2. The Labour Market and Skill Mismatches

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2.1. Introduction

The labour market can be defined as a “place” (not necessarily a physical place) where employers (“demand”) and workers (“supply”) interact with each other. The dynamics of this labour market are relevant for an economy as they determine different socio-economic outputs, such as productivity, unemployment, wages, and poverty, among others. Provided that the labour market influences various outcomes and different disciplines address these issues (e.g. sociology, economy, etc.), this chapter discusses labour market definitions and explains the theoretical framework adopted throughout this book to analyse labour demand based on the information found on online job portals.

The second section of this chapter explains what is understood by labour demand and labour supply in the academic literature on economics, and possible ways to statistically measure these concepts. Moreover, it defines and highlights informal economy as a key issue, especially in Latin American countries like Colombia. Subsequently, the concept of skills is introduced, and its possible implications for unemployment and informal economy are explained. With these basic definitions outlined, the third section of the chapter describes the Colombian labour market and its main outcomes, such as unemployment, wages, etc., under the assumption of perfect competition.

However, the assumptions of perfect competition are substantial and might not be appropriate for different economies such as the Colombian economy. Consequently, it is necessary to consider labour market failures—for example, imperfect information—that might appropriately explain the comparatively high rates of informal economy and unemployment levels in Colombia. Thus, the fourth section of this chapter focuses on explaining how imperfect information might increase skill mismatches and, consequently, create labour market segmentation between formal and informal workers along with a comparatively high unemployment rate, proposing thus that information failures might be one
of the leading causes of high unemployment and informality rates, especially in developing countries like Colombia.

2.2. Basic definitions

Comparable to other markets (e.g. financial markets, physical consumer markets, etc.), the labour market is composed of demand and supply (Cahuc, Carcillo, and Zylberberg 2014). The merchandise to be exchanged consists of “labour services” that represent human activities (distinguished by numbers of workers or hours of work); these human activities are one of the inputs in the production of goods and services (ILO 2018). Consequently, the dynamics between demand and supply have various implications for a range of individuals, for instance, for people with different characteristics (i.e. skills), employers who create job offers with certain requirements, and government institutions, among others. Thus, this section explains who form the labour demand and labour supply (e.g. unemployed, formal, and informal workers), as well as the relevance of skills in labour market outcomes.

2.2.1. Labour supply

In a basic economic model, people or households possess a limited quantity of “labour” that they can offer in the labour market in order to have an income to acquire goods and services (Cahuc, Carcillo, and Zylberberg 2014). Therefore, the labour supply or labour force is composed of people who offer their “labour.” As shown in Figure 2.1, the labour supply or economically active population (EAP) is composed of 1) people who do not have a job but are looking for one (unemployed) and 2) people who are part of the working-age population hired by employers (employed) or are self-employed (ILO 2010). For statistical purposes, according to the International Labour Organization (ILO), all working-age people who did not participate in the production of goods and services for at least one hour in the reference week (one week before the survey is conducted) because they did not need to, could not or were not interested in earning a labour income, are considered out of the labour force (or inactive) (ILO 2010). An unemployed individual is a person without work
who has sought a job during the last four weeks and is available for work within the next fortnight; or who is currently without a job but has accepted a job to start in the next fortnight. An employed individual is employed when he/she worked for at least one paid or unpaid hour in the reference week. These employed and unemployed individuals are considered as labour force (EAP).

2.2.2. Labour demand

In contrast, companies or establishments require “labour services” as an input to produce goods and services in the private and public sectors. Consequently, labour demand refers to the demand for workers (or hours of work) in an economy. This demand consists of the level of employment (satisfied labour demand) plus the number of available job vacancies, which equates to the labour required but not filled by an employee over a certain period of time (unsatisfied labour demand or unmet demand) (Farm 2003; Williams 2004).
In this sense, a job vacancy is defined as a “paid post that is newly created, unoccupied, or about to become vacant:

a) for which the employer is taking active steps and is prepared to take further steps to find a suitable candidate from outside the enterprise concerned; and

b) which the employer intends to fill either immediately or within a specific period” (Eurostat 2017).

Therefore, the total number of vacancies in an economy is determined by the number of unfilled job openings and, additionally, the number of jobs that are temporarily filled by internal substitutes (Farm 2003).

To summerize this subsection, the classic economic model (Cahuc, Carcillo, and Zylberberg 2014) describes the labour market in the following way: people (or households) offer a certain quantity of their “labour” at a certain labour price level (wages) in order to generate income and acquire different goods and services available in other markets. At the same time, establishments in this model require a certain quantity of “labour” at a certain labour price level (wages) to produce goods and services, and while some workers have a job and are employed, others are looking for one and are unemployed. Nevertheless, as shown in Figure 2.1, the fact that people are employed does not imply that they are working in regulated and good working conditions (e.g. informal economy).

2.2.3. Informal economy

To measure informal economy, the ILO (2003) recommends making a distinction between informal sector and informal employment. On the one hand, the informal sector is an enterprise-based definition, which considers people working in units that have “informal” characteristics regarding their unregistered and/or unincorporated legal status, small size, non-registration of their employees, lack of formal labour relations and bookkeeping practices, as well as under-payment/non-payment of taxes, among others. On the other hand, informal employment is a job-based definition and covers individuals whose main job lacks basic legal and social protections (or employment benefits); for
example, lack of social protection, no income taxation, and so forth. It is necessary to clarify that none of these informal economy concepts refer directly to underground, illegal, and non-market production. These kinds of activities belong to illegal economy and (usually) are difficult to measure with standard labour market surveys such as household or sectoral surveys (Perry et al. 2007).

The above definitions of informal sector and informal employment highlight different aspects of an informal economy and can be used for various public policy objectives, such as payroll taxes, social protection, among others (ILO 2003). Consequently, it is possible that people work informally for enterprises that operate in the formal economy or workers might have formal jobs (e.g. with social security) in enterprises in the informal sector (see Figure 2.2).

![Composition of informal economy](image)

**Figure 2.2. Composition of informal economy**

Based on ILO recommendations, in national household surveys, countries like Colombia consider the following individuals to be informal workers: private employees and workers in establishments, businesses or companies that occupy up to five people (in all their agencies and branches), including the employer and/or partner; unpaid family workers; domestic employees; self-employed workers, except independent professionals, while government employees are excluded from this definition (Hussmanns 2004). Evidently, Colombia’s household surveys classify informal workers according to the concept of informal
sector.\(^1\) As mentioned by Freije (2002), despite there is no consensus on how to measure informality, most of the researchers in Latin America rely on the firm size approach to measure this phenomenon. Indeed, the ILO (2019) reported that 13 out of 18 countries surveyed in Latin America\(^2\) include firm size as a criterion when defining the informal sector.

However, this way of measuring informality has some limitations. As mentioned above, informal employees may be formally working in large factories and, in consequence, the way in which Colombia measures informality might underestimate the phenomenon (ILO 2012). However, using a measure employed by the DANE to calculate informality via social security contributions (pensions) and firm size, Bernal (2009) found that—at least for the Colombian case—the size of the informal sector is remarkably similar between social security and firm size informality measurements. The same author found that workers who pay social security contributions (pension and/or health) are less likely to belong to small firms. In addition, the ILO (2011) studied 47 medium- and low-income countries and concluded that almost all workers employed by the informal sector are also in informal employment.

Another concern with the firm size criterion is that all self-employed workers might be considered as informal workers. According to monthly labour market figures released by the DANE,\(^3\) around 80% of self-employed workers and around 20% of salaried workers are informal. Consequently, the firm size informality definition tends to be correlated with self-employment, but the relation is not one to one. Additionally, for 14 Latin American countries,\(^4\) Perry et al. (2007) demonstrated that firm size (among other variables, like

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\(^1\) Even though official informality statistics are based on the concept of the informal sector, it is possible to calculate informality using an informal employment approach (e.g. pension and/or health contributions, among other benefits). Moreover, Colombia excludes agricultural activities from its official informal sector statistics, since including such activities requires developing a more robust definition, especially regarding jobs held by own-account workers and members of producer cooperatives in the agricultural industry (ILO 2003).

\(^2\) Argentina, the Plurinational State of Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Guatemala, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, El Salvador, Uruguay, Suriname, and Guyana.


\(^4\) Chile, Uruguay, Brazil, Argentina, El Salvador, Venezuela, Mexico, Dominican Republic, Guatemala, Colombia, Nicaragua, Ecuador, Bolivia, and Peru.
low educational attainment) are strongly correlated with characteristics of the informal economy such as lack of social protection. These results suggest that criteria based on firm size (in the informal sector) are a suitable approach to calculate informality rates, at least for the Colombian case.

Thus, this document uses the informality definition based on firm size because: 1) the results in Colombia (and in Latin America) suggest that this definition is an appropriate approach to measure informality; 2) the Colombian government adopted this definition as an official statistic to measure informality; and 3) one of the primary purposes of this book is to compare official labour market statistics with vacancy data to test the representativeness of job portals (see Chapter 8).

The magnitude of the informal economy problem depends on different processes. On one side, there is an “exclusion” process. More specifically, workers and companies would prefer formal jobs with benefits mandated by the State; however, some barriers restrict agents’ access to the formal economy. These restrictions or barriers can take different forms, such as excessive taxation or lack of certain worker characteristics (e.g. skills), that make it difficult to enter the formal economy. This framework suggests that informal firms and workers are a disadvantaged group.

On the other side, some workers and firms voluntarily choose to remain in the informal economy, based on their preferences for work and the net benefit of being in the informal versus formal economy. In order to belong to the formal economy, workers and firms need to incur certain costs, such as tax revenue, health, and work insurance, and, in return, the state must provide benefits, such as health care, access to credit, etc. However, these benefits might not compensate for the cost of formality (such as taxes). Thus, informal economy can be an “escape” for workers and firms to avoid the formal economy and its failures related to the provision of services (Perry et al. 2007). These facts highlight that the benefits of being in the formal economy are not enough to move some agents into this economy.

Informal economy is usually a term that describes individuals working in unregulated jobs and is associated with inadequate working conditions, lack of social security, lower productivity, limited access to the financial system, etc. As Perry et al. (2007) pointed out, the size of the informal economy is relevant because it affects a country’s productivity and growth. Informal firms might experience more barriers to access credit, broaden their sale markets,
and innovate, which might reduce their potential productivity. For instance, the lack of social protection and other work risks might result in a lower incentive for establishments to invest in human capital (see Section 2.4) and lead to lower worker productivity.

Informal economy, along with unemployment, is considered one of the most important indicators to measure well-being in the labour market (OIT 2013; Mondragón-Vélez, Peña, and Wills 2010). Both phenomena are prevalent in Latin American economies and reflect a vast underutilisation of the labour supply. This result reveals the inability of Latin American economies to generate “quality” employment for those who want to work and can work (ILO 2019a). For these reasons, it is essential to measure and consider informal economy in the analysis of any country’s labour market, especially in countries like Colombia where the informality rate is comparatively high, at around 49.4% in 2016 (DANE 2017a) (see Chapter 3).

To conclude this subsection, informal economy is a relevant phenomenon, which affects different socio-economic outcomes, such as productivity, social protections, etc. The high incidence of the informal economy in Latin American countries like Colombia makes it an important factor to be considered in Colombian labour market analysis. However, this term might cover a variety of activities that can be measured in different but correlated ways. Despite some limitations, the Colombian literature suggests that a valid criterion to classify workers as informal is based on company size, which is the one adopted in the official Colombian labour market statistics and in this book.

Related to unemployment, the informal economy phenomenon might arise due to an extended number of factors; rigid wages, comparatively high non-wage costs, technological shocks, and discrimination (e.g. gender preferences) are examples of such factors, and a vast body of theoretical frameworks have been developed to analyse their role. One of these theoretical frameworks stresses the importance of skills in labour market outcomes, such as unemployment and informal economy. Individuals possess different labour characteristics that make them more or less productive for specific jobs (Albrecht, Navarro, and Vroman 2007), so while companies hire labour with different attributes to perform different tasks and produce their products, the misallocation between the skills possessed by workers and the skills demanded by employers might influence unemployment and informality rates.
This framework might be applied in a context such as Colombia where there is a comparatively high portion of companies complaining about the skills of the labour supply, and at the same time there is a high proportion of workers desiring formal jobs (Chapter 3 provides a detailed discussion of the Colombian context). Thus, worker skills are important for the economy, which is examined in more detail in the following subsection.

2.2.4. Skills

Skills are a relevant factor that have strong implications for employment outcomes, such as productivity, wages, job satisfaction, turnover rates, unemployment, informal economy, etc. (Acemoglu and Autor 2011; OECD 2016a). However, the concept of skills can be understood and interpreted from different perspectives: social constructionist, positivist, and ethnomethodological, among others (Attewell 1990; Green 2011; Warhurst et al. 2017). Additionally, there are multiple typologies of skills (e.g. worker skills and skills as attributes of jobs). Thus, this section discusses the definition of skill adopted in this document to analyse labour demand based on information from online job portals.

2.2.4.1. Defining skills

Each school of thinking emphasises the importance of different elements that should be considered by the concept of “skill.” Within the social constructionist school, for instance, skills are a complex construction of job tasks, labour supply and demand, and certain social conditions (Vallas 1990). Consequently, skills are defined by the tasks associated with each job, together with the capacity to enclose a number of people into a profession or career. Therefore, as Gambin et al. (2016) pointed out, from a social constructionist perspective social “norms” and task complexity determine what a valued skill means. This approach is part of an ongoing, subjective, and extended debate in which it is difficult to delimit what social processes might affect the construction of skills in a particular society. Consequently, the social constructionist school often finds it challenging to generalise and compare skills between different societies or groups (Green 2011).
The positivist approach emphasises other aspects. This approach states that skills are objective attributes of individuals or jobs, which are independent of the observer. This view focuses on obtaining uniform skill measures to provide the most precise skills indicators for positivist-based research (Attewell 1990).

Even though there are different ways to define “skills,” most perspectives agree that the concept of skills is strongly related to task complexity required to carry out a specific job. In concordance with Green (2011, p. 11): “all skills are social qualities, yet are rooted in real, objective processes, not in perceptions.” Thus, this book interprets skills as attributes of people or jobs, which are required to perform certain tasks in the labour market. Consequently, in this document, skill refers to any measurable quality that makes a worker more productive in his/her job, which can be improved through training and development (Green 2011). Simply put, according to Gambin et al. (2016), a skill refers to “the ability to carry out the task that comprises a particular job.”

This perspective might be particularly helpful to ease the operationalisation of skills into quantitative measurements (to provide easily measured variables), as well as to enable policymakers and researchers to obtain precise quantitative results to produce straightforward public policy recommendations (Attewell 1990), which is also one of the main objectives of this document. However, this positivist viewpoint has some limitations; for instance, to measure a skill with a variable like years of education could be considered reductionist. As will be discussed in the next subsection, variables like education might fail to properly measure skill acquisition and job performance (Attewell 1990).

Despite the limitations present in all schools of thinking, a positivist perspective (frequently presented in economic studies) is adopted in this document in order to provide imperfect but sufficiently reliable and valid indicators for public policy recommendations regarding skills within vacancy data on online job portals. This definition of “skills” still encompasses many elements, such as qualifications, competences, education, and aptitudes, among others (Green 2011), which can be measured by different indicators depending on the typology used and the tools available to measure those qualities (skills). The economic literature has used a variety of proxies to measure the different dimensions of skills in the labour market, some of which are limited, since a portion of the typologies overlap, while others do not make a clear separation between skill categories (as will be explained in more detail in the next subsection).
Given that multiple typologies of skills are used even within the same economic discipline, it is necessary to discuss which are the most appropriate ones for this book. These different typologies can be organised into two groups: those that focus on the worker’s skills and those that use a task-based approach.

2.2.4.2. Worker skills

At an early stage, human capital theory stated that necessary skills for work could be obtained through education (Becker 1962; Mincer 1958). In consequence, educational attainment is regarded as a way to define skills. An educated worker is considered highly skilled and, thus, more productive when he/she accumulates more years of education and experience. Accordingly, increased human capital through education (the main source of scientific knowledge) is thought to increase employee productivity in a range of tasks (Attewell 1990; Becker 1962; Mora and Muro 2008).

Consequently, the accumulation of skills (in terms of knowledge) rather than the use of skills toward specific jobs has been the focus of analysis for academics and policymakers (Becker 1994; Psacharopoulos 1985; 2006). However, the economic literature has found that educational attainment only explains a relatively small fraction of the variance of life accomplishments between individuals (Kautz et al. 2014, p. 9) Additionally, measuring skills by observing educational levels has several limitations. First, educational attainment might be a weak indicator to measure knowledge levels. Education (or qualification) is acquired before people start to participate in the labour market; however, those qualifications might not be appropriate or might depreciate over time, compared to other skills learnt in the workplace.  

Second, Becker (1994) acknowledges that educational measures ignore some sources of learning, and Cunha and Heckman (2007) suggest that skill formation/acquisition occurs through a variety of processes and situations. For instance, skills can be acquired outside of schools, through on-the-job

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5 For instance, with the emergence of modern devices (e.g. computers), new technologies have been introduced in the labour market to perform different jobs (such as programming, social media manager, etc.), which, in general, were not taught in the educational system years ago. Thus, for some jobs, being up-to-date and being able to use these new technologies can be considered more valuable for the labour market compared to years spent in education.
training (such as apprenticeships, coaching, etc.) and/or off-the-job training (such as lectures, simulations, etc.). An extended literature review on labour economics shows the effects of job training on different outcomes. Bassanini et al. (2007, p. 128) completed an exhaustive review of data resources (Continuing Vocational Training Survey, CVTS; International Adult Literacy Survey, IALS, among others) for on-the-job training in Europe. The authors found evidence that on-the-job training has a positive correlation with private returns for employees and employers (Bassanini et al. 2007, p. 128). Likewise, Asplund (2005), Barrett and O’Connell (1999), and Blundell et al. (1999), among others, extensively reviewed the different effects of off-the-job training on social and private outcomes. Most of the studies reviewed found a positive impact on social and private returns. 6

Third, education variables do not take into account other skills generated via learning-by-doing in the production process. People continue to learn new skills and reinforce them through repetition (Arrow 1962; Dehnbostel 2002; Rutherford 1992). Different empirical studies show that these learning processes increase a firm’s productivity. For instance, Bahk and Gort (1993) observe that in 15 industries in the US, learning-by-doing generates skills (knowledge) and reduces the production costs of incumbent, established organisations.

Finally, employers not only require cognitive and academic skills (qualifications), but also consider personal characteristics as important elements to perform a job. As Green (2011) and Grugulis, Warhurst, and Keep (2004) note, companies have labelled behavioural characteristics (e.g. reliability, responsibility, leadership, motivation, politeness, and commitment, among others) as skills needed in the production process. It is not just the knowledge learnt through formal education, job training or learning-by-doing that produces more-skilled workers; personal characteristics, such as traits, behaviours, and attitudes towards work are also considered as skills (Grugulis, Warhurst, and Keep 2004; Kautz et al. 2014). For instance, Brunello and Schlotter (2011) and Lindqvist and Vestman (2011) note that wages tend to be higher for workers with higher non-cognitive skills, while people with low non-cognitive skills are

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6 Nevertheless, some studies suggest that off-the-job training might have greater impacts on productivity than on-the-job training in US manufacturing industries (for example, Black and Lynch 1995).
significantly more likely to become unemployed. In contrast, when Cunninghamham and Villaseñor (2016) reviewed 27 studies on the skills-demand profiles of employers in developed and developing economies, they found a greater demand for socio-emotional\(^7\) and higher-order cognitive skills\(^8\) than for basic cognitive\(^9\) or technical skills.\(^{10}\)

Given the importance of the behavioural characteristics of workers and analysing these skills, broader typologies have been recently adapted to measure more of these skill dimensions. For instance, Green (2011) notes that contemporary approaches favour the categorisation of cognitive,\(^{11}\) physical, and interactive skills.\(^{12, 13}\)

### 2.2.4.3. Skills as attributes of jobs

As an alternative to the above worker skills approach, other typologies focus on the attributes of jobs rather than the attributes of a person to measure job complexity. More complex activities require greater skills (Attewell 1990; Green 2011); thus, task-based typologies have become widely used in the economic literature on labour market because these typologies provide a framework to describe processes and changes in job tasks, such as job polarisation,\(^{14}\) and the effect of implemented new technologies in the occupational structure (Acemoglu and Autor 2011; Autor and Dorn 2012).

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\(^7\) Socio-emotional skills are behaviours, attitudes, and traits that are considered necessary complements to cognitive skills in the production process.

\(^8\) Higher-order cognitive skills comprise the capacity to deal with complex information processing. These tasks include critical thinking, application of knowledge, analysis, problem-solving, evaluation, oral and written communication, and adaptive learning.

\(^9\) Basic cognitive skills comprise fundamental academic knowledge and comprehension, including literacy and mathematics.

\(^10\) Technical skills are defined as the specific knowledge required to carry out an occupation.

\(^11\) Cognitive refers to areas where thinking activities, such as reading, numeracy, and IT, among others, are required.

\(^12\) Physical skills are task-related, which refers to dexterity and strength, while interactive skills comprise all forms of communication, including emotional and aesthetic behaviour.

\(^13\) For a more detailed description of other typologies used to categorize the behavioural characteristics of workers see Green (2011).

\(^14\) Job polarisation consists of a decline in the employment share of middle-skilled cognitive and manual jobs characterised by routine tasks.
Occupation classifications appear to be the most common task-approach used in the economic literature. According to the ILO (2012b, p. 59), an occupation can be defined as a “set of jobs whose main task and duties are characterised by a high degree of similarity.” Occupational groups or titles are constructed by a group of experts who survey different workplaces and observe workers doing their jobs (ILO 2013).\(^\text{15}\)

Nevertheless, this occupational approach has its limitations. Within occupations, skill levels or the kinds of skills being utilised can differ depending on the sector, company size or the country (UKCES 2012). Moreover, occupation classifications are not updated as fast as labour market changes occur. For instance, the International Standard Classification of Occupations (ISCO) is updated approximately every ten years; yet, between these processes and periods, many changes in terms of skills can occur. Thus, prevailing occupation classifications can be obsolete when analysing actual labour market skills.

Another limitation worth considering is that most occupation classifications do not take into account personal features, such as attitudes, traits, and values. An exception can be seen in the Occupational Information Network (O*NET) system in the US, which contains information on hundreds of standardised and occupation-specific descriptors. It describes occupations in terms of knowledge, skills, and abilities required by workers, as well as how the work is performed in relation to tasks, work activities, and other descriptors (onetcenter.org 2016).

Given the above labour market concepts (supply, demand, unemployment, informal economy, and skills, among others), the literature has provided a theoretical framework that helps to understand the labour market dynamics of interest for this document. The following two sections present the main theoretical model for this study in order to explain why skill mismatches might arise, as well as their relevance and implications for labour market outcomes such as unemployment and informality.

\(^{15}\) While different occupational classifications exist, like the SOC (Standard Occupational Classification) in the US, every classification system agrees with the ILO’s basic definition of occupation. The main differences emerge in the grouping of each occupational category.
2.3. How the labour market works under perfect competition

The third section of this chapter describes the labour market and its main outcomes, such as unemployment, wages, etc., under the assumption of perfect competition. At an early stage, to analyse the matching problem between the demand and supply of skills in the labour market, scholars in the field of economics have developed a basic theoretical framework based on the assumptions of perfect competition (Cahuc, Carcillo, and Zylberberg, 2014). This framework outlines that, on the one hand, employers faced with a need for labour services (a derived demand, based on the demand for their product) create job offers with certain requirements (skills), and, on the other, existing employees and new applicants with those characteristics accept these jobs when the wage offered is more than their reservation wage.16

2.3.1. Labour demand

The labour market works under perfect competition when employers and workers are perfectly informed about the quality (e.g. job requirements, localisation of job opportunities, etc.) and price of “labour” (e.g. wages), all agents are price-takers (which means that there are no monopolistic/monopsonistic powers), and there is perfect human rationality (all agents are capable of analysing all possible economic decisions and outcomes, and choosing the path that maximises their utility or profits) (Cahuc, Carcillo, and Zylberberg, 2014; Sen 1977). Given these assumptions, what defines a labour market can be expressed as follows.

On one side, picture a representative firm, which produces goods and services by using two inputs, Labour (L) and Capital (K), at a certain technology level. Consequently, the production function (F) of this representative firm is given by:

16 Cappelli (2015) points out that there is another theoretical framework that explains the relationship between labour supply and employer demand. Employers can select general skills at entry-level positions and train their employees over a working lifetime to develop specific skills needed for the company. However, the same author notes that this approach has become less plausible in recent years because employers tend to hire applicants who already have the specific skills they require.
A web-based approach to measure skill mismatches and skills profiles for a developing country

\[ Y = F(L, K) \]

where \( Y \) denotes the physical output of the firm and \( pY \) is its value-added form, where \( p \) is the market price of the product. The cost of labour used in the production takes the form of wages and other on-costs, such as national insurance (the price per hour of hiring a unit of labour services), while the cost of capital is the price of renting a unit of capital.\(^{17}\)

In the short run, when capital is fixed, the marginal product of labour falls as the number of employed individuals rises. The initial condition for employing anyone at all is that the value of the marginal product of the first worker exceeds their going wage; if so, the firm expands its number of employees until the marginal return to the last unit of that labour equals the marginal wage (cost of labour):

\[ p F' (L) = w \]

On the other side, there are a large number of workers who offer a certain quantity of labour and will receive a wage if they are hired.

**2.3.2. Labour supply**

The utility function of a representative worker is composed of two parameters: income \((R)\),\(^{18}\) which is equal to their wage (times the number of hours worked if the worker is hired, and zero if the worker is not hired),\(^{19}\) and the individual’s leisure time (the number of hours not spent at work). There is decreasing marginal utility of income (which is spent on goods and services or saved) and leisure time; thus, the line in the utility function for combinations of income and leisure to yield a given level of utility (i.e. an indifference curve) is convex to the origin (zero income and leisure). Indifference curves further from the origin are associated with higher levels of utility.

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\(^{17}\) This is a first approximation because it may be cheaper for the firm to buy capital goods in order to avoid paying profit to those who rent out the goods. The rental price is the rental firm’s estimate of forgone interest, plus depreciation of the capital, plus their profit.

\(^{18}\) For simplicity, it is assumed that other forms of income do not exist.

\(^{19}\) It is assumed that the total income of workers is consumed by different goods and services.
2.3.3. Market equilibrium

An equilibrium in the market is achieved where the upward sloping labour supply curve cuts (in other words, it equals) the downward sloping labour demand curve at a certain level of wages ($w^*$) (labour supply equals demand). Only individuals whose reservation wage ($\theta$) (reflecting their disutility of work) is greater than the equilibrium wage do not participate in the labour market (inactive). In a perfect competition model, as there is perfect information in terms of labour supply and demand, all individuals who wish to participate in the labour market ($\theta \leq w^*$) will find a job, and firms will find a worker to fill their vacancies.

The model does not explicitly talk about the role of skills in the labour market; yet it is relatively easy to incorporate this aspect into this labour market model. As mentioned above in Section 2.2, Mincer (1958) and Becker (1962) introduced the idea that education is an investment in the economic model. Thus, education makes an individual more productive and might create wage differentials.

To be more specific, if people know the relevant characteristics of each job (perfect information), they can choose a general level of training ($i$) that will increase their production function: $y(i)$. Firms will demand workers with a certain level of training ($i$) until the marginal benefit of using one unit of that labour equals the marginal wage: $w(i)$. Consequently, the wage of a worker, $w(i)$, will be a function of the level of qualification, all other things being equal, and the possibility of a higher wage acts as an incentive for training. Thus, individuals will train until the marginal cost of training equals the marginal return of this investment. Once more, under the assumptions of perfect competition, an equilibrium is reached when labour demand equals labour supply, and all individuals who wish to participate ($\theta_i \leq w_i^*$) will find a job.

Therefore, one of the most remarkable results from this model is that under perfect competition there is no structural unemployment, instead all workers receive a wage ($w^*$) at their level of employment ($E^*$) (Figure 2.3). Nevertheless, there is a possibility that unforeseen impacts on the supply of labour might create disequilibrium in the short run (Bosworth, Dawkins, and Stromback, 1996, p. 200). For instance, as shown in Figure 2.3, improvements in technologies such as computers might increase the demand for people who know how to use that technology (from $D_0$ to $D_1$), and, consequently, wages will rise from
$W_0$ to $W_1$. This situation might create a scarcity ($E_1^* - E_0^*$) of those people for a period. However, as all agents are (somehow) well informed, workers will start offering labour according to employer requirements.

![Labour market equilibrium under perfect competition](image)

*Source: Author’s elaboration.*

When job seekers know the job requirements (skills, experience, occupational requirements, etc.) and the localisation of job opportunities (cities, companies, etc.), they will train and search in the proper places where vacancies are available. Moreover, as employers know the characteristics of job applicants (e.g. skills), they will hire people who match their job requirements. Additionally, education and training providers (as any other firm) will have all the relevant information to create and adjust their curriculum contents according to employer requirements. Thus, people will find a job according to their characteristics (skills) and employers will find workers according to their requirements. Hence, unemployment rate remains comparatively low under perfect competition and there are no barriers that force a worker to work involuntarily in the informal economy.

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20 Note that for education and training providers, to offer the “right” skills, it is necessary to assume that there are no institutional barriers. For example, providers must have the capacity to invest in the equipment necessary to train people in the skills required by employers.
According to the perfect competition model, people make optimal decisions based on the options (information) available to them. Thus, the perfect information assumption is a key element for the well-functioning of the labour market because it helps people to choose the option that maximises their utility or profit. When there are information problems, even fully rational agents in a non-monopolistic labour market might not know the option that could provide the maximum utility/profit. In the labour market, this information problem means, for instance, that job seekers and training centres might not know what skills are being demanded. Some people might acquire the “wrong” skills according to labour demand. Consequently, there will be people with certain skills who are excluded from the formal economy because their skills are not being demanded, and there will be unfilled vacancies because there are no people with the proper skills.

2.4. Market imperfections and segmentation

To develop the above ideas, Section 4 explains how imperfect information (e.g. labour market failures) might increase skill mismatching and, consequently, might create labour market segmentation between formal and informal workers along with a comparatively high unemployment rate.

2.4.1. Segmentation

The above assumptions about perfect information (defined in Section 2.3), where all agents in the model are price-takers and rational, are too simplistic (Garibaldi 2006). An extended literature review has shown that the high incidence of informality in countries like Colombia can be due to labour market segmentation (Doeringer and Piore 1971; Reich, Gordon, and Edwards 1973) (see Chapter 3). Specifically, barriers might exclude some workers from the comparatively high-productive sector (e.g. formal sector) and drive those excluded individuals to a more disadvantaged sector, such as the informal market (Piore 1972; Gambin et al. 2016; Palmer 2018).

This duality of the labour market is represented in Figure 2.4. Panel A depicts the more productive formal market sector in which equilibrium wage
is $W_{for}^*$ at a level of employment $E_{for}^*$. While Panel B illustrates the more disadvantaged segment in which the equilibrium wage is $W_{infor}^*$ at a level of employment $E_{infor}^*$.

Figure 2.4. Labour market segmentation

By comparing Panel A and Panel B, two aspects arise. First, labour demand and supply in the formal sector is comparatively more inelastic than the informal sector. This result reflects the fact that in the formal market there are more labour regulations (such as minimum wages, non-wage labour costs, etc.) and more training time, among other entry costs, that make supply and demand less responsive to changes in wages than in the informal sector. Second, wages in the formal sector are higher than in the informal (disadvantaged) sector ($W_{for}^* > W_{infor}^*$); consequently, this outcome shows that there are incentives to be part of the formal sector. However, there are some barriers that prevent people from entering the more advantageous segment of the labour market.

The economic literature reveals several barriers that might explain this labour market segmentation (Reich, Gordon, and Edwards 1973). One of these barriers is that potential workers possess imperfect information about the skills required to fulfil employer requirements. Imperfect information might explain
why some workers, even when there are incentives (e.g. higher wages) for them to belong to the formal segment of the labour market, remain outside of this more advantageous sector, while some vacancies remain unfilled.\textsuperscript{21} Thus, as $W_{\text{for}}^* > W_{\text{inf}}^*$ and the labour conditions$_{\text{for}} > \text{conditions}_{\text{inf}}$, there is an incentive for workers to develop the required skills to transfer from the informal to the formal sector, although doing so might take time.

2.4.2. Imperfect market information

As pointed out by Gambin et al. (2016), there are different causes of imbalances (imperfections) in the labour market. For instance, there might be capital constraints, uncertainty about future demand, labour market immobility, institutional barriers, etc., which prevent people from making investments in training or from mobilising workers to places or sectors that require certain skills. However, as previously mentioned, perfect information is one of the necessary conditions for the well-functioning of the labour market (but it is not a sufficient condition). This assumption supposes that all workers know the particularities (e.g. skills required, wages, among others) of all available jobs, and they only need to decide the quantity of labour (number of hours) offered that they are prepared to work, while firms know the characteristics of all potential workers and can choose the one who most suits their job requirements, and education and training institutions offer programmes that are aligned with employer needs. However, labour market failures arise due to imperfect information, which occurs when agents in the economy (in this case, employers, employees, and training centres) are not fully informed about the price or quality of the product they are going to buy or sell. Therefore, agents might not make optimal decisions (Stiglitz et al. 2013).

For instance, education and training institutions need to have up-to-date labour market information (e.g. skills and occupational requirements, number of people demanded, etc.) to design (curriculum contents, number of courses, etc.) and offer programmes that cover the needs of the labour market. However, training centres (usually) do not have the necessary means and resources to

\textsuperscript{21} As will be shown in more detail in Chapter 3, evidence suggests that this situation is prevalent in countries like Colombia.
know employer requirements (see Chapter 3 and 4). Given the difficulties in obtaining proper labour market information, education and training providers cannot respond properly to labour market changes. As mentioned by Almeida, Behrman, and Robalino (2012), this lack of proper information prevents education and training programmes from being aligned with labour demand needs. Consequently, misaligned, outdated or low-quality curriculum contents will arise due to imperfect labour market information (see Chapter 3). People might not have the “right” skills, and companies might not find workers with the skill sets they need. Thus, limitation on information might create phenomena such as skill mismatches. In particular, skill mismatches occur when there is imperfect information in the job search process or in the workplace regarding the particularities of jobs; mismatches that misalign the labour demand and supply of skills (UKCES 2014). These phenomena can acquire different forms, such as skill gaps, skill surpluses, and skill shortages, with various consequences on the economy, such as unemployment, informality, job dissatisfaction, among others.

Once a job match is completed, employers might realise that their current employees need more skills to be completely proficient in their jobs; this problem is called a skill gap and is considered part of the phenomenon of skill mismatch. Nevertheless, the definition of skill gaps per se does not capture the entire skill mismatch phenomenon. For instance, a skill surplus might occur within workplaces. This term refers to a situation where a certain job does not require the highest level of an employee’s competences (Adalet McGowan and Andrews 2015). According to Green and Zhu (2008), graduate over-qualification (which is a way to measure skill surpluses) was about 33% in the UK in 2006. This underutilisation of labour supply creates a misallocation of education and training resources (money and time are invested in programmes not demanded by the labour market), as well as increases job dissatisfaction (people do not fully use the skills they possess: underemployment) and employee turnover, which might be due to a loss of pay from being over-qualified (Green and Zhu 2008; Okay-Somerville and Scholarios 2013).

22 Several economic studies have shown the importance of skill gaps in the economy. For instance, in an Irish-based study, McGuinness and Ortiz (2016, p. 19) suggest that the phenomenon of skill mismatch increases labour costs by approximately 25%, thus negatively affecting the competitiveness of Irish firms.
However, given the multiple configurations that the skill mismatch problem encompasses and labour market data available to analyse an economy such as Colombia’s, hereinafter this study will focus on skill shortages. This term refers to issues that arise in the job searching process when there are no applicants, or the applicants do not have the minimum level of skills needed to carry out the tasks required by employers. There is a skill shortage when the labour supply lacks skills in relation to what employers currently demand to fill their vacancies (Green, Machin, and Wilkinson, 1998).  

Claims of skill shortages have been made globally. For instance, the European Company Survey for Spring 2013 reports that around 39% of firms in Europe experienced difficulties in finding workers according to skill requirements (Cedefop 2015, p. 20). Similarly, the ManpowerGroup (a well-known international consulting firm) carries out a Talent Shortage Survey, where employers around the world are asked whether they have difficulties in filling their jobs (Mazza 2017). As reported in 2016, due to skill shortages, 40% of the companies interviewed worldwide faced difficulties to fill their vacancies (ManpowerGroup 2016). However, in countries like Colombia this phenomenon is even larger (as will be shown in more detail in Chapter 3).

The human capital framework in economics has developed different theories to consider the possibility of imperfect information, as well as to explain labour market outcomes in a more realistic way. The search and matching theory, for example, has become one of the most prominent theories to explain skill mismatches and their relation to unemployment (Andrews et al. 2008). This model states that vacancies and workers are heterogeneous in terms of one characteristic: skills. However, obtaining information about the price and quality of labour can be costly, and not everyone has access to this information, which is a limitation that might affect the behaviour of workers and firms.

With imperfect information, the opportunity cost (θ parameter) is not the only relevant parameter to determine whether a person is employed or not. In addition, individuals need to devote time to find a job and firms might need to wait or search actively for the candidate that suits their requirements. Thus,

\[ \theta \]

This definition excludes other causes of shortages such as firm size and lack of union recognition, among other causes (Green, Machin, and Wilkinson, 1998).

Chapter 9 discusses different possible ways to measure skill shortages.
included here is the possibility that the labour market does not instantly correct mismatches such as skill shortages (hereinafter skill mismatches refer to skill shortages). The efficiency at which the market makes matches between vacancies and workers depends on the matching function (the formation of new relationships such as job formation), which can be expressed as follows (Mortensen and Pissarides 1994):

\[ m = m(u,v) \]

Where \( v \) represents the number of vacancies, \( u \) represents unemployed workers, and \( m \) indicates the rate of job matching (number of hired people and vacancies filled) over a given time period. Moreover, \( m \) is assumed to be homogeneous of degree one, which means that if \( u \) and \( v \) are doubled, the number of matches (\( m \)) will increase by the same proportion.

Equation 1 can derive the probability that a vacancy is filled:

\[ q = \frac{m(v,u)}{v} \quad (1) \]

As vacancies are filled at the Poisson rate, Equation 2 can be expressed as follows:

\[ \frac{m(v,u)}{v} = m \left( \frac{u}{v}, 1 \right) \equiv q(\alpha) \quad (2) \]

Where \( \alpha \) is \( v/u \), and it is interpreted as labour market tightness, an indicator to identify possible difficulties to fill vacancies, or whether it takes a relatively long time to fill an available job.

Employees also make decisions about educational (skills) investments and where to look for a job according to available information. Subsequently, job opportunities reach jobseekers with a certain probability given by the following:

\[ p = \frac{m(v,u)}{u} = \frac{v}{u} m \left( \frac{u}{v}, 1 \right) \quad (3) \]

Thus, the probability that a worker finds a job and a vacancy is filled is a function of market tightness, which depends on the quality of labour (skills) offered and demanded, among other characteristics.
Vacancies are offered in different places, such as newspapers or online job portals, and the information available there might restrict the number of job advertisements a person screens to make decisions about which roles to apply for. Also, individuals might not have access to or use certain sources that display vacancy information. Consequently, workers’ decisions can be based on imperfect information, hence they might or might not properly anticipate an employer’s requirements to fill certain vacancies (Mortensen 1970).

Therefore, according to employer requirements, a lack of proper skills (e.g. cognitive and non-cognitive skills) might affect the labour market matching function and create labour market segmentation. Indeed, as mentioned in Section 2.2.4, both cognitive and non-cognitive skills are relevant for the well-functioning of the labour market. As remarked by Desjardins and Rubenson (2011), cognitive skills such as literacy are becoming more important in today’s economy due to skill-biased technical changes (e.g. information and communication technologies or ICTs) Moreover, Brunello and Schlotter (2011) and Lindqvist and Vestman (2011) pointed out that people with low non-cognitive skills are significantly more likely to become unemployed. Thus, the combination of cognitive and non-cognitive skills demanded by employers and possessed by job seekers will considerably determine the performance of the matching function and other labour market outcomes, such as unemployment and informality rates.

If the likelihood of finding a formal job is relatively low (which might mean that companies do not demand the cognitive and non-cognitive skills some workers have attained), it can take time to find a job. Individuals whose skills are not in demand in the labour market have two options: 1) they can continue searching or create a job for themselves through self-employment, or 2) take an informal job as a way to earn an income and fulfil personal and family responsibilities. Those individuals who value an informal job more than the expected value of searching for and taking a job in the formal sector will be part of the informal economy (Albrecht, Navarro, and Vroman 2007). From the other perspective of the labour market, firms might not be able to gather perfect information about the skills possessed by potential individuals and have knowledge about where to find them (Desjardins and Rubenson 2011; Oyer and Schaefer 2010). According to this view, employers will hire an
individual when the expected value of matching that individual exceeds the cost of posting a vacancy\textsuperscript{25,26} (Burdett and Smith 2002).

Consequently, hiring is an important and costly selection process for heterogeneous productive individuals and firms, and its efficiency depends on the research behaviour of employers and job searchers, as well as on the information available to them (Banfi and Villena-Roldán 2019). In this sense, companies can face some difficulties in finding people that meet their requirements. Due to that, they spend significant resources on advertising, posting job vacancies, and screening to select appropriate workers (Autor 2001).

Even with those strategies in place, it is possible to reach a situation where unemployed or informal workers with certain characteristics (skills) are willing to work in formal jobs and vacancies available to be filled. This situation can occur because the skills possessed by job seekers are not those required by the companies, resulting in skill shortages (or a skill mismatch).

Provided that companies require different skill combinations, and workers have restricted access and limited capacity to respond to those requirements, one straightforward solution to tackle this phenomenon and its consequences is to lower the cost of having (relevant) information about the current labour demand for skills. By doing so, workers have proper insights about current job roles, which might shape their decisions to acquire skills according to employer requirements. The matching function will become more efficient if workers have less imperfect information about the employers’ needs, and thus unemployment and (involuntary) informality will be reduced.

Moreover, the role of education and vocational education and training (VET) systems is relevant to reduce skill mismatches. Education and VET systems are one of the main ways to prepare (deliver skills to) people for work

\textsuperscript{25} When the cost of posting a vacancy exceeds the profit to be gained from the match, employers do not post vacancies (Burdett and Smith 2002).

\textsuperscript{26} Other models also recognise that employers might not possess perfect information about worker skills. For instance, Spence (1978) developed a job-market signalling model where employers are not sure about the “productive capabilities” (skills) of a potential employee. To overcome this issue, employers believe that credentials, such as higher education, are positively correlated with a worker’s “productive capabilities.” Consequently, potential employees need to send a signal about their skill levels to potential employers by acquiring credentials. In this case, credentials are considered as a proxy to measure skills and help employers and employees in the hiring process.
(Green 2011; OECD 2014a), and they might be affected by a restricted access and a limited capacity to analyse and anticipate employer requirements. Consequently, it is almost pointless that workers have the right information about current employer requirements for skills, that is, in case if there are no education and training systems in place that provide them. In consequence, the better understood how to adopt and develop this knowledge into education and training programs and into worker decisions, the better the match will be between worker skills and vacancies (Cedefop 2012a) (see Chapters 9 and 10).

2.5. Conclusion

This chapter has outlined a basic labour market framework in order to properly use vacancy data and address the phenomena of unemployment and informal economy. The labour market is a space where workers (labour supply) offer a quantity of “labour services” with certain qualities to fill vacancies, and employers (labour demand) hire this merchandise at a certain price (wages). In terms of the labour market, people can be divided into three groups: 1) workers whose labour services are bought by employers in the formal economy; 2) workers employed in the informal economy, who are characterised by a lack of social security, limited access to the financial system, etc.; and 3) workers who offer their labour services but are not hired by employers (unemployed). The size of each group depends on different elements. However, the literature discussed in this chapter stresses that skills are a relevant factor to determine labour outcomes, such as unemployment and the size of the informal economy.

Due to their importance and multiple dimensions (e.g. qualifications, competences, education, aptitudes, etc.), skills can be defined in different ways; nevertheless, most of those definitions link the task complexity of each job to the characteristics that each worker needs in order to successfully carry out these job tasks. For this reason, this book considers that a skill is any measurable quality that increases worker productivity and can be improved by training and/or development. Using this definition, it is possible to analyse and extract information on vacancies to construct more reliable indicators of the skill level required by employers (e.g. qualifications), as well as to address possible skill mismatch issues.
Under perfect competition, the over- or undersupply of skills (skill mismatches) only arise in the short term and have relatively small implications for unemployment and informality rates (exclusion). However, the conditions required for perfect competition rarely exist because agents have imperfect information about offered and demanded skills. This imperfection in the labour market might create a situation where there is a lack of skills in relation to what employers currently require in order to fill their vacancies: a skill shortage. Skill shortages might create labour market segmentation where workers with the “right” skills have more probabilities to belong to the formal economy, while workers without the “right” skills (according to demand) have more chances of being in the informal economy or unemployed. Consequently, unemployment and informal economy might increase and/or persist over time.

The above skill mismatch problem involves the coordinated actions of at least three different agents in the economy: employers, workers, and education and VET systems. The level of coordination between these three groups determines the extent of skill mismatch. This coordination depends on the availability of information about skill requirements and the capability of workers to process and adopt that information into their decisions, as well as the availability of education and training systems.

In this sense, one way to tackle the skill mismatch phenomenon is to gather information about labour demand, and to extract meaningful information in order to address the decisions of workers and education and VET systems, according to different company requirements. New technological developments offer new opportunities in this respect. This particular theoretical framework and straightforward solution might be especially useful for countries like Colombia where: 1) informality and unemployment rates are high, 2) complaints about skill shortages (skill mismatch) are relatively high, 3) information about company requirements is available from resources such as job portals, and 4) education and VET institutions have difficulties to adapt their programs according to labour demand.

For these reasons, the next two chapters demonstrate that in the context of the Colombian economy, novel sources of information and data analysis regarding the labour demand for skills might have an important effect on public policy and could reduce unemployment and informal economy at a lower cost in terms of time and monetary sources.