9. Possible Uses of Labour Demand and Supply Information to Reduce Skill Mismatches

Jeisson Cárdenas Rubio

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9. Possible Uses of Labour Demand and Supply Information to Reduce Skill Mismatches
9.1. Introduction

As explained in Chapters 3 and 4, Colombia does not have a proper system to identify possible skill mismatches (skill shortages), hence education and training providers experience difficulties in training people according to current employer requirements. As a potential solution to this issue, Chapters 7 and 8 have demonstrated that job portals are rich sources of representative information for the analysis of a considerable segment of the Colombian labour demand (job openings). The systematic collection and depuration of this information via web scraping and text mining, among other techniques, provide (at a low cost) valuable information about 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, more specifically, for tackling two main issues in the Colombian labour market: unemployment and informality. Thus, this chapter shows how the vacancy database, along with household survey information, can be used as a 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 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.), as well as its structure and changes over time. Vacancy information combined with labour supply information generates the possibility of describing and comparing the characteristics of labour demand and supply in Colombia, while a 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 shortage problems occur.
Second, and more importantly, with the combined use of household surveys (GEIH) and the 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 Chapters 7 and 8, vacancy information provides detailed and updated information regarding employer requirements at a low cost and in real time. Specifically, the vacancy information provides insight about new job titles and skills demanded in Colombia; consequently, job portals are 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, education and training providers have useful inputs as a basis for their curricula (according to employer requirements), and public policymakers can identify any barriers (or lack of skills) that obstruct the entrance of people into formal economy.

Given these three advantages of the information collected from job portals, this chapter discusses how the vacancy database can be used to build a detection system of skill shortages, and to regularly update occupational classifications according to employer requirements. The second section of this chapter characterises the labour market (formally and informally employed, as well as unemployed) by educational and occupational levels from 2016 to 2018. The third section elaborates on a set of macro-indicators—for the first time in Colombia—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 labour force skills according to employer requirements.
9.2. Labour market description

The theoretical framework of this book (see Chapter 2) has stressed that a considerable proportion of unemployment and informal economy is explained by a misallocation between skills possessed by job seekers and skills demanded by employers. 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, Chapter 3 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, by occupation, the characteristics of formally and informally employed workers, and those who were unemployed, from 2016 to 2018. This characterisation of the labour market illustrates the structure of the Colombian labour market and provides an idea of labour market issues, for example, where possible or more remarkable skill mismatch problems occur. One of the most distinctive elements of this characterisation is that it shows—for the first time—a disaggregated occupational analysis based on the Colombian household survey using a relatively updated classification such as ISCO-08. As shown in the previous chapter, one of the most important 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 international comparisons. Perhaps the reason why researchers had not considered using the occupational variable before for identifying skill mismatches is that this variable was aggregated and outdated given that updating all household historical survey records according to ISCO-08 via manual codifiers would require a considerable amount of time and money (Chapter 8). However, the previous chapters have shown that it is

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129 For the employment time series analysis, data were available from 2010 to 2018.
possible to overcome these issues with the help of tools such as Cascot and machine learning techniques.

As mentioned in Chapter 8, official labour market information (GEIH) is representative of urban and rural areas, while the vacancy information might not provide accurate results for the country’s rural zones. This chapter examines the results from the GEIH regarding Colombian urban zones to make adequate comparisons between the labour supply and labour demand information.

### 9.2.1. Colombian labour force distribution by occupational groups

Tables 9.1 and 9.2 describe the occupational composition of formal and informal workers and unemployed people at a four-digit ISCO level from 2016 to 2018 (the full tables can be found in Appendix H, Tables H.1 to H.3). Most of the formal workers are “Sales demonstrators,” followed by “(Secondary or university) education teachers,” and “Security guards,” while most of the informal workers are “Sales demonstrators,” “Domestic cleaners and helpers,” and “Car, taxi, and van drivers.”

| #  | 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%            |

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130 Given that the GEIH might have representativeness issues when the data is 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.

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

132 Occupations with the lowest frequency (10% of occupations in the GEIH) were dropped to avoid representativeness issues and outliers.
According to Table 9.2, 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.”

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As mentioned in Chapter 8, 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.
Table 9.2. Occupational distribution of jobs sought by unemployed people in Colombia

| #  | 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%      |
| 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: Author’s calculations based on GEIH information, 2016-2018.*

Figure 9.1 summarises the labour market structure of the Colombian workforce by occupational groups: 41.2% of the 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 the informal workers and 44.2% of those unemployed. This evidence seems to confirm what was mentioned in Chapter 3, that a lack of skills is a prevalent problem in Colombia and contributes to high rates of unemployment and informality.
9.2.2. Unemployment and informality rates

The above results show the composition of the Colombian workforce by occupational groups, and they allow identifying the general structure and patterns in the labour force by occupation, skill level, and formal/informal/unemployed workers. However, the above analysis does not indicate which occupational groups tend to have the highest informality and unemployment rates. For instance, Table 9.1 shows that 16.4% of the informal workers are “Sales demonstrators.” The high proportion of this occupation in the informal labour market might be due to the fact that a considerable number of Colombian workers is employed 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 9.3 shows that the occupations with the highest informality rates are “Domestic cleaners and helpers,” “Motorcycle drivers,” and “Shop keepers” (full tables can be found in Appendix H, Tables H.4 and H.5).
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Table 9.3. 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: Author’s calculations based on GEIH information, 2016-2018.

By contrast, Table 9.4 presents occupations that tend to have lower informality rates, where “Computer network professionals,” “Dieticians and nutritionists,” and “Geologists and geophysicists” are among the occupations with the lowest level of informality.

Table 9.4. 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%             |
Additionally, using 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 (A Programming Language), customer service, communication, and knowledge in alarm and control systems. Consequently, these low rates, along with 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.

Based on information about what jobs are being sought by potential workers, Table 9.5 presents occupations with a higher unemployment rate. As evidenced in the table, “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, also shown in this table, occupations with higher unemployment rates tend to have a

| #  | ISCO title                              | Informality rate |
|----|-----------------------------------------|------------------|
| 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: Author’s calculations based on GEIH information, 2016-2018.*
prolonged (above average) duration of unemployment. These results do not contradict the unemployment rates reported by the DANE: according to the Colombian office of national statistics, the unemployment rate for undergraduates was relatively high (around 10%) in 2016, and the average duration of unemployment for undergraduates is 26 weeks, while it is 18 weeks for people with only a high school certificate.

Table 9.5. **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                             |
| 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: Author’s calculations based on GEIH information, 2016-2018.*

See [https://www.dane.gov.co/index.php/estadisticas-por-tema/mercado-laboral/fuerza-laboral-y-educacion](https://www.dane.gov.co/index.php/estadisticas-por-tema/mercado-laboral/fuerza-laboral-y-educacion).
Tables 9.4 and 9.5 show the importance of analysing unemployment and informality rates at the same time. Occupations such as “Geologists and geophysicists,” “Economists,” or “Filing and copying clerks” tend to have low informality rates, but high unemployment rates and prolonged unemployment periods. Consequently, an increase in labour supply in occupations with relatively low informality rates might increase the unemployment rate. Thus, any public policy that attempts to reorient labour supply according to employer requirements should consider unemployment and informality rates together.

By contrast, Table 9.6 presents occupations with lower unemployment rates. The data presented in the table show that “Religious professionals” have the lowest unemployment rate (0.3%), followed by “Motorcycle drivers” (0.5%) and “Shopkeepers” (0.7%). Moreover, as also evidenced in this table, occupations with lower unemployment rates tend to have a shorter (below average) duration of unemployment.

| #  | 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                             |
Additionally, the results from Table 9.6 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 9.4).

Importantly, Tables 9.3 and 9.6 also highlight the importance of analysing unemployment and informality rates at the same time in order to draw proper public policy advice from data. Occupations such as “Motorcycle drivers,” “Shopkeepers,” “Refuse sorters,” and “Hairdressers,” among others, tend to have low unemployment rates and shorter unemployment periods, but high informality rates. Consequently, increased labour supply in occupations with relatively low unemployment rates might increase the informality rate.

Figure 9.2 summarises 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, as also shown in this figure, the duration of unemployment is higher for high-skilled people.

According to the theoretical framework of this book (see Chapter 2) and the evidence presented in this chapter, skill mismatches are widespread in the Colombian economy, the consequences of which are reflected in its relatively high unemployment and informality rates. However, low-skilled occupations tend to present more signs of oversupply (high informality and unemployment rates). Consequently, Colombian public policies should pay special attention to informing, educating, and training people with low skills according to the employers’ needs.
Figure 9.2. **Unemployment and informality rates and duration of unemployment by skill level**

As mentioned in Chapters 2 and 3, the informal economy, overall, tends to pay lower salaries than the formal economy. Figure 9.3 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 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, this supports the claim indicated in Chapter 2 that informal workers (in terms of income) have an incentive to be part of the formal economy.

In summary, the informality and unemployment rates in Colombia are relatively high. Informal labour (once compared with formal and unemployed population) is mainly composed of adults (more than 29 years old) with a high school educational level or less (see Chapter 3). On the one hand, in concordance with previous results, people in low-skilled occupations have the highest informality rates, while, on the other hand, the unemployed population is mainly composed of young adults (less than 29 years old) (see Chapter 3). 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 more frequently for adults with (at most) 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 work in low- or high-skilled occupations. Thus, regardless of the skill group, the Colombian labour market displays potential signals of skill mismatches.

Nevertheless, low-skilled occupations tend to express more signs of oversupply: 1) a considerably higher informality rate compared to medium- and high-skilled occupations; and 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 9.3).

Differences in the average wages of formal and informal workers by skill level show that informal and unemployed workers—regardless of their skill level—have a strong incentive to be part of the formal economy. As explained in Chapters 2 and 3, despite this financial incentive to participate in the formal economy, the evidence suggests that misallocation between skills possessed by job seekers and 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, 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 increase unemployment rates. Policymakers and training providers should be aware of this duality to provide adequate skills that genuinely improve people’s employability.

9.2.3. 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 its dynamics. Given that possible changes might occur in the labour market, the conditions for a specific group of occupations might improve/worsen over time. Consequently, analysing labour market dynamics by occupations or skill levels will reveal whether there are favourable/unfavourable changes for a particular segment of the labour force. With this in mind, Figure 9.4 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 9.4. Labour market composition of Colombian workers by skill level, 2010-2018

Source: Author’s calculations based on GEIH information, 2010-2018.
As shown in the figure, the overall structure of employed workers in Colombia has not considerably changed during this nine-year period. However, this composition has not changed because employment growth/decline has been relatively the same across all occupational groups. Figure 9.5 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 growth in demand has slowed during the last few years.

Figure 9.5. Employment growth by skill level, 2011-2018

Chapter 3 has shown that the labour participation rate has been relatively consistent over the last decade (around 64%), while the unemployment rate has started to increase in the last four years. Figure 9.6 indicates how the unemployment rates for each skill level have increased. This evidence suggests that imbalances between labour supply and demand have been prevalent for all skill levels in the last few years.135

Indeed, the Talent Shortage Survey released in 2019 by ManpowerGroup indicates that, in Colombia, there has been an increasing trend of talent shortages since 2011 (ManpowerGroup, n. d. 2019).

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Moreover, Chapter 3 has also demonstrated that informality rates have slightly decreased in the last four years. Figure 9.7 confirms in more detail how 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.
Thus, by considering the behaviour of unemployment and informality rates, in general, it can be observed that labour market outcomes have worsened across all skill groups since 2016. Specifically, the evidence indicates that low-skilled occupations show more signs of oversupply. Moreover, the recent increase in unemployment and informality rates (oversupply) suggests that there has been an increase in skill mismatch problems too.

However, a more detailed analysis might reveal that despite worsening 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 H (Table H.6) demonstrates that the employment growth trend has been positive between 2010 and 2018: around 47.4% correspond to high-skilled occupations, followed by 37.1% for medium-skilled and 15.5% for low-skilled occupations. Importantly, most of the occupations with the highest growth in labour demand (analysed in Chapter 6) are also in the mentioned list of occupations with positive employment growth (Table H.6). Such is the case, for instance, 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 with a positive trend in real wages growth between 2010 and 2018 is also available in Appendix H (Table H.7). Around 42.6% of the occupations with a positive trend in wage growth are medium-skilled occupations, followed by 35.7% for high-skilled and 21.6% for low-skilled occupations. Most occupations with the highest growth in labour demand (as mentioned in Chapter 6) are found in the list of occupations with a positive trend in wage growth (Table H.7).

In summary, evidence suggests that Colombian workers face high rates of unemployment and informality, and, overall, their employment conditions have deteriorated since 2016. 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 that 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 costs) 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.

9.3. Measuring possible skill mismatches (macro-indicators)

Measuring 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, increased wages for 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 divided skill mismatch indicators in four categories (see Table 9.7 for a summary): employer-based, price-based, and volume-based indicators, as well as indicators of imbalance. As explained in Chapter 3, in Colombia, it is not possible to build employer-based macro-indicators because there are no sources of information (employer surveys) available. Instead, indicators of imbalance are used that 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 are a possible sign of skill shortages. As explained in Chapter 2, 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 9.7. 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 provide a valuable employer perspective; it is limited, however, since it only provides what employers choose to report. |
| Indicators of imbalance         | Indicators of imbalance focus directly on vacancy levels within an occupation. A high vacancy/unemployment ratio within an occupation suggests that employers are having difficulty filling vacancies given the available supply of workers. Similarly, an increase in the average duration of vacancy indicates that employers are finding it more difficult to fill vacancies. |
| Price-based indicators          | In 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 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, or seeking to work, in an occupation may also indicate shortage (conversely, high unemployment amongst people seeking work in a particular occupation is an indicator that an occupation is not in shortage). |

*Source: MAC 2017.*

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 skill 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 has been impossible because there has been no information about the labour demand or it has not been comparable with labour supply information, for example, not available at an occupational level (see Chapters 3 and 4). Therefore, one of the contributions of this document is that it makes
Colombian information about labour demand (job portals) and labour supply (household surveys) comparable in order to identify possible skill shortages.

In recent years, information from job portals has started to be considered as a source to measure possible skill shortages. For instance, the MAC has recently considered the use of this kind of information to design and update its skill shortage indicators. However, due to the collection of vacancy information provided by Burning Glass Technologies\textsuperscript{136} (see Chapter 6), so far this source of information is only 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 Chapter 4), has highlighted the potential of online vacancy information to provide information that reduces skill mismatches (Cedefop 2018). However, at the time of writing this book, the MAC’s or Cedefop’s skill mismatch indicators based on information from job portals have not been released.

Thus, Section 9.3 discusses how labour demand (job portals) and labour supply (household surveys) information can be used to determine possible skill shortages given the available sources of labour market information in a developing country such as Colombia.

### 9.3.1. Beveridge curve (indicators of imbalance)

The previous chapter has evidenced that information from job portals provides consistent information in terms of data representativeness with 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 Chapter 3, the Beveridge curve relates vacancies to unemployment levels in order to determine how well, or inadequately, vacancies match unemployed workers. The curve is calculated by dividing the job openings

\textsuperscript{136} Burning Glass Technologies count the number of advertised job postings as vacancies and do not consider (so far) the number of job placements a job advertisement might include (MAC 2017).
rate (the number of job placements as a per cent of total employment plus job placements) by the unemployment rate (total unemployed people divided by the total of employed and unemployed labour force):

\[
\text{Beveridge curve} = \frac{\text{job placements}}{\frac{\text{total employment} + \text{job placements}}{\text{unemployed}}} \quad \frac{\text{labour force}}{}
\]

The points on the curve indicate the current business cycle of an economy.\(^{137}\) 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 in 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 a job vacancy (Bleakley and Fuhrer 1997). Theoretically, this curve slopes downward as the unemployment rate gets higher, the vacancy rate lower, and vice versa.\(^{138}\)

Despite measuring labour market mismatch rather than skill mismatch, the Beveridge curve provides a first approach to assess the state of labour market matching. Moreover, it was expected that the Colombian Beveridge curve is strongly influenced by skill mismatches because the evidence found in Colombia, thus far (see Chapter 3), showed that skill mismatch problems are one of the most important causes of unemployment. Additionally, disaggregating the

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137 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).

138 Empirically, different authors have demonstrated the downward slope of this curve in the US and other countries (Elsby, Michaels, and Ratner 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 book was also expected to show a downward slope.
curve into occupational (one-digit) ISCO groups helped to determine which occupations might be experiencing more or fewer skill mismatch problems.

This document estimates the Beveridge curve at a one-digit occupational group level for the period 2016-2018 (similar to Turrell et al. 2018)\textsuperscript{139} (see Figure 9.8). As can be observed here, 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 Chapter 8). 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.

Figure 9.8. Beveridge curve by (major) occupational groups

\textsuperscript{139} Given that the GEIH information has representativeness problems when data are excessively disaggregated (i.e. by quarter, four-digit occupational groups, etc. [see Chapter 3]), this book estimates the Beveridge curve at a one-digit occupational group level.
Possible uses of labour demand and supply information to reduce skill mismatches

Clerical support workers

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

Source: Author’s calculations based on vacancy and GEIH information, 2016-2018.
In more detail, the Colombian Beveridge curve by occupational groups indicates two facts. First, the initial quarter of each year is characterised by higher unemployment rates and lower vacancy rates, while the last quarter of each year is characterised by lower unemployment rates and higher vacancy rates. This exercise shows that vacancies have, as expected, a positive relation with employment and a negative association with unemployment rates. 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 9.8) 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” suggests fewer labour market frictions for those occupational groups.\footnote{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 in Colombian labour matching.}

9.3.2. 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 9.7, 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 in employment/unemployment rates are sought as a sign of skill shortages.
This subsection focuses on volume-based indicators. As the name “volume-based” implies, these indicators are based on the number of working or unemployed people, or the number of hours worked.\footnote{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 trend of unemployment might represent lower utilisation of a particular occupation; therefore, it might suggest that the occupation is not in shortage.} Given the existing labour supply and new sources of labour demand information available in Colombia, it has become possible to estimate volume-based (and price-based) indicators of skill mismatch.

As mentioned in Chapter 3, 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 book. Thus, based on the system developed by the MAC and information available for Colombia, this document proposes the following volume-based measures to identify possible skill shortages.

\textbf{9.3.2.1. Percentage change in unemployment by sought occupation (three years)}

As mentioned above, a decrease in the number of unemployed individuals is 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, in most of the indicators that use household survey information) might excessively fluctuate and produce volatility in volume-based indicators, affecting thus 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.
Figure 9.9 depicts the percentage change in unemployed individuals by sought occupation. Additionally, this and the following figures 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 9.3.4, these thresholds help to determine at which point a specific indicator value should be considered as a sign of skill mismatch. As observed in this figure, 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%.

Figure 9.9. Percentage change in unemployed individuals by sought occupation

Source: Author’s calculations based on GEIH information, 2016-2018.

Note: Median (a), third quartile (b), and the median plus 50 per cent of the median (c).

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142 The median is a measure of central tendency that is not affected by outliers.

143 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 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
The distribution of this indicator shows that the number of unemployed individuals (by sought occupation) has increased for some occupations, while for other occupations 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 occupations is concentrated on the right of Figure 9.9, around a 0% change in unemployment. Moreover, the fact that the median is negative (-2.8%) indicates that more than half of the 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 reductions in unemployment occurred in occupations with relatively few job seekers, while increases in unemployment happened in occupations with a relatively high number of job seekers.

9.3.2.2. 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 Chapter 2). 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 (see Figure 9.10).
As Figure 9.10 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.

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

As discussed in the previous chapter, 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 because people left their jobs (replacement demand). It is logical to think that when there is an increase in 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 Chapter 8). Consequently, new hires can be used as an indicator of possible skill shortages.

As in the case of 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 cannot find a formal job. Thus, this indicator is calculated by only accounting for the number of new hires in the formal economy (see Figure 9.11). As can be observed, 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 increase in the number of new formal hires. Indeed, this distribution is slightly left-skewed.

Figure 9.11. **Percentage change in new hires by occupation**

Source: Author’s calculations based on GEIH information, 2016-2018.

Note: Median (a), third quartile (b), and the median plus 50 per cent of the median (c).
9.3.2.4. Percentage change in hours worked for formal employees (three years)

Alternatively, higher utilisation of the workforce for a particular occupation can occur through increases in the number of 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 decrease. In this case, an increase in hours worked do not indicate that there is a possible skill mismatch.

Figure 9.12 illustrates the percentage change in hours worked for formal 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.

9.3.2.5. Percentage change in job vacancy advertisements by occupation

As mentioned above, indicators based on labour supply might be influenced by other factors (e.g. labour participation) rather than a higher labour demand utilisation. Moreover, the previous chapters have shown that information from job portals represents occupational economic seasons and trends in 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 these three
Figure 9.12. **Percentage change in hours worked for formal employees by occupation**

*Source:* Author’s calculations based on GEIH information, 2016-2018.

*Note:* Median (a), third quartile (b), and the median plus 50 per cent of the median (c).

Figure 9.13. **Percentage change in job placements by occupation**

*Source:* Author’s calculations based on vacancy database, 2016-2018.

*Note:* Median (a), third quartile (b), and the median plus 50 per cent of the median (c).
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 9.13 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 percent of the median is 6.1%. In accordance with Chapter 7, 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, which means that relatively few occupations experienced decrease in the number of advertised vacancies, while a higher number of occupations experienced an increase in job placements.

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 search process (e.g. lower search cost) rather than real increase in 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.

**9.3.3. Price-based indicators: Wages**

As explained in Chapter 2, skill shortages might lead to increased wages. As 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 and hourly wages of Colombian workers (prices), while information from job portals provides reliable information about vacancy wages (see Chapters 7 and 8). Therefore,
it is possible to build price indexes based on labour demand that are compatible with labour supply-based indicators, which might determine possible skill shortages.

**9.3.3.1. Percentage change in median real hourly wage for formal employees (three years)**

Estimating percentage change in wages might provide evidence regarding possible skill shortages. However, there are some points to consider in order to define this indicator in a way that it 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 wage 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 value for the real wages (adjustment for inflation) of formal employees by dividing real salaries by the number of hours worked and averaging annual wage changes across three years. Figure 9.14 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 real hourly wage for formal employees indicates that more than half of the occupational groups have experienced increases in real hourly wage. This result suggests that, for a considerable number of occupational groups, labour demand might have increased.
Figure 9.14. Percentage change in mean real hourly wage for formal employees by occupation

Source: Author’s calculations based on GEIH information, 2016-2018.

Note: Median (a), third quartile (b), and the median plus 50 per cent of the median (c).

9.3.3.2. Relative premium for an occupation:
Controlling for education, region, and age

Alternatively, occupational shortages might indicate a relatively 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:

\[
\ln(w) = \beta_0 + \beta_1 \text{occupation}_i + \epsilon
\]

Where \( w \) is wages, \( \beta_0 \) is the intercept, \( \text{occupation} \) is a dummy variable that takes the value of one when the premium is estimated for the occupation \( i \), and \( \epsilon \) is the error term.
However, the premium of a certain occupation compared to another might be affected by the characteristics of the geography or the people. For instance, the remuneration for an occupation might be affected by 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 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 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 the Mincer equation (see Chapter 2). 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 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 the 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 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 Chapter 8); 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\(^{144}\) (nine groups). Thus, the relative premium for an occupation can be expressed as follows:

\[
\ln(w) = \beta_0 + \beta_1 \text{occupation}_{io} + \beta_2 \text{education}_{io} + \beta_3 \text{age}_{io} + \beta_4 \text{region}_{io} + \epsilon
\]

\(^{144}\) Higher levels of disaggregation can cause representativeness problems.
Where \( w \) indicates people’s wages, \( \beta_0 \) 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 and in the one-digit ISCO group \( o \). The education and age variables are the worker’s education (measured in years of education) and age, respectively, while region is the department\(^{145}\) where the person works, and \( \varepsilon \) is the error term.

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

Figure 9.15 presents the distribution of regression coefficients. 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 is a considerable number of occupational groups with positive hourly pay premia, which might indicate a shortage.

### 9.3.3.3. Relative vacancy premium for an occupation: Controlling for region and experience

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 information comes from employer sources. Moreover, as showed in the previous chapter, 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.

\(^{145}\) Amazonas, Antioquia, Arauca, Atlántico, Bogotá, Bolívar, Boyacá, Caldas, Caquetá, Casanare, Caúca, César, Chocó, Córdoba, Cundinamarca, Guainía, Guaviare, Huila, La Guajira, Magdalena, Meta, Nariño, Norte de Santander, Putumayo, Quindío, Risaralda, San Andrés and Providencia, Santander, Sucre, Tolima, Valle del Cauca, Vaupés, and Vichada.
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:

$$\ln(w) = \beta_0 + \beta_1^{occupation} + \beta_2^{diploma} + \beta_3^{experience} + \beta_4^{region} + \varepsilon$$

Where $w$ is the vacancy’s wages, $\beta_0$ 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 that indicate educational requirements (six categories, see Chapter 6, Table 6.2146). The variable $experience$ is a dummy variable that takes the value of one if a vacancy requires experience and zero

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146 Due to frequency issues, the categories of specialisation, master’s and doctoral degrees were grouped in one category: “Postgraduate.”
otherwise, *region* is the department where the job vacancy is available, and $\varepsilon$ is the error term.

Figure 9.16 presents the distribution of regression coefficients. 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. As can be observed, the measures of central tendency tend to be positive in both Figure 9.15 and Figure 9.16. However, there are differences in the magnitude of the measures of central tendency for each one given that Figure 9.15 presents a higher hourly pay premium than Figure 9.16. As mentioned in Chapter 8, these differences might be explained by several reasons, such as the bargaining process or an employer’s behaviour when posting wages in job advertisements. Despite their differences, Figures 9.15 and 9.16 show that there is a considerable number of occupational groups with positive hourly pay premia, which might indicate a skill shortage.

Figure 9.16. **Occupational pay premia within job placements**

Source: Author’s calculations based on vacancy database, 2016-2018.

*Note*: Median (a), third quartile (b), and the median plus 50 per cent of the median (c).
9.3.4. 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 taken part of an extended discussion regarding the adaptation of possible thresholds. As this institution has pointed out, there is no economic rule that fixes indicator thresholds. Consequently, given the MAC’s recommendations and similarities between the MAC indicators and Colombian skill shortage indexes, this book 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 the occupations) at risk of skill shortages (see MAC 2008). Consequently, even in situations where labour market works under perfect competition (see Chapter 2), 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 are -0.8% and -1.3%, respectively (see Figure 9.10). 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 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 9.9). 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, an increase of more than 4.6% in formal employment by occupation suggests shortages (Figure 9.10).

For the “new hires” indicator, the median plus 50 per cent provide intuitive results. Increases of more than 6.9% in formal hires by occupation suggest the occurrence of skill shortages (Figure 9.11). 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 (Figure 9.12). 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 an increase 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% (Figure 9.13); therefore, increases in the percentage of online job vacancy advertisements of more than 6.1% are 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 9.14). Consequently, increases in percentage change of more than 7.4% regarding the mean hourly pay for formal employees suggest occupational deficits.

Regarding the occupational hourly pay premia of formal workers (Figure 9.15), 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 9.16). Thus, in such cases, the third quartile value (12%) is selected to classify occupations and increases of more than 12.0% in the occupation pay premia for job placements suggest skill shortages. Table 9.8 summarises these indicators alongside their corresponding threshold values for an occupation to be considered in short supply.

Table 9.8. **Skill shortage indicators and thresholds**

| Indicator                                                                 | Threshold type          | Threshold value |
|---------------------------------------------------------------------------|-------------------------|-----------------|
| % change in unemployed individuals by sought occupation                    | Median plus 50%         | -4.2%           |
| % change in formal employment                                             | Top quartile (75)       | 4.6%            |
| % change in the proportion of formal workers in their job for less than a year (new hires) | Median plus 50%         | 6.9%            |
| % change in hours worked for formal employees                             | Top quartile (75)       | 1.1%            |
| % change in job vacancy advertisements by occupation                      | Median plus 50%         | 6.1%            |
| % change in median (real) hourly pay for formal employees                 | Median plus 50%         | 7.4%            |
| Relative premium for an occupation, controlling for education, region, and age | Median plus 50%         | 2.8%            |
| Relative vacancy premium for an occupation, controlling for region and experience | Top quartile (75)       | 12.0%           |

Source: Author’s calculations based on vacancy database and GEIH, 2016-2018.

Once the measurement methods and thresholds have been established, the next step is to determine when an occupation shows strong signs of skill mismatch. As mentioned before, there is not an indicator that satisfactorily identifies every skill shortage. Instead, it would be excessively restrictive to expect that occupations in short supply will be identified by every indicator. Consequently, Figure 9.17 shows the number of occupations according to the percentage of indicators that suggest skill shortages. As can be observed, for instance, in 110 occupations, 25% or more of the indicators suggest skill shortages, while in 69 groups, at least, 50% of the indicators suggest skill mismatch issues.
Figure 9.17. **Number of occupations according to the percentage of indicators that suggest skill shortages**

![Graph showing the relationship between the percentage of indicators suggesting skill shortages and the number of occupations.](image)

*Source: Author’s calculations based on vacancy database and GEIH, 2016-2018.*

Figure 9.17 helps to determine when an occupation shows strong signs of skill 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, while the remaining 50% do not. Moreover, the number of occupations with more than half of their indicators signalling skill 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 document suggests accepting a skill shortage if more than 50% of an occupation’s indicators exhibit no missing values.\(^{147}\) The MAC (2008) uses a similar condition to determine skill shortages in the UK.

\(^{147}\) For some occupations, data were only available for a subset of indicators.
9.3.5. Skill shortages in the Colombian labour market

Table 9.9 lists the occupations that exhibit a strong sign of skill shortages. According to this table, 30 occupations are currently in short supply: 46.7% of the categories belong to high-skilled occupations, 36.6% to medium-skilled occupations, and 16.7% to low-skilled occupations. This evidence suggests that there exist formal labour market opportunities for people at all skill levels.

Table 9.9. Occupations in skill mismatch

| Code  | ISCO titles                                             | Total indicators available | Total indicators passed | Percentage of indicators passed |
|-------|--------------------------------------------------------|-----------------------------|-------------------------|--------------------------------|
| 2513  | Web and multimedia developers                          | 8                           | 8                       | 100.0%                         |
| 2412  | Financial and investment advisers                      | 8                           | 7                       | 87.5%                          |
| 2421  | Management and organisation 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%                          |
As can be seen, “Web and multimedia developers,” “Financial and investment advisers,” and “Management and organisation 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 Chapter 3, that labour market changes and new occupations might emerge; cases of occupations related to Big Data technologies (machine learning engineers, data sciences, Big Data engineers, among others) are representative examples.

The results from Table 9.9 strongly evidence that formal jobs have the best opportunities to absorb labour supply, which constitutes an important information for the Colombian government, education and training providers, and people in general in order to make policy decisions, provide training, and find employment. Consequently, based on the labour supply and demand model, in order to tackle informality and unemployment rates, it is necessary to make informal and unemployed people aware that jobs in certain occupations (see Table 9.9) 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.

9.4. 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 information from job portals is not limited to the provision of skill mismatch (macro) indicators. As shown in previous chapters, vacancy information provides detailed and updated information regarding employer requirements. Specifically, vacancy information provides detailed information about job requirements, and, hence, these 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 provide individuals with the proper skills demanded by employers. 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.

9.4.1. Skills

As demonstrated in Chapter 7, 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, providing a complete list of skills required for each vacancy would be a time-consuming task. Second, job descriptions tend to be concise and precise seeking to capture the attention of job applicants. Thus, employers only provide 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 a particular occupation, and the candidate who possesses those key skills will have better chances to obtain a job.

Consequently, a skills analysis might reveal the key skills and individual needs to apply for a certain job. Importantly, together with macro-indicators, job vacancy information can show which occupations are in short supply, as well as the key skills required to apply for those occupations. For instance, Table 9.10 presents five illustrative examples of occupations with skill shortages and what skills are frequently demanded for those occupations (“Web and multimedia developers,” “Draughtspersons,” “Travel guides,” “Bicycle and related repairers”, and “Productions clerks”).

| 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         |

148 Given the quantity of the information and occupational categories, this subsection focuses on some illustrative cases.
### Possible Uses of Labour Demand and Supply Information to Reduce Skill Mismatches

| ISCO title                      | Skill title                      | Skill type       | Skill reusability level |
|--------------------------------|----------------------------------|------------------|-------------------------|
| 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     |
| ISCO title                     | Skill title                          | Skill type       | Skill reusability level |
|-------------------------------|--------------------------------------|------------------|-------------------------|
| 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              |
| ISCO title                  | Skill title                      | Skill type          | Skill reusability level |
|----------------------------|----------------------------------|---------------------|-------------------------|
| 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            |
| ISCO title       | Skill title               | Skill type       | Skill reusability level |
|------------------|---------------------------|------------------|-------------------------|
| Draughtspersons  | Geometry                  | Knowledge        | Cross-sector            |
| Draughtspersons  | Innovation processes      | Knowledge        | Sector-specific         |
| Draughtspersons  | Adobe Illustrator         | Knowledge        | Sector-specific         |
| Draughtspersons  | Manage ICT projects       | 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         |
| ISCO title                  | Skill title             | Skill type          | Skill reusability level |
|----------------------------|-------------------------|---------------------|-------------------------|
| 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         |
| ISCO title            | Skill title                      | Skill type           | Skill reusability level |
|----------------------|----------------------------------|----------------------|-------------------------|
| 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            |
As observed in this table, the skill most demanded for “Web and multimedia developers” is SQL, followed by database (according to the 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 in Chapter 2, 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
frequently mentioned transversal skills. For instance, for “Web and multimedia developers,” and “Draughtspersons,” the most requested skills are for knowledge of English and for a person who can work in teams. Moreover, in some cases (such as “Production clerks”) transversal skills such English, work in teams and communication are the most, or one of the most, frequently requested skills 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”), information from job portals provides a limited number of demanded skills. Due to the lack of observations, it is not possible to obtain a more comprehensive skill list for specific occupations.

With the information in Table 9.10, policymakers can design and induce training and educational programs that provide (at the very least) the most frequently demanded skills by employers. Likewise, with this information, education 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.

9.4.2. Skill trends

The results from Table 9.10 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. Increased demand of a particular skill for an occupation means that employers consider that characteristic more critical than others, or they are unable to find people with those requirements. Thus, analysing skill trends means identifying among the demanded skills the ones that are becoming more/less important for the labour market.

For illustrative purposes, Table 9.11 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 others, exhibit a positive trend. Thus, special emphasis must be placed on providing those skills to “Web and multimedia developers.” Moreover, the
results from Table 9.11 can be extended to other occupations. Consequently, the education and training system in Colombia—for example, career advisers, among others—can eventually improve the efficiency of addressing labour supply according to labour demand trends.

Table 9.11. **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: Author’s calculations based on vacancy and GEIH information, 2016-2018.*

### 9.5. 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) who work in low-skilled occupations, while unemployment problem occurs with relatively more frequency in people younger than 29 years old who work in low- or high-skilled occupations. Furthermore, the considerable gap in the average wages of formal and informal workers by skill level indi-
icates that informal workers and those who are unemployed (regardless of their 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; and 2) a high unemployment rate (slightly below 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 skill monitoring) to reduce imperfect information issues by identifying possible skill shortages. Thus, this chapter has demonstrated that it is possible to develop a system for the identification of skill mismatches based on online vacancy information and household surveys in countries like Colombia.

Despite the relatively short period covered by the data, a Beveridge curve by occupational groups was estimated for Colombia 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 and lower vacancy rates, while the last quarter of the year is characterised by lower unemployment and higher vacancy rates; and 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 note that “there is no one ‘best way’ to do it” (Bosworth 1993). Indeed, different approaches can be adapted from the literature (see Section 9.3). Given the relatively long experience of the MAC in designing skill mismatch indicators, as well as the vacancy and household survey information available for Colombia, this book concludes that the MAC indicators are a suitable framework for the Colombian context.

One of the most relevant elements for the adaptation of the MAC indicators to the Colombian context is the difference between the formal and informal economy in Colombia. Increases in the level of employment might be due to increases in the number of informal workers. In this scenario, growth in the number of employees does 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 there exist formal labour market opportunities 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 a continuous and consistent monitoring of skill shortages at a relatively low cost and over a short time period. However, the scope of job vacancy information is not limited to the estimation and improvement 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 the skills of object-oriented modelling, create software design, and Apache Tomcat, among other skills.

Based on these results, 1) policymakers and education and training providers can quickly promote and update policies and curricula, 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 employer requirements; and 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 a 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.