenters and joiners	Medium
7119	Building frame and related trades workers not elsewhere classified	Medium
7123	Plasterers	Medium
7125	Glaziers	Medium
7126	Plumbers and pipe fitters	Medium
7127	Air conditioning and refrigeration mechanics	Medium
7211	Metal moulders and coremakers	Medium
7212	Welders and flamecutters	Medium
7213	Sheet-metal workers	Medium
7214	Structural-metal preparers and erectors	Medium
7221	Blacksmiths, hammersmiths and forging press workers	Medium
7223	Metal working machine tool setters and operators	Medium
7224	Metal polishers, wheel grinders and tool sharpeners	Medium
7231	Motor vehicle mechanics and repairers	Medium
7233	Agricultural and industrial machinery mechanics and repairers	Medium
7234	Bicycle and related repairers	Medium
7314	Potters and related workers	Medium
7315	Glass makers, cutters, grinders and finishers	Medium
7316	Sign writers, decorative painters, engravers and etchers	Medium
7317	Handicraft workers in wood, basketry and related materials	Medium
7322	Printers	Medium
7323	Print finishing and binding workers	Medium
7411	Building and related electricians	Medium
7412	Electrical mechanics and fitters	Medium
7512	Bakers, pastry-cooks and confectionery makers	Medium
7513	Dairy-products makers	Medium
7514	Fruit, vegetable and related preservers	Medium
7516	Tobacco preparers and tobacco products makers	Medium
7521	Wood treaters	Medium
7522	Cabinet-makers and related workers	Medium
7531	Tailors, dressmakers, furriers and hatters	Medium
7532	Garment and related pattern-makers and cutters	Medium

7533	Sewing, embroidery and related workers	Medium
7534	Upholsterers and related workers	Medium
7535	Pelt dressers, tanners and fellmongers	Medium
7536	Shoemakers and related workers	Medium
7541	Underwater divers	Medium
7544	Fumigators and other pest and weed controllers	Medium
7549	Craft and related workers not elsewhere classified	Medium
8111	Miners and quarriers	Medium
8112	Mineral and stone processing plant operators	Medium
8114	Cement, stone and other mineral products machine operators	Medium
8122	Metal finishing, plating and coating machine operators	Medium
8131	Chemical products plant and machine operators	Medium
8141	Rubber products machine operators	Medium
8142	Plastic products machine operators	Medium
8143	Paper products machine operators	Medium
8151	Fibre preparing, spinning and winding machine operators	Medium
8153	Sewing machine operators	Medium
8155	Fur and leather preparing machine operators	Medium
8156	Shoemaking and related machine operators	Medium
8157	Laundry machine operators	Medium
8159	Textile, fur and leather products machine operators not elsewhere classified	Medium
8160	Food and related products machine operators	Medium
8171	Pulp and papermaking plant operators	Medium
8172	Wood processing plant operators	Medium
8181	Glass and ceramics plant operators	Medium
8183	Packing, bottling and labelling machine operators	Medium
8211	Mechanical machinery assemblers	Medium
8219	Assemblers not elsewhere classified	Medium
8312	Railway brake, signal and switch operators	Medium
8321	Motorcycle drivers	Medium
8331	Bus and tram drivers	Medium
8332	Heavy truck and lorry drivers	Medium
8341	Mobile farm and forestry plant operators	Medium
8342	Earthmoving and related plant operators	Medium
8343	Crane, hoist and related plant operators	Medium
8344	Lifting truck operators	Medium
9111	Domestic cleaners and helpers	Low
9112	Cleaners and helpers in offices, hotels and other establishments	Low
9121	Hand launderers and pressers	Low
9122	Vehicle cleaners	Low
9211	Crop farm labourers	Low
9213	Mixed crop and livestock farm labourers	Low
9215	Forestry labourers	Low
9313	Building construction labourers	Low

9321	Hand packers	Low
9329	Manufacturing labourers not elsewhere classified	Low
9333	Freight handlers	Low
9411	Fast food preparers	Low
9412	Kitchen helpers	Low
9520	Street vendors (excluding food)	Low
9611	Garbage and recycling collectors	Low
9613	Sweepers and related labourers	Low
9621	Messengers, package deliverers and luggage porters	Low
9622	Odd job persons	Low
9629	Elementary workers not elsewhere classified	Low

Source: DANE-GEIH. Own calculations

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