



SEARCH AND MATCHING WHEN WORKERS HAVE PERSONALITY

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Abstract: The search and matching model is a compelling analytical framework that academic economists have at their disposal to explain and replicate observable labor market patterns and regularities. In the prototypical search and matching framework, the representative worker is in control of a series of variables (*e.g.*, her job search effort, her wage-setting bargaining power, and her productivity performance), which she efficiently manages given the underlying assumption of full rationality. This assumption neglects the fact that workers may possess different personalities and that personality may exert a decisive influence on behavior and, ultimately, on employment and unemployment outcomes, as well as on the formation of wages. The current study revisits the search and matching model, endowing the labor force with potentially distinct personality traits. The big five personality traits of psychological analysis are considered, to approach eventual deviations of the model's results relatively to the no-personality benchmark. Each of the traits (openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism) affects the labor market in distinct ways, given the unique influence they have over each dimension of the workers' behavior.

Keywords: Search and matching; Personality traits; Labor market equilibrium; Unemployment rate; Micro-based behavioral economics.

JEL classification: D91; J21; J23; J31.

1. INTRODUCTION

The search and matching model of the labor market is a theoretical framework aimed at justifying and explaining the persistence of involuntary unemployment. In this framework, two separate groups of agents – workers and firms – solve the

respective intertemporal optimization problems and engage in a bargaining process with the goal of accomplishing an outcome that is potentially satisfactory for both parties, namely in what concerns job creation and wage setting. Within each group, agents are identical and, thus, the corresponding problems might be approached under the perspective of representative agents (a representative worker and a representative firm).

The appeal of the model comes from the fact that the decisions of each group, or each representative agent, are taken in a fully decentralized and uncoordinated way and, therefore, no pre-established consensus between job seekers and employers should be expected to exist. This class of models is characterized by the persistence of frictions: both the job searching effort by workers and the recruitment effort by employers are time-consuming and resource-consuming. The representative firm puts effort in making job vacancies available; the representative worker desires to fill such vacancies and purposefully acts to attain such goal. From the interaction between agents, a matching process emerges, and jobs are potentially created.

The optimizing behavior of workers and firms in the search and matching model allows for the derivation of a pair of equations, which might be interpreted as demand-side and supply-side representations of the labor market forces. The two equations, which take, respectively, the designations of job creation condition and wage equation, establish relationships between two pivotal variables: the tightness of the labor market (defined as the ratio between available job vacancies and unemployment) and the wage rate. From the intersection of the curves, the market equilibrium is determined, *i.e.*, equilibrium values for the two mentioned variables are computed. The equilibrium level of a third fundamental variable, the unemployment rate, is also uncovered, given the Beveridge curve relation between the tightness measure and the rate of unemployment.

Search and matching theory has its origins on the pioneer work of Pissarides (1985, 2000), Mortensen (1986), and Mortensen and Pissarides (1994), and gained momentum with a long list of subsequent contributions that, one way or another, have incremented value to this equilibrium unemployment theory. A far from complete selective reading list could be organized around the following studies: Petrongolo and Pissarides (2001), Shimer (2004, 2005), Yashiv (2007), Coles (2008), Dolado *et al.* (2009), Cahuc and Le Barbanchon (2010), Mortensen (2010), Miyamoto (2011), Pissarides (2011), Lise *et al.* (2015), and Flinn *et al.* (2017). The search and matching model is, nowadays, a consensual stylized interpretation of how the labor market works, and its fundamental notions, structure and mechanics can be found in most textbooks on macroeconomics and economic dynamics (*e.g.*, Alogoskoufis, 2019, ch.18; Romer, 2019, ch.11; Miao, 2020, ch.19).

A paradoxical premise of the search and matching framework, as characterized in the above paragraphs and as it is usually described in the literature, is that the variables that are included in the model to allegedly reflect the participation of workers in the labor market are, in fact, fully detached from any consideration about the true nature of the individuals that compose the labor force (*i.e.*, who they are and how they act). Specifically, variables as labor productivity, the rate of job destruction, the bargaining power of job seekers, or the job search intensity, are simply taken as exogenous parameters of the model, thus being fully independent of the psychological profile of the individuals who participate in the productive value-creating activities. In this study, this premise is relaxed, namely by assuming that workers have personality and that different personalities potentially exert a multiplicity of possible effects over the above-mentioned set of variables.

To address personality issues in the context of the equilibrium unemployment setup, one relies on the taxonomy offered by psychological analysis, which identifies the existence of five autonomous personality traits (Digman, 1990; Goldberg, 1990, 1993; Costa and McCrae, 1992; John and Srivastava, 1999). The big five, as they are generally known, include openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism, and they are often referred to by the corresponding acronym, OCEAN. Each of the OCEAN traits impacts differently on the ability of workers to act in diverse circumstances (*e.g.*, when searching for a job, when working, or when negotiating wages). As a result, a variety of possible outcomes may emerge, regarding the labor market equilibrium, what contrasts with the unique formal outcome that is derived when approaching the model from the point of view of the no-personality full-rationality benchmark setup.

By introducing personality traits in the search and matching framework, the goal is not to claim that these traits are, forcibly, the main or the decisive determinant of labor market outcomes, namely regarding employment and wages (surely, macroeconomic, social, and political forces have a central role to play). However, the argument one wants to convey is that once controlled for other determining factors, the personality of workers can be highlighted as an important element for the characterization of the equilibrium and the dynamics of the labor market: unemployment and wage outcomes are not dissociable from the specific labor force for which they are derived, and, therefore, the particular characteristics of the labor force must be taken into account when scrutinizing the labor market and its corresponding equilibrium.

On the first stage of the analysis, the personality results will be assessed and discussed within a static representative agent environment. This environment excludes agent heterogeneity and, consequently, it excludes heterogeneity of

personalities as well: the dominant personality in the economy is the personality of the representative agent. On a second stage, the homogeneity setting is replaced by an evolving economy of overlapping generations, where, at each date, the oldest worker abandons the economy and a new one, with a new set of personality traits, enters the labor market. Such setting will allow for the derivation a new set of interesting results, namely concerning the possible persistence of fluctuations on wages and unemployment, exclusively emanating from the personality traits of people participating in the labor market (*i.e.*, people entering and exiting the labor market).

The remainder of the paper is organized as follows. Section 2 briefly reviews the main elements of the search and matching model, attributing special relevance to the characterization of the labor market equilibrium. Section 3 characterizes the big five personality traits, briefly reviewing the extensive literature that has dealt with this issue. In section 4, the impact of personality on the determinants of workers' behavior is sorted out; in particular, an assessment of the relevant empirical literature is made, in order to identify which traits influence, and in what circumstances, the attitudes, choices and behaviors of jobseekers and employed workers.

In section 5, the influences highlighted in the precedent section are incorporated into the search and matching model and the disturbed equilibrium outcomes are characterized. Section 6 sets up a dynamic economy, where the single source of perturbation over the labor market equilibrium is the systematic entry and exit in the economy of generations with different personalities, what translates into time trajectories of wages and unemployment subject to bounded irregular fluctuations. Section 7 concludes.

2. LABOR MARKET EQUILIBRIUM UNDER SEARCH AND MATCHING

The central element of the search and matching model is the matching function. The matching function is a sort of production function for jobs. The inputs are the unemployment rate (u) and job vacancies per labor unit (v), and the output is the percentage of potentially created jobs, *i.e.*, the percentage of successful matches (m). Let $m = f(u, v)$; function f obeys to a few trivial properties: it is a continuous and differentiable function, with positive first derivatives ($f_u, f_v > 0$) and negative second derivatives ($f_{uu}, f_{vv} < 0$); the function is also homogeneous of degree 1. A particular function with the above properties, which will be used to guarantee the computation of explicit values for the model's endogenous variables, is:

$$m = \mu \sqrt{su} \sqrt{v} \quad (1)$$

Parameter $\mu > 0$ translates the technology of job creation. Parameter $s > 0$ measures the workers' search intensity; the stronger the intensity of search (*i.e.*,

the higher the value of s), the more successful the matching process will be. The fact that the unemployment – matching elasticity is equal to the vacancy – matching elasticity and both equal to $\frac{1}{2}$, is the convenient assumption adopted to obtain explicit equilibrium values for the variables of the model.

A pivotal variable in the analysis is the degree of tightness of the labor market, which is defined as the ratio between vacancies and unemployment, $\theta \equiv \frac{v}{u}$. From the tightness ratio, two relevant definitions emerge: (i) the probability of filling a vacancy,

$$q(\theta) = \mu \sqrt{\frac{s}{\theta}} \quad (2)$$

and, from the workers' perspective, (ii) the probability of finding a job:

$$p(\theta) = \mu \sqrt{s\theta} \quad (3)$$

As equations (2) and (3) make it evident, $\theta'(\theta) < 0$ and $p'(\theta) > 0$.

In equilibrium, the unemployment rate will be constant. This necessarily implies that the number of created jobs must be equal to the number of jobs that are lost. Imagining that jobs are lost at a given constant job destruction rate $\lambda \geq 0$, the following equality must hold,

$$\lambda(1 - u) = p(\theta)u \quad (4)$$

Expression (4) indicates that the total number of jobs lost must be identical to the number of jobs that are probably created. Rearranging (4), the equilibrium unemployment rate is connected to labor market tightness via a relation of opposite sign (this is known as the Beveridge curve),

$$u = \frac{\lambda}{\lambda + p(\theta)} \quad (5)$$

Both classes of agents, workers and firms, behave optimally: workers maximize the present value of expected future income (under the contingencies of employment and unemployment), and firms maximize the present value of expected future profits (from both already existing jobs and jobs that are potentially created through vacancies that are made available).

By solving the firm's problem, one arrives to the first fundamental condition necessary to characterize the labor market equilibrium in the search and matching model. This is known as the job creation condition, and it is a relation of opposite sign between the tightness of the labor market and the wage rate (the tighter the

labor market, the longer will be the time length until the vacancy is filled and, therefore, the higher will be the marginal cost of maintaining the vacancy; this makes the firm to be willing to pay lower wages, for any given productivity level),

$$w = A - \frac{(r - \lambda)Ac}{q(\theta)} \quad (6)$$

In equation (6), w represents the real wage rate, r is the real interest rate at which the future is discounted, A is a labor productivity index, and c corresponds to a fixed unit cost associated with making vacancies available. The equation indicates that the firm will be willing to hire a worker and, thus, create a job, if the obtained return, equal to productivity, covers for two types of costs: wages that have to be paid to workers, and the opportunity cost of maintaining a job (which corresponds to the marginal hiring cost). If the firm does not have to worry about the hiring process, then the outcome in equation (6) is simply the competitive market condition under which the wage rate is equal to marginal productivity.

From the worker's optimization problem and the bargaining process that follows, a second equation required to analyze labor market equilibrium is derived. This corresponds to the wage equation, which is a relation of positive sign between labor market tightness and the wage rate. The equation takes the following linear form:

$$w = (1 - \beta)z + \beta A(1 - c\theta) \quad (7)$$

In equation (7), $\beta \in (0, 1)$ represents the relative bargaining power of the unemployed worker (and $1 - \beta$ is the bargaining power of the other player, *i.e.*, the employer). Parameter $z \geq 0$ is the unemployment benefit, received by workers that are out of work and searching for a job. Equation (7), derived from the intertemporal optimization problem of the representative worker, indicates that the real wage is partially determined by the unemployment benefit and partially determined by productivity; the weights are the bargaining capabilities of each of the involved agents: a strong bargaining power from the workers' side makes the wage approach the unemployment benefit (note that it is implicitly assumed that $z < A$).

The same sign relation between labor market tightness and the wage rate is justified under the observation that a stronger labor market tightness is synonymous of more vacancies per unemployed worker, a fact that implies a weaker bargaining position of the representative employer, what leads to the inevitable acceptance of a higher wage.

The intersection of the job creation condition and the wage equation allows for the determination of the equilibrium values of the labor market tightness and the wage rate. Given the equilibrium value of q , through the Beveridge curve, it is also possible to determine the equilibrium level of the unemployment rate. Figure

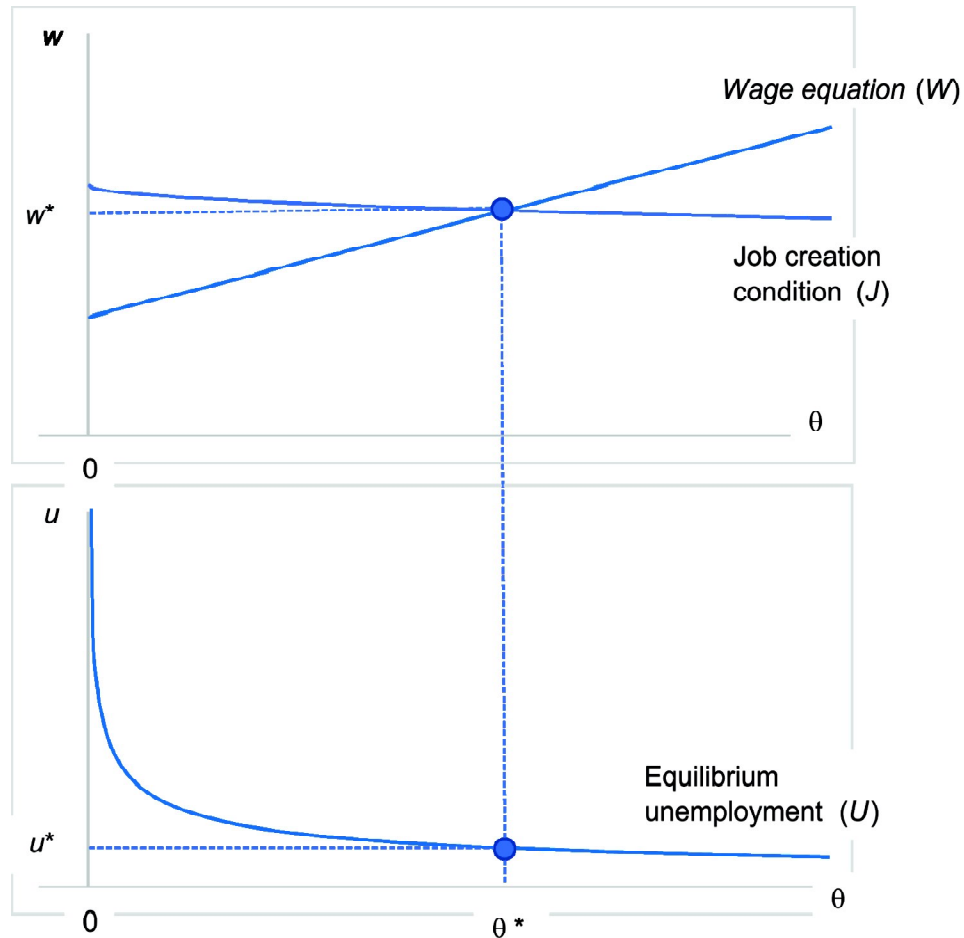


Figure 1: Labor market equilibrium

1 depicts the curves and the equilibrium points. One should note that the job creation condition can be interpreted as a demand-side labor market relation, while the wage equation is a supply-side labor market condition.

For the assumed functional form of the matching function, one can calculate explicit equilibrium values for the endogenous variables of the model, which will depend on the values of the several relevant parameters, namely the matching technology (μ), the search intensity (s), the job destruction rate (λ), the productivity of labor (A), the real interest rate (r), the unit cost of vacancy availability (c), the unemployment benefit (z), and the bargaining power of workers (β). The solution for the tightness variable is derived by equalizing the right-hand-side of equations (6) and (7). The feasible solution is

$$\theta^* = \left[\sqrt{\frac{1}{s} \left(\frac{r+\lambda}{2\beta\mu} \right)^2 + \frac{1-\beta}{\beta} \frac{A-z}{Ac} - \frac{r+\lambda}{2\beta\mu\sqrt{s}}} \right]^2 \quad (8)$$

Replacing (8) into (6) or (7), the equilibrium wage rate is computed,

$$w^* = (1-\beta)z + \beta A \left\{ 1 + c \left[\sqrt{\frac{1}{s} \left(\frac{r+\lambda}{2\beta\mu} \right)^2 + \frac{1-\beta}{\beta} \frac{A-z}{Ac} - \frac{r+\lambda}{2\beta\mu\sqrt{s}}} \right]^2 \right\} \quad (9)$$

Finally, the equilibrium unemployment rate is obtained from (5), taking (8) into account,

$$u^* = \frac{\lambda}{\lambda + \sqrt{\left(\frac{r+\lambda}{2\beta} \right)^2 + \frac{1-\beta}{\beta} \frac{A-z}{Ac} \mu^2 s - \frac{r+\lambda}{2\beta}}} \quad (10)$$

Consider a numerical example. Following Alogoskoufis (2019, ch.18), let $\mu = 0.5$, $s = 1$, $\lambda = 0.025$, $A = 1$, $r = 0.03$, $c = 0.5$, $z = 0.475$, $\beta = 0.5$. For these parameter values, the equilibrium levels of the endogenous variables come: $\mu^* = 0.847$, $w^* = 0.949$, $u^* = 0.051$. In this example, the ratio between vacancies and unemployed people is lower than 1, the equilibrium wage rate corresponds to 94.9 per cent of marginal productivity, and the equilibrium unemployment rate remains at 5.1 per cent.

Changes in parameter values will eventually shift the position of the curves in Figure 1 and, thus, disturb the equilibrium levels of the variables in expressions (8) to (10). The argument in this study is that personality traits of workers have influence on the value of some of the relevant parameters, making disturbances in such traits to trigger perturbations on the labor market equilibrium. These perturbations are analyzed later in the discussion, after the characterization of the psychological forces that shape human personality.

3. THE BIG 5 PERSONALITY TRAITS OF PSYCHOLOGICAL ANALYSIS

A significant portion of the forces that shape the labor market equilibrium, as characterized in the precedent section, is attached to the behavior of workers, in searching for jobs, in negotiating wages and benefits, and in the way they perform in the workplace. There are multiple factors determining such behavior, associated with the economic setting, the social environment, and the political context. One of these factors is surely attached to the patterns of thoughts and feelings that make people to act in certain ways in certain circumstances, *i.e.*, with what one can designate by individual personality (Roberts, 2009).

The objective of the analysis to pursue in the following sections is to explore and understand how personality directly impacts the behavior of workers, and indirectly exerts influence over the equilibrium levels of labor market tightness, the wage rate, and the unemployment rate. To proceed with such an analysis, one must somehow typify personalities. At this respect, the classification based on the big five personality traits of psychological analysis is adopted.

The big five typology was initially proposed in the early 1990s (Digman, 1990; Goldberg, 1990, 1993; Costa and McCrae, 1992; John and Srivastava, 1999), and became a popular taxonomy in psychology to approach a multiplicity of topics, e.g. from education (Busato *et al.*, 1998; van Eijck and de Graaf, 2004; Komarraju *et al.*, 2009) to politics (Caprara *et al.*, 1999; Mondak, 2010; Aidt and Rauh, 2017; Hugh and Le Roux, 2019). Inevitably, this taxonomy ended up being used to address a large variety of economic issues as well (Borghans *et al.*, 2008; Almlund *et al.*, 2011; Heckman, 2011; Rustichini *et al.*, 2012).

The big five personality traits, jointly referred to by the acronym OCEAN, are openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Although, in some circumstances, some of the traits may overlap in the individual's personality profile, they are interpreted as autonomous entities that can easily be distinguished from one another, given their underlying significance.

Openness to experience is associated with intellectual curiosity, creative thinking, open-mindedness, and a taste for the new and the unconventional. Conscientiousness presupposes a sense of responsibility, reliability, organization, and self-discipline; this trait is also attached to a willingness to conform, careful and goal-oriented behavior, and a desire to comply with social norms. Extraversion is synonymous of self-confidence, sociability, audacity, and surgency. Agreeableness is the personality trait linked to friendliness, trustfulness, and a warm, kind, and sympathetic behavior. Finally, neuroticism is linked to emotional instability, anxiety, and social distress.

Personality traits in general, and the OCEAN traits in particular, possess a few interesting and appealing properties that are worth highlighting in the context of their association with the labor market model. The most prominent of these properties is that the characterized traits are abstract concepts, in the sense that they cannot be subject to direct observation and measurement. It is through the inspection and analysis of complex patterns of behavior, with the eventual aid of self-perception inquiries, that one might infer about the personality profile of a given individual (McCrae and Costa, 1997).

A second fundamental property about personality traits is that they are largely uncorrelated with other features that influence human behavior, namely cognitive skills-. There is no evidence suggesting that individuals who rank in different

positions of a same personality measurement scale necessarily possess distinct intellectual capabilities, or vice-versa (McCrae and Costa, 1994).

Also relevant is the evidence that personality traits, although not necessarily immutable, tend to remain relatively stable over the life cycle of the individuals; they are typically perceived as a steady pattern of thoughts and feelings. The traits characterize who we are, and who we are (*e.g.*, introverted, neurotic, conscientious) does not change from one day to the next; on the contrary, they are long lasting features (McCrae and Costa, 1999; Cobb-Clark and Schurer, 2012). Finally, one should note that personality traits are not, in a significant extent, influenced by context (religion, culture, or geography) and, therefore, they tend to be universal; *e.g.*, a person can be more or less agreeable or more or less extraverted regardless of her education, religious convictions, or socio-cultural context in which she was raised (Kajonius and Giolla, 2017).

The highlighted traits of personality exert influence on workers' behavior at multiple levels, and a voluminous literature has dissected such impact over the last few years. In the next section, empirical literature that connects the big five to the labor market is explored, with the objective of identifying how each of the traits eventually influences the values of the parameters that shape the equilibrium in the search and matching model.

4. THE BIG 5 AND THE DRIVERS OF EMPLOYMENT AND WAGES

In section 2, eight determinants of the labor market equilibrium were identified; they correspond to the relevant parameters in the search and matching model. From these drivers of employment and wages, four of them are, at least partially, associated with the worker's behavior. It is the case of the job destruction rate, the labor productivity, the bargaining power of the job seeker and the search intensity. These four features are contingent on the personality of workers, and empirical literature has accessed the intensity with which personality traits impact them. This section surveys the links established in the empirical literature between personality and workers' decisions and behavior.

Besides the four mentioned elements, another one can be indirectly associated with the personality of the individuals in an economy, namely the unemployment benefit. In democratic countries, political choices have impact on public policies and, particularly, on the policies concerning the assistance to unemployed people. Left-wing governments typically support more generous benefit policies than right-wing governments. Therefore, by identifying which types of personalities tend to elect each kind of government, one is able to make parameter z depend on the personality of the agents in the economy.

An inspection of the existing literature allows for finding significant interdependencies between personality traits and the main drivers of workers'

behavior. Some meaningful results found by means of the empirical research are highlighted below.

One of the central parameters in the search and matching model is the job destruction rate. Although assumed exogenous in the original version of the model, it can easily be associated with various economic and non-economic forces. It can also be attached to personality traits, namely with each of the traits composing the big five. Empirical studies linking personality traits with job destruction and job turnover point to some unambiguous observations. Agreeableness is the personality trait that is most directly associated with turnover intentions and turnover decisions; the relation is of opposite sign: agreeable people are less likely to lose their job or to wish to change job (Salgado, 2002; Zimmerman, 2008; Bolton *et al.*, 2010; Wille *et al.*, 2010; Jeswani and Dave, 2012). Similar results of negative association between personality traits and the rate of job loss were found for conscientiousness (Zimmerman, 2008; Bolton *et al.*, 2010; Singh *et al.*, 2014), and extraversion (Salgado, 2002; Jeswani and Dave, 2012).

In the opposite direction, openness to experience was found to be a good predictor of job change (Salgado, 2002; Wille *et al.*, 2010; Woo *et al.*, 2016). Not surprisingly, a positive correlation between neuroticism and job loss and job turnover has been found as well (Salgado, 2002; Zimmerman, 2008; Singh *et al.*, 2014). Hence, it is possible to identify on the surveyed empirical studies an effect of each of the big five over the job destruction rate. Letting ϕ_i^λ , $i = o, c, e, a, n$, be an array of parameters that quantify the impact of each trait over rate λ , one can assert, based on the literature, that $\phi_o^\lambda > 0$, $\phi_c^\lambda < 0$, $\phi_e^\lambda < 0$, $\phi_a^\lambda < 0$, $\phi_n^\lambda < 0$. These signs will be relevant in the next section, when incorporating personality into the analysis of labor market equilibrium.

Proceeding to our second relevant feature, labor productivity, one is also able to identify some uncontestable evidence. The most striking piece of evidence is the one pointed out by Cubel *et al.* (2016), who unequivocally show that there exists a positive association between conscientiousness and productivity and a negative association between neuroticism and productivity. To these results, Fletcher (2013) adds one more: by observing that a large fraction of economic activity (and jobs) is nowadays concentrated on the services sector, and that services require intense job interaction in the workplace, extraversion should also be interpreted as a personality trait that promotes productivity.

Likewise, agreeableness is perceived as an important feature in promoting productivity in the type of jobs that are demanded by the contemporaneous economy (Chandel and Shahi, 2018; Caulo *et al.*, 2021). Li *et al.* (2014) stress that all personality traits, with exception of neuroticism, are positively correlated with productivity, and therefore the following parameter signs can be, based on the evidence, taken into consideration: $\phi_o^A > 0$, $\phi_c^A < 0$, $\phi_e^A < 0$, $\phi_a^A < 0$, $\phi_n^A < 0$.

For search intensity, the results are similar to those found for productivity. Good performances in job interviews and the overall probability of success in finding a job are positively stimulated by extraverted, conscientious, open and agreeable personalities, while neuroticism works in the opposite direction (Caldwell and Burger, 1998; Uysal and Pohlmeier, 2011; Seo and Kang, 2019). Therefore, one establishes that: $\phi_o^s > 0$, $\phi_c^s < 0$, $\phi_e^s < 0$, $\phi_a^s < 0$, $\phi_n^s < 0$.

The next item to consider is the bargaining power of the job seeker. Agreeableness is found to penalize the bargaining capacity of the worker relatively to the employer (Evdokimov and Rahman, 2021). Considering the other traits, openness to experience, conscientiousness, and extraversion are features that typically favor the capacity to negotiate and to attain favorable negotiation results; the opposite is true for neuroticism (Ma, 2005; Yiu and Lee, 2011). Hence, $\phi_o^\beta > 0$, $\phi_c^\beta < 0$, $\phi_e^\beta < 0$, $\phi_a^\beta < 0$, $\phi_n^\beta < 0$.

Finally, one approaches the unemployment benefit. Typically, the unemployment benefit is set by governments and is contingent on political choices and even political ideologies. Workers influence the amount of the support to the unemployed not directly, but through which party they vote on. Left-wing governments are typically prone to offer higher benefits than right-wing governments. Where people vote, in turn, is influenced by personality. Conservative ideologies are often attached to individuals who score high in conscientiousness, introversion and emotional stability, while left-wing political and ideological preferences are associated with openness to experience and agreeableness (Barbaranelli, 2007; Hanania, 2017; Furnham and Fenton-O'Creedy, 2018). The respective impacts on the unemployment benefit will be such that: $\phi_o^z > 0$, $\phi_c^z < 0$, $\phi_e^z < 0$, $\phi_a^z < 0$, $\phi_n^z < 0$.

In the next section, the identified signs will be incorporated in the equilibrium analysis of the search and matching model.

5. PREVAILING PERSONALITIES AND EQUILIBRIUM OUTCOMES

The signs indicating the most probable direction of the impact of each of the big five personality traits over an array of five relevant labor market variables were identified in the previous section, through a short survey of the available empirical literature. As a simplifying assumption, consider now that positive impacts are valued 1 while negative effects are valued -1. Table 1 synthesizes the collected information.

In the characterized setting, personality will be measured by an array of variables \mathcal{P}_i , one for each of the assumed personality traits, $i = o, c, e, a, n$. When $\mathcal{P}_i = 0$, the trait is in a state of neutrality, and if this state holds for all the traits, then the benchmark labor market outcomes of section 2 apply. When $\mathcal{P}_i > 0$, the respective personality trait is assumed to have a value larger than the norm (*i.e.*, the agent is

Table 1: Impact of personality traits on labor market variables

	l	A	s	b	z
o	$\phi_o^\lambda = 1$	$\phi_o^A = 1$	$\phi_o^s = 1$	$\phi_o^\beta = 1$	$\phi_o^z = 1$
c	$\phi_c^\lambda = -1$	$\phi_c^A = 1$	$\phi_c^s = 1$	$\phi_c^\beta = 1$	$\phi_c^z = -1$
e	$\phi_e^\lambda = -1$	$\phi_e^A = 1$	$\phi_e^s = 1$	$\phi_e^\beta = 1$	$\phi_e^z = 1$
a	$\phi_a^\lambda = -1$	$\phi_a^A = 1$	$\phi_a^s = 1$	$\phi_a^\beta = -1$	$\phi_a^z = 1$
n	$\phi_n^\lambda = -1$	$\phi_n^A = -1$	$\phi_n^s = -1$	$\phi_n^\beta = -1$	$\phi_n^z = 1$

relatively more open to experience, conscientious, extraverted, agreeable, or neurotic than the assumed benchmark); the opposite occurs for $\mathcal{P}_i < 0$ (in this case, the agent is relatively more close to experience, unconscientious, introverted, unagreeable, or emotionally stable than the norm). Therefore, the values of \mathcal{P}_i represent the personality profile of the agent or group of agents under consideration, in a scale that considers both positive and negative values (and where higher levels of \mathcal{P}_i , in absolute value, will represent more extreme personalities).

For purposes of simulation, consider that influences the values of λ, A, s, β, z , making them approach a lower bound, $\underline{\lambda} < \lambda, \underline{A} < A, \underline{s} < s, \underline{\beta} < \beta, \underline{z} < z$, or, alternatively, an upper bound $\bar{\lambda} < \lambda, \bar{A} < A, \bar{s} < s, \bar{\beta} < \beta, \bar{z} < z$. The direction of this influence depends on how personality impacts behavior, given the contents of Table 1. Therefore, in the search and matching model of section 2, the values of the five parameters that suffer the influence of personality are now values that may deviate from the benchmark levels (which hold under personality neutrality) and eventually approach the defined lower or upper bounds. Specifically, the original variables are replaced by the following,

$$\hat{\lambda} = \frac{\underline{\lambda}(\bar{\lambda} - \lambda) + \bar{\lambda}(\lambda - \underline{\lambda})e^{\Sigma i \phi_i^\lambda \mathcal{P}_i}}{\bar{\lambda} - \lambda + (\lambda - \underline{\lambda})e^{\Sigma i \phi_i^\lambda \mathcal{P}_i}} \quad (11)$$

$$\hat{A} = \frac{A(\bar{A} - A) + \bar{A}(A - \underline{A})e^{\Sigma i \phi_i^A \mathcal{P}_i}}{\bar{A} - A + (A - \underline{A})e^{\Sigma i \phi_i^A \mathcal{P}_i}} \quad (12)$$

$$\hat{s} = \frac{\underline{s}(\bar{s} - s) + \bar{s}(s - \underline{s})e^{\Sigma i \phi_i^s \mathcal{P}_i}}{\bar{s} - s + (s - \underline{s})e^{\Sigma i \phi_i^s \mathcal{P}_i}} \quad (13)$$

$$\hat{\beta} = \frac{\underline{\beta}(\bar{\beta} - \beta) + \bar{\beta}(\beta - \underline{\beta})e^{\Sigma i \phi_i^\beta \mathcal{P}_i}}{\bar{\beta} - \beta + (\beta - \underline{\beta})e^{\Sigma i \phi_i^\beta \mathcal{P}_i}} \quad (14)$$

$$\hat{z} = \frac{\underline{z}(\bar{z} - z) + \bar{z}(z - \underline{z})e^{\Sigma i\phi_i^z P_i}}{\bar{z} - z + (z - \underline{z})e^{\Sigma i\phi_i^z P_i}} \quad (15)$$

How the assumptions about personality disturb the labor market equilibrium is something that will depend on the specific values of parameters. To simulate the model, take the same array of parameter values as in section 2 and add the following boundary values, which deviate 25 per cent relatively to benchmark levels, $\underline{\lambda} = 0.01875$; $\bar{\lambda} = 0.03125$; $\underline{A} = 0.75$; $\bar{A} = 1.25$; $\underline{s} = 0.75$; $\bar{s} = 1.25$; $\underline{\beta} = 0.375$; $\bar{\beta} = 0.625$; $\underline{z} = 0.35625$; $\bar{z} = 0.59375$.

Start by considering that workers in the economy may have three (randomly chosen) different personality profiles, namely those indicated in Table 2, alongside with the benchmark neutrality case.

Table 2: Three possible personality profiles

<i>Benchmark</i>	<i>Scenario I</i>	<i>Scenario II</i>	<i>Scenario III</i>
0	3	1	-1
0	-6	4	-3
0	-1	1	0
0	-2	-6	2
0	5	0	-3

For each of the above scenarios, and given the way in which personality exerts influence over the drivers of the labor market, as displayed in Table 1, the new values of each of the disturbed parameters are those presented in Table 3.

Table 3: Parameter values in the three selected scenarios

	<i>Benchmark</i>	<i>Scenario I</i>	<i>Scenario II</i>	<i>Scenario III</i>
λ	0.025	0.03123	0.02976	0.01934
A	1	0.75001	1	1.11553
z	0.475	0.59375	0.35633	0.52988
β	0.5	0.37523	0.62500	0.38686
s	1	0.75001	1	1.11553

Table 3 reveals that the three scenarios imply different directions on the change of parameter values: the first two scenarios generate a rate of job destruction higher than the original, while in the third scenario the opposite occurs. Productivity decreases in the first case, it is maintained in the second, and increases in the third (the same for the search intensity). The unemployment benefit increases, and the bargaining power of the job seekers falls, in the first and third scenarios, relatively to the benchmark, with the opposite occurring in scenario II. Equilibrium levels

Table 4: Equilibrium values in the three selected scenarios

Benchmark	Scenario I	Scenario II	Scenario III
0.847	0.443	0.622	1.380
0.949	0.715	0.953	1.054
0.051	0.098	0.070	0.030

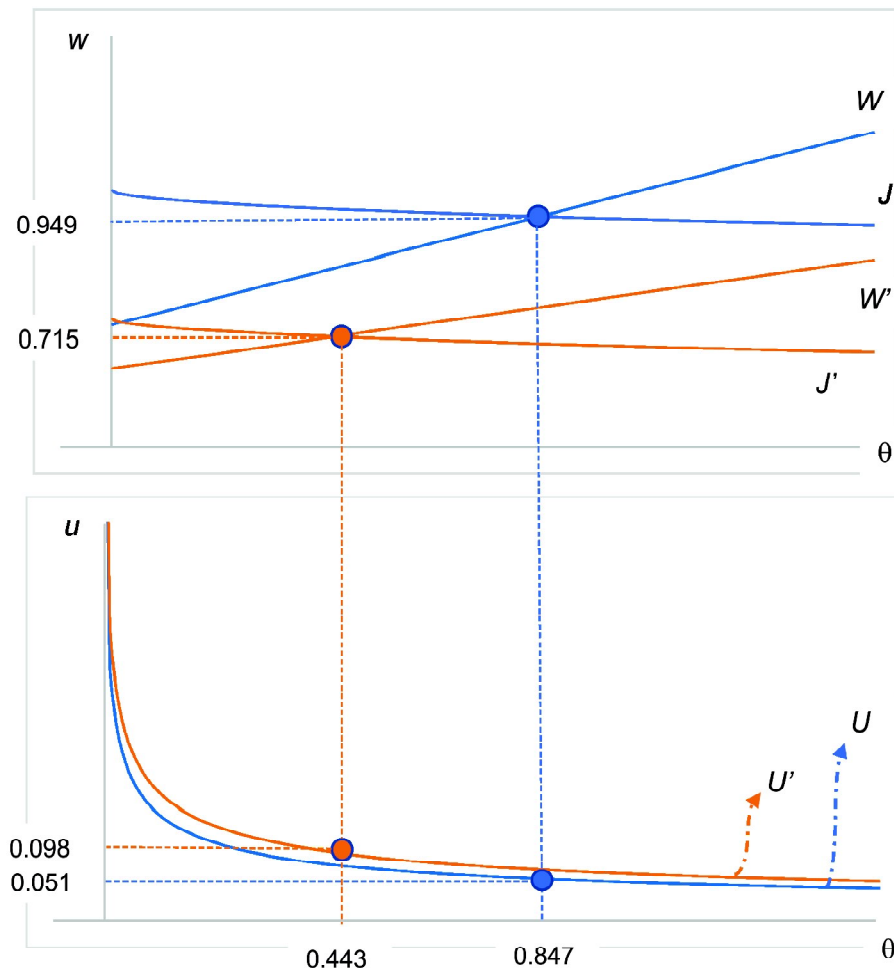


Figure 2: Perturbation of the labor market equilibrium (scenario I)

for each of the variables of the model in each of the scenarios are displayed in Table 4.

Figures 2 to 4 represent the labor market equilibrium curves and the equilibrium unemployment curve for each of the three scenarios, compared with

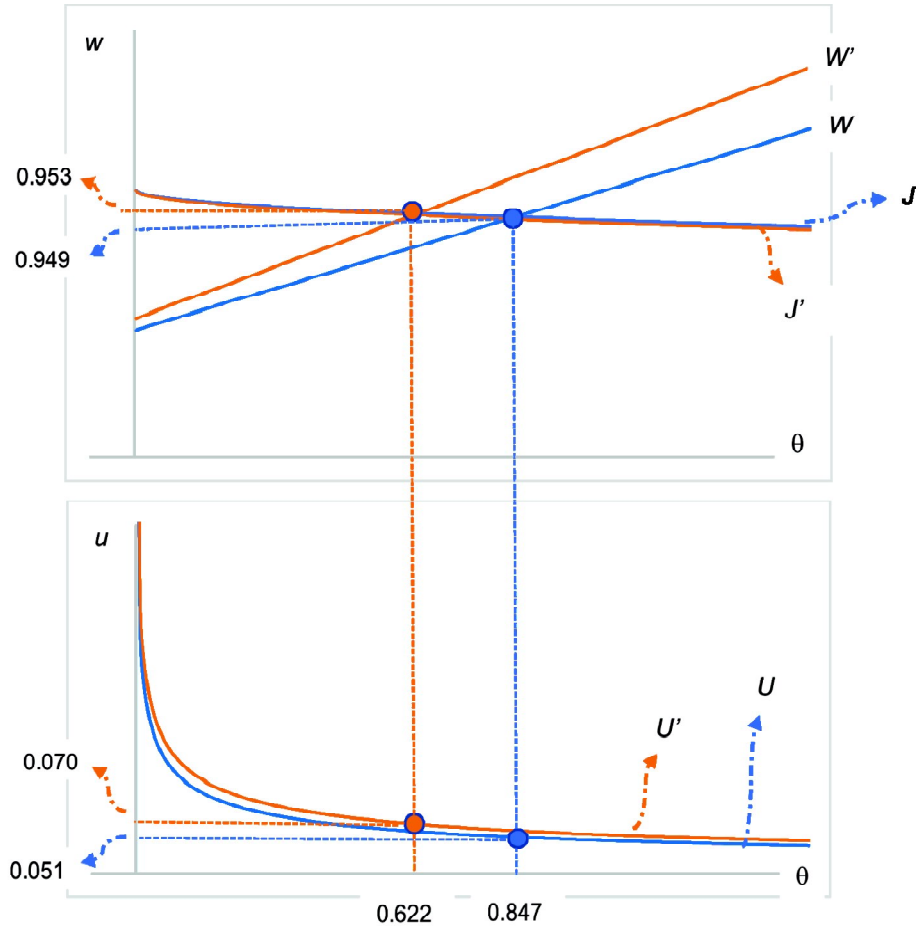


Figure 3: Perturbation of the labor market equilibrium (scenario II)

the benchmark case. In the first scenario (Figure 2), the job creation condition shifts downward (pushed by the falls in productivity, job retention, and search intensity), and the wage equation moves down as well (*i.e.*, to the right), given the changes in the values of parameters β , z and A . As a result, a new equilibrium is formed for a lower level of tightness of the labor market and a lower wage rate. The increase in the job destruction rate and the decrease in the search effort measure imply an upward shift in the unemployment curve, and the formation of a new equilibrium unemployment rate that is higher than the original.

The second personality traits' profile implies productivity and search intensity indexes equal to the ones under personality neutrality. Thus, the perturbations on the curves and over the equilibrium are circumscribed to the effects emanating from changes on the values of the other three parameters. The job creation condition

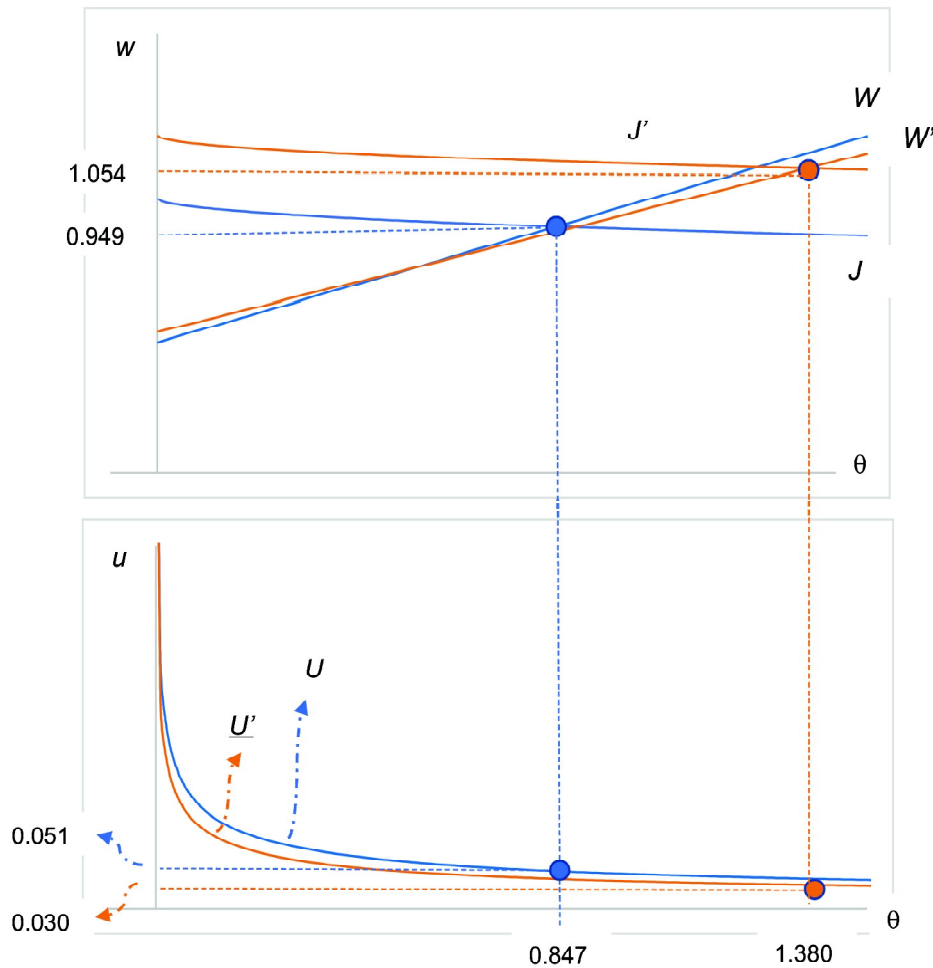


Figure 4: Perturbation of the labor market equilibrium (scenario III)

slightly shifts downward because of the increase in the job destruction rate; the wage equation shifts upward due to the combined effect of the increase in the bargaining power of workers and the fall in the unemployment benefit. The overall result is a decrease in the equilibrium value of labor market tightness and a small increase in the wage rate. The unemployment curve shifts upward, and the equilibrium unemployment rate will locate above the one calculated for the benchmark neutrality case.

Scenario III involves assuming a set of personality traits that, on the overall, are favorable to good labor market outcomes, namely a negative index of neuroticism and a positive index of agreeableness (despite the negative conscientiousness). The lower job destruction rate and the higher levels of search

intensity and productivity (relatively to the no-personality case) that emanate from this personality profile, suggest that the wage rate will increase, and that the unemployment rate will fall. In fact, the job creation condition moves up and the wage equation becomes flatter, generating a new equilibrium with higher values of labor market tightness and wage. The unemployment equation shifts downward (lower job destruction), leading to an equilibrium level of the unemployment rate lower than the one in the no-personality case.

The analysis so far has assumed three possible personality profiles, which were chosen randomly. One observed that all the traits contribute to change the forces that affect the supply and demand of labor, implying a perturbation of the original equilibrium results. Consider now that all personality traits remain in a state of neutrality except one, in rotation, in order to better identify how each of the traits individually impacts labor market outcomes. Figures 5 to 7 show the equilibrium values of the labor market tightness, the wage rate, and the unemployment rate, respectively, for different personality values of each trait (when all the other maintain neutrality).

Labor market tightness increases with the rise in agreeableness and conscientiousness indexes (although this last trait with a peak at $\mathcal{P}_c = 0$). As openness to experience, extraversion and neuroticism gain strength, labor market tightness falls (although, in the last case, with a peak at $\mathcal{P}_n = 0$). Concerning equilibrium wage, this increases with the values of all personality traits except neuroticism. For the unemployment rate, higher unemployment is observed for more intense openness to experience and neuroticism, and the opposite for the other traits.

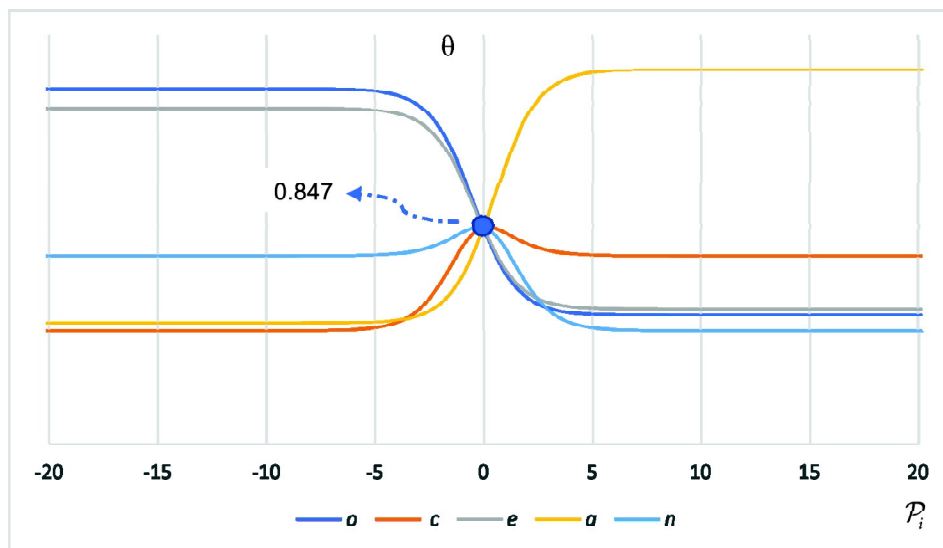


Figure 5: Equilibrium labor market tightness (personality neutrality for all traits except one)

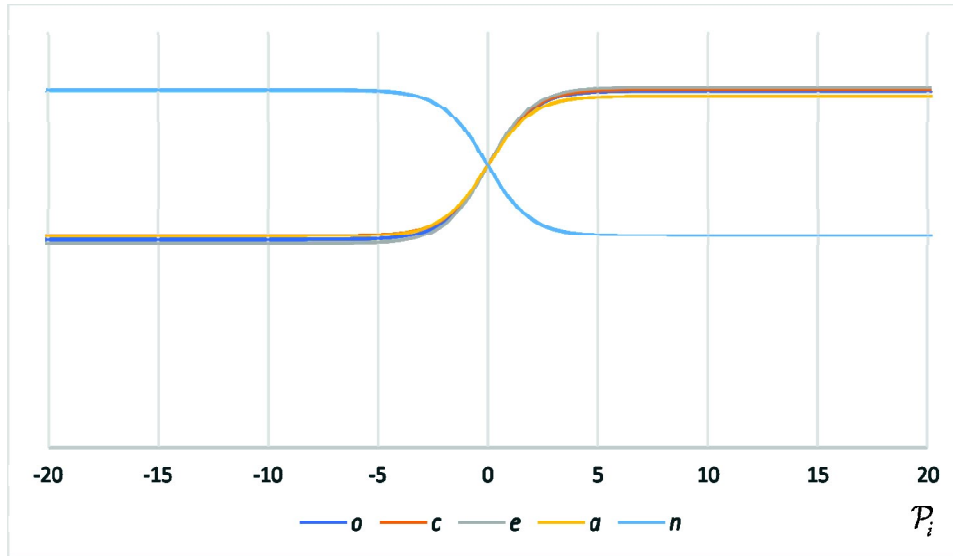


Figure 6: Equilibrium wage rate (personality neutrality for all traits except one)

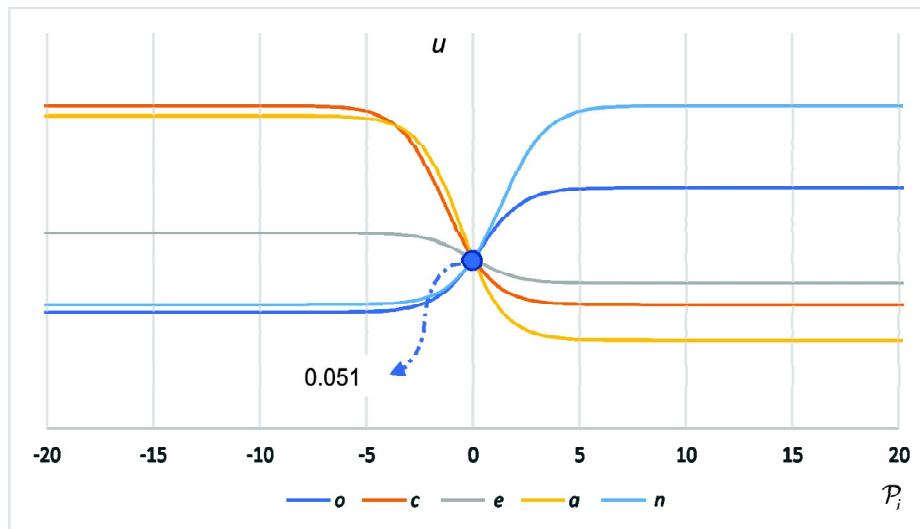


Figure 7: Equilibrium unemployment rate (personality neutrality for all traits except one)

For wages and unemployment, the presented trajectories correspond to sigmoidal curves, shaped by the evolution of the personality trait from deeply negative to deeply positive values. This *s*-shaped curve format is disturbed when the values of the traits remain fixed (except one), but not necessarily at the personality neutrality state. Figures 8 to 10 repeat the same exercise as the one

underlying the previous figures, but with the personality values of scenario I (that is, one of the traits evolves, while the others remain at the values of this scenario). The figures show a complex pattern of evolution of each of the equilibrium variables, when one personality trait varies given non-neutral values of the other personality traits.

The previous exercise is repeated for scenarios II and III to confirm the diversity of outcomes one might find when assuming different personality profiles for the

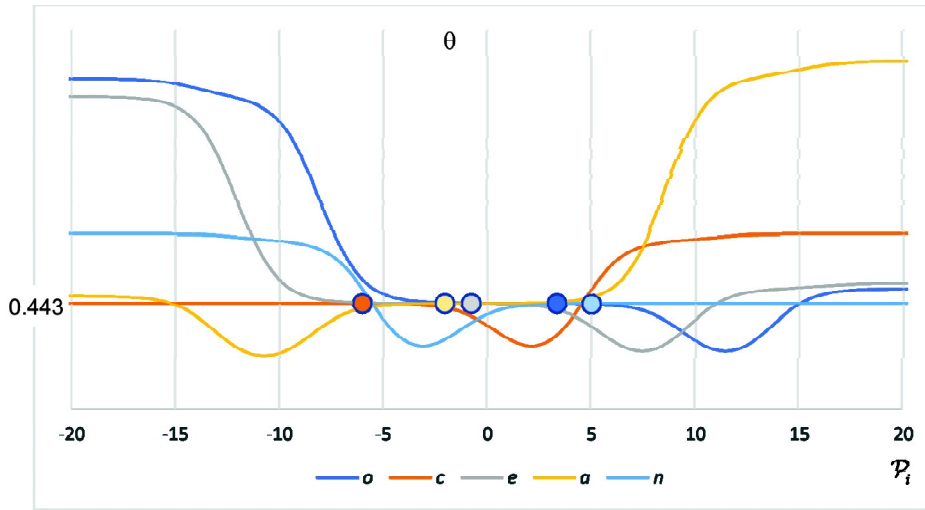


Figure 8: Equilibrium labor market tightness for different personalities (scenario I)

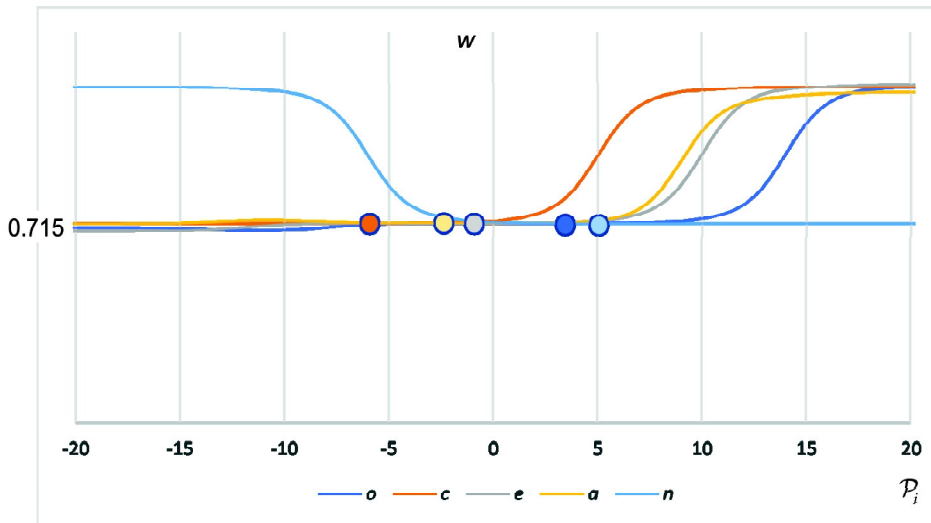


Figure 9: Equilibrium wage rate for different personalities (scenario I)

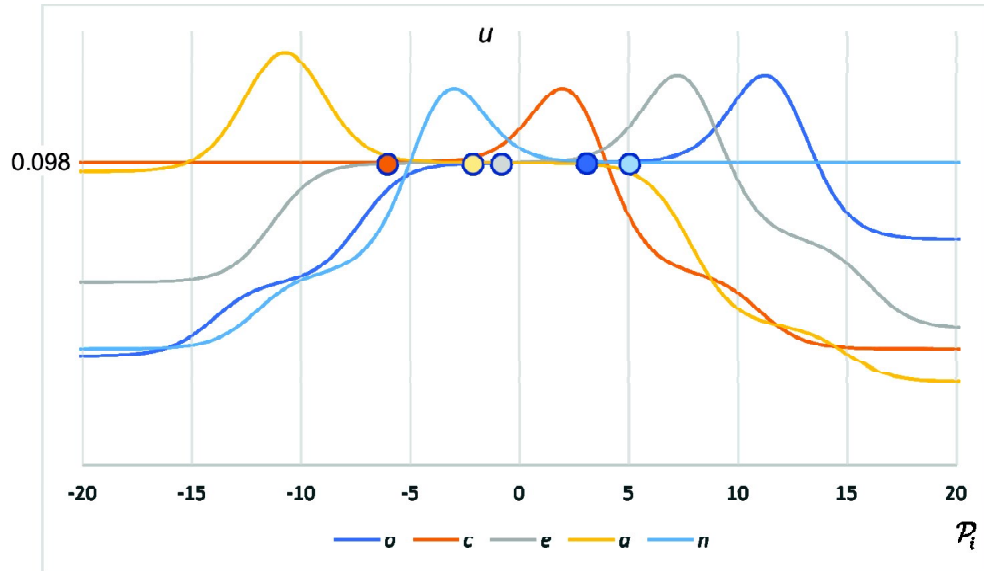


Figure 10: Equilibrium unemployment rate for different personalities (scenario I)

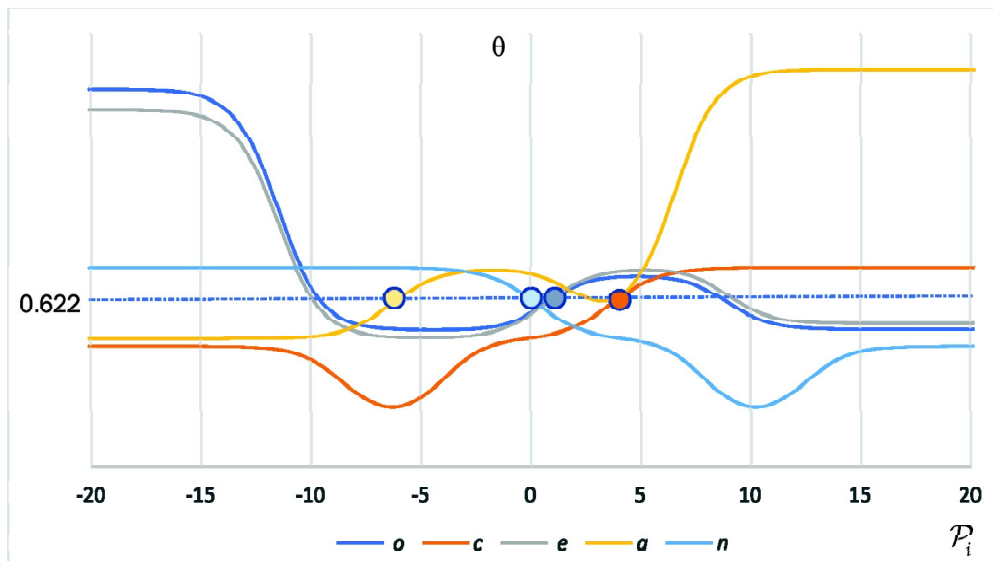


Figure 11: Equilibrium labor market tightness for different personalities (scenario II)

workforce (Figures 11 to 16). Every change in the equilibrium position is the result of the movement in the job creation condition and on the wage equation, whose intersection forms a new equilibrium every time personality changes and, consequently, the values of the relevant parameters of the model change as well.

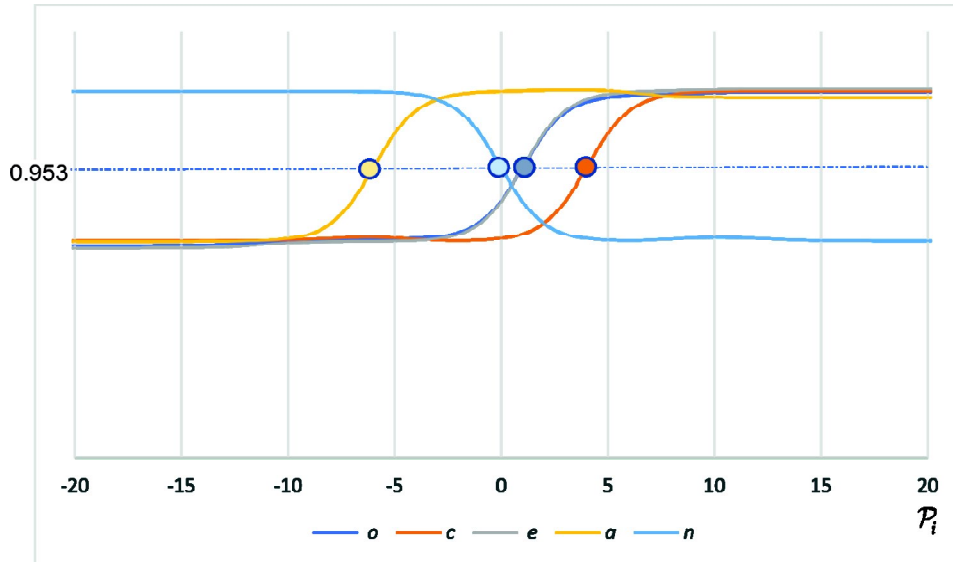


Figure 12: Equilibrium wage rate for different personalities (scenario II)

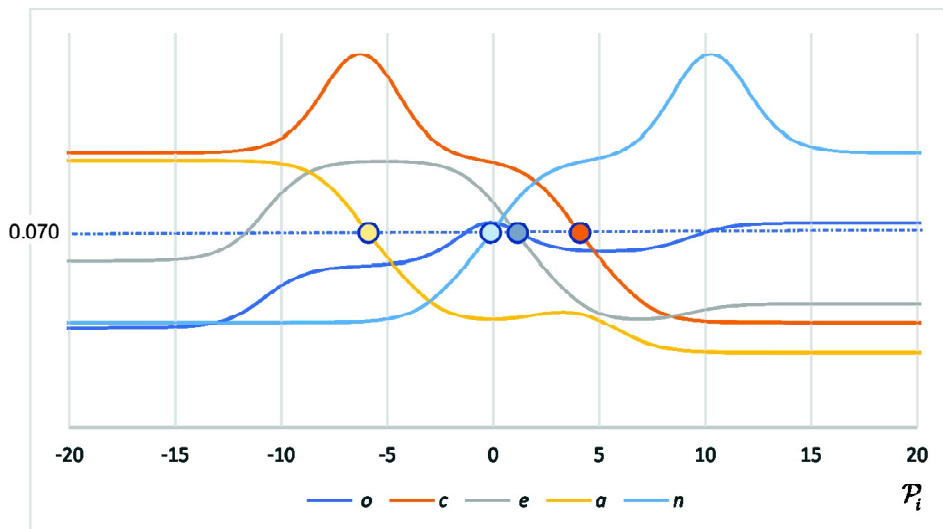


Figure 13: Equilibrium unemployment rate for different personalities (scenario II)

6. EVOLVING PERSONALITIES AND UNEMPLOYMENT CYCLES

The analysis conducted thus far has investigated how the personality of the labor force contributes to shape labor market equilibrium outcomes, in the context of the search and matching model. In the approached scenarios, the labor force is reduced to a representative agent and, thus, the personality profiles one has

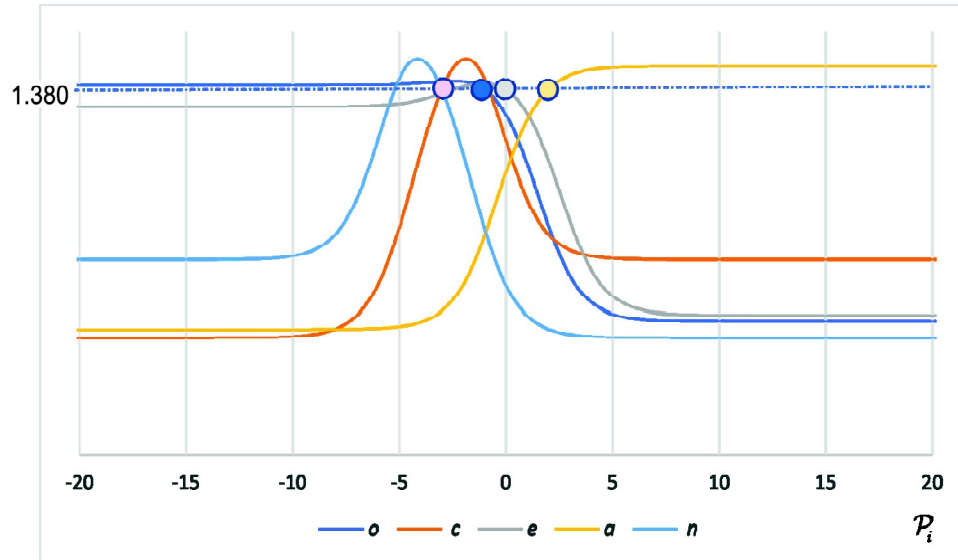


Figure 14: Equilibrium labor market tightness for different personalities (scenario III)

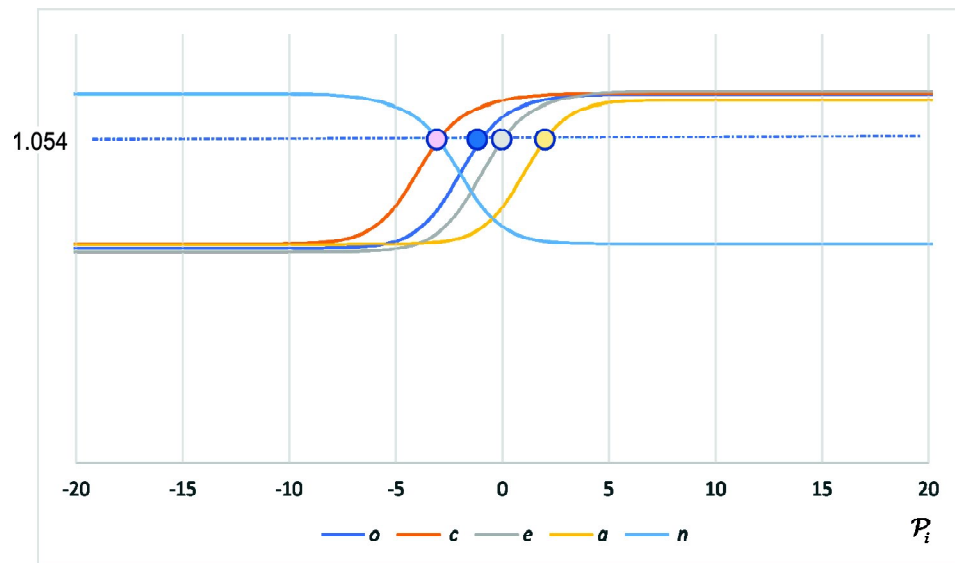


Figure 15: Equilibrium wage rate for different personalities (scenario III)

considered are simply the representation of the personality of this average or aggregate agent. In the absence of heterogeneity, there is no possibility of addressing the implications of an eventual interplay among agents holding distinct personalities, and therefore the labor market equilibrium is unique and immutable

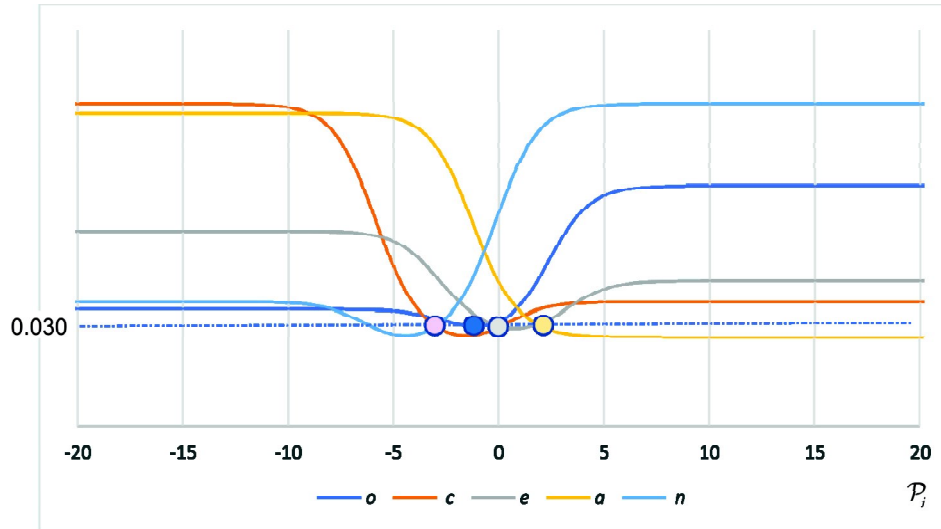


Figure 16: Equilibrium unemployment rate for different personalities (scenario III)

for any given set of personality traits that is taken to psychologically characterize the economy's underlying agent.

In this section, the analysis goes beyond the representative agent, by assuming a sequence of overlapping generations. Each generation will be composed by a single (representative) individual; however, across generations agents are different, namely regarding the personality traits with which they are endowed. Personality traits are randomly assigned to every new generation that, at every date, enters the labor market, and these traits are kept by the individual of such generation over the entire life cycle. The renewal of generations that will take place over time will imply a systematic change on the profile of the labor force and, ultimately, on the equilibrium levels of the labor market variables (labor market tightness, unemployment and wages), leading to persistent oscillations on the trajectories followed by these variables.

Formally, take a sequence of overlapping generations, each one composed by a single (representative) individual endowed with a random set of personality traits. Generations live for T periods and when one generation abandons the economy (at the end of the respective life cycle) another one is born; therefore, the workforce that populates the economy is always a number equal to T (except, eventually, for an initial transition phase). Workers maintain a same set of personality traits over the entire life cycle, but there is no guarantee that the generation that enters the economy at a given date holds exactly the same personality traits as the one that exits the labor market (in fact, it would be a great coincidence if such occurred).

Again, the search and matching model is solved, and the equilibrium values of unemployment and wages are derived. The difference, relatively to the representative agent setting, is that now the parameters that characterize the behavior of the workforce are averages of the parameter values pertaining to each individual agent. Because generations are systematically renewed, those average values are constantly changing, provoking constant changes in the equilibrium levels of the aggregate variables of the labor market. The emergent time series, formed under the characterized mechanism, will display irregular fluctuations. The single potential source of instability, conducting to these fluctuations, is the change in the average personality profile of the population that occurs at every period, as the oldest generation disappears and gives place to a newborn generation, endowed with its idiosyncratic random array of personality traits.

To illustrate the overlapping generations setup, assume that the population level is set at $T=0$, and that all the parameter values considered in previous sections continue to hold. Assume as well that personality traits for each generation are randomly generated from a normal distribution with zero mean and standard-deviation equal to 25 (the large standard-deviation allows for significant departures of neutrality at the individual level, an effect that is smoothed when considering

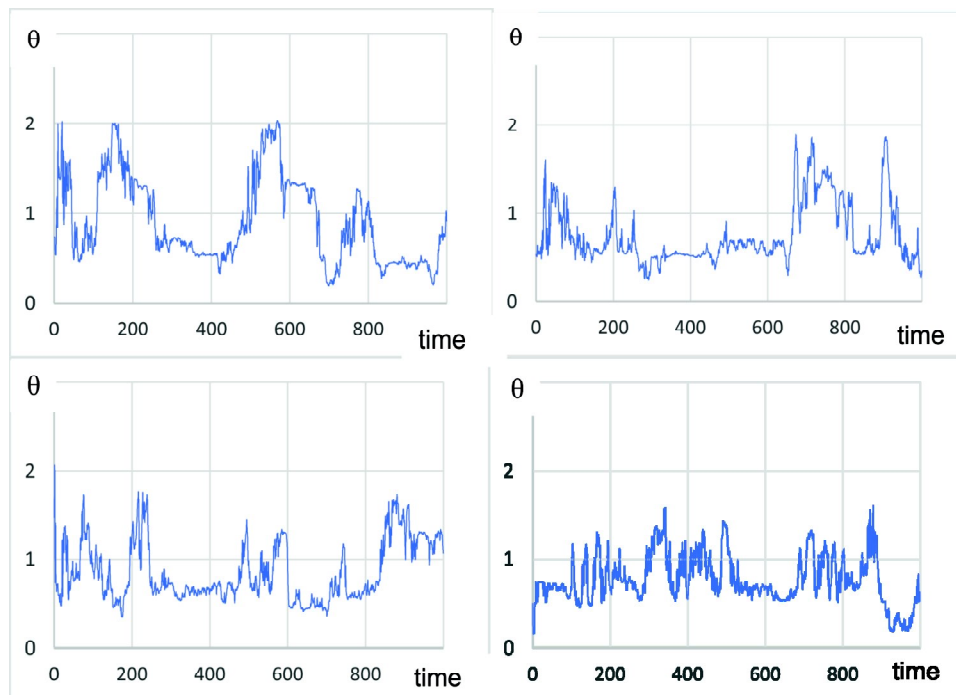


Figure 17: Labor market tightness trajectories (overlapping generations)

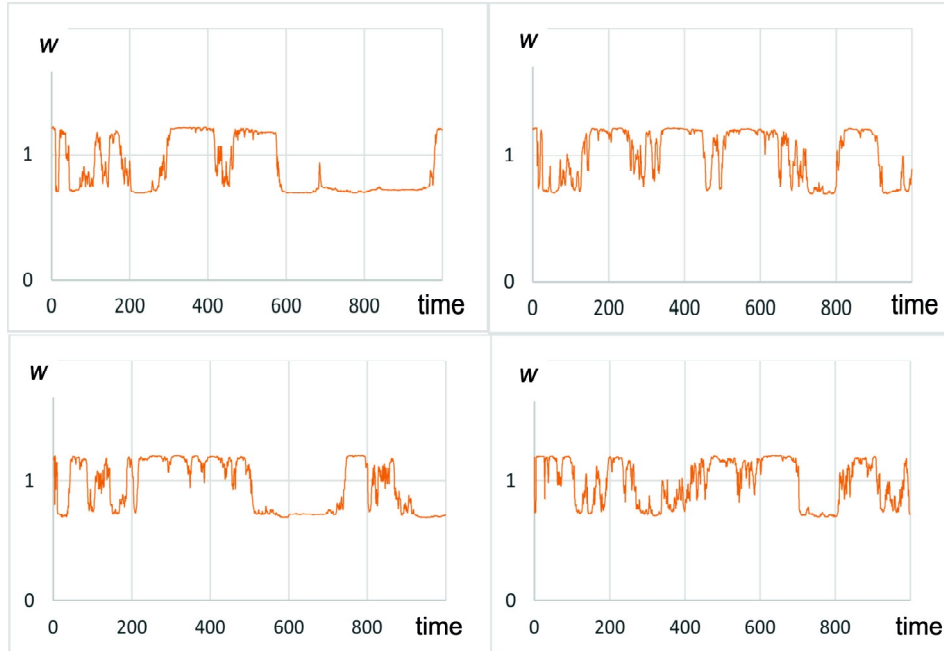


Figure 18: Wage rate trajectories (overlapping generations)

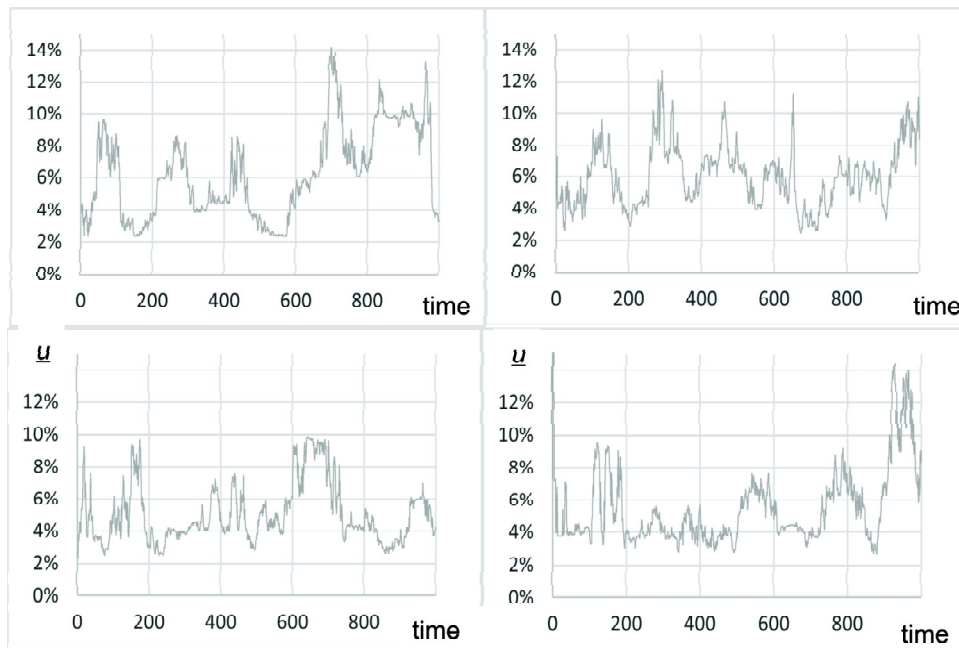


Figure 19: Unemployment rate trajectories (overlapping generations)

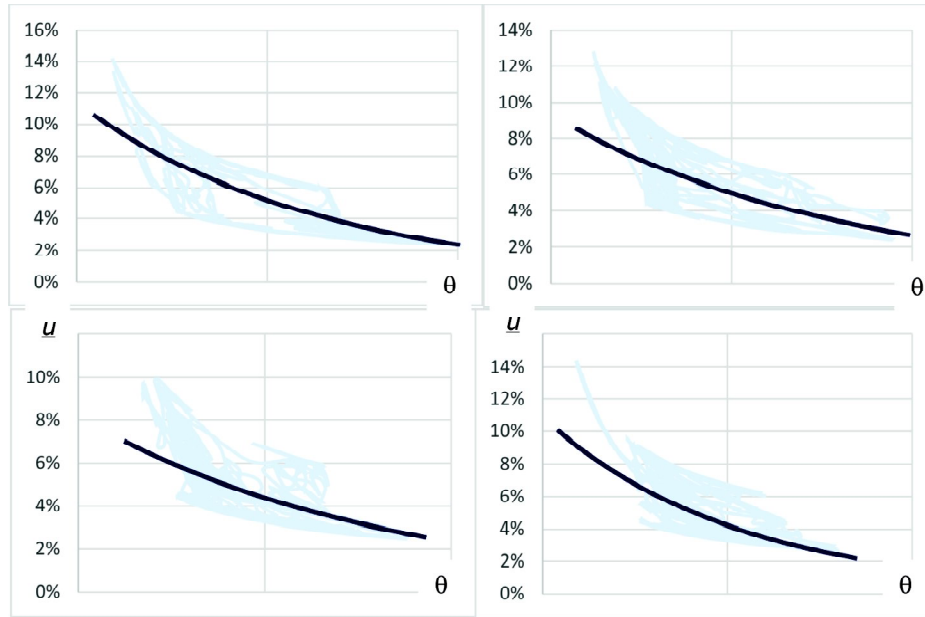


Figure 20: Beveridge curve in the overlapping generations framework

average values across the population). Figures 17 to 19 present the time trajectories of the three endogenous variables of the model under evolving personalities, for a time interval of 1,000 time periods.

In each figure, four panels are presented, representing four possible outcomes, given the stochasticity associated with personality traits. It is visible, from the figures, the oscillating pattern of the labor market tightness, the formation of wage cycles with long periods of high wages alternating with long periods of relatively low wages, and the bounded instability in the unemployment rate with peaks that reach values close to 14 per cent, which alternate with periods of relatively low unemployment (lower than 5 per cent).

To complement the above characterization of the overlapping generations economy, Figure 20 shows, for the cases illustrated in the graphics with the trajectories, the equilibrium relation between labor market tightness and the unemployment rate (the Beveridge curve or equilibrium unemployment curve). With overlapping generations endowed with different personalities, the unemployment curve is, on average, a relation of opposite sign, as expected, and as revealed by the trend line added to the graphics.

7. CONCLUSION

The search and matching model identifies a series of determinants of the labor market equilibrium. Among these, there are features that depend (at least partially)

on the behavior of workers, as productivity performance, the job search effort, the wage bargaining power, and the ability to maintain jobs. Furthermore, workers are also voters, and their vote is decisive in choosing political leaders that are more or less prone to assist individuals when faced with the undesired situation of involuntary unemployment.

Workers have personality, and their personalities influence the above-mentioned forces. Therefore, one should expect an indirect effect of personality traits over labor market outcomes. This effect has been explored and discussed in the paper. Taking into account the big five personality traits of psychological analysis, and reviewing the empirical literature on the impact of each trait over each of the mentioned labor market features, an investigation on how labor market outcomes are disturbed by personality has been undertaken. High conscientiousness, high agreeableness, and high extraversion tend to promote good labor market outcomes, regarding wages and employment. Neuroticism has the opposite effect, while openness to experience exerts positive effects over some variables and a negative effect over others (e.g., job turnover).

The analysis has mostly focused on characterizing how the labor market is disturbed in a representative agent setting; however, in a second stage, personality traits were also interpreted as a possible source of fluctuations: as new generations enter the market, endowed with specific personality traits, different from those of the ones that retire in the same period, irregular fluctuations emerge, fluctuations that are visible in the trajectories of the vacancies-unemployment ratio, of the wage rate and of the unemployment rate.

Obviously, much of the labor market outcomes are determined by macroeconomic factors, and other factors of a sociological and political nature. Although these are important, this study has emphasized that workers are not neutral from the personality point of view, and when some personality traits dominate across the population of workers, this can have an important impact on the unemployment rate and other labor market features.

Declarations

- Ethics approval and consent to participate: the document fully complies with ethical standards.
- Consent for publication: the research involved no human participants.
- Availability of data and materials: not applicable.
- Competing interests: the author has no financial or non-financial interests to disclose.
- Funding: no funding was received for conducting this study.

- Author's contributions: I am the single author of the study.
- Acknowledgements: support from CEFAGE research center is gratefully acknowledged.
- Authors' information: Orlando Gomes is professor of economics at the Lisbon Accounting and Business School – Lisbon Polytechnic Institute.

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