

# The long journey to permanent employment

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## Abstract

We propose the expected hitting time, i.e., the average time it takes to individuals from any labour market state to achieve permanent employment, as a new indicator to assess the effectiveness of labour market reforms. As it reflects changes in transition probabilities across all states in the economy, it offers a comprehensive measure of the underneath labour market dynamics. When we apply this metric to the Italian labour market for the period 2013-2020 we find that the expected hitting times from temporary employment, unemployment and inactivity fluctuated significantly in response to the several policies implemented. Interestingly, we find large differences across categories of workers, and sizable asymmetric responses to policy interventions by gender, education and geographical areas.

**Keywords:** Labour market flows, instantaneous transition rates, Markov process in continuous time, labour market forecasting.

**JEL Classification:** C18, C53, E32, E24, J6.

## 1 Introduction

In dual labour markets, securing a permanent job is a highly desirable goal for the majority of working-age individuals. Even in the UK, where the labour market seems

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to be less segmented, two-thirds (65%) of temporary and contract workers declared in 2022 they would like to move to a permanent role.

The desire of a permanent job is linked to a large number of associated benefits, the most straightforward being the reduced job uncertainty, which translates into less anxiety regarding the recurrent need to find another job and a predictable income stream. Moreover, permanent jobs are typically associated with higher salaries and more comprehensive benefits, improving an individual's overall standard of living and financial security (Tealdi, 2019). Beyond financial advantages, permanent positions are more likely to provide access to training programs and opportunities for career advancement (Bratti et al., 2021; Pijoan-Mas and Roldan-Blanco, 2022; Garcia-Louzao et al., 2023). The security of a permanent job also extends beyond the workplace. Studies suggest a correlation between permanent employment and improved life decisions. For example, recent research indicates higher fertility rates among individuals with permanent jobs (Prifti and Vuri, 2013; De Paola et al., 2021) as well as easier access and more generous loanable funds for home buyers (Mistrulli et al., 2023). Conversely, job insecurity can lead to stress and anxiety, potentially impacting mental and physical health (Shahidi et al., 2016; Ritzen, 2019; Moscone et al., 2016). Finally, permanent jobs are often associated with safer working environments: temporary jobs, frequently characterized by time pressure and less stringent safety regulations, may expose workers to a higher risk of workplace accidents (Picchio and Van Ours, 2017; Koranyi et al., 2018). However, achieving the permanent employment dream might take quite a long time, particularly for specific categories of workers.

In this paper, we quantify the average expected time it takes to get a permanent contract starting from a set of different labour market states, such as unemployment, inactivity or temporary employment. Specifically, we compute the expected hitting times which are built on transition probabilities across states and embed all possible different trajectories individuals may be facing before ending up with a permanent contract. Although transition probabilities may be informative per se, if they are analyzed individually they offer a segmented picture with respect the whole labour market dynamics. Moreover, it may happen that particularly in response to policy interventions a set of changes in transition probabilities signal an improvement in the labour market, while others point to a worsening, leaving policy makers with an ambiguous outcome. An example which we studied in a companion paper (Fiaschi and Tealdi, 2024) is the

implementation of a reform in Italy in 2018 which increased the employment protection legislation associated with temporary contracts with the objective of reducing job uncertainty. While the reform was successful in increasing the transition probability from temporary to permanent employment, it also reduced the probability for inactive people to enter the labour force. If policy makers had to assess the overall impact of the reform, this would be a hard task, in the absence of an indicator able to synthetically capture the complex dynamics of the labour market. We believe our proposed methodology has the potential of filling this gap and providing policy makers with a useful and comprehensive policy tool.

While the literature on temporary contracts is abundant, no paper has ever quantified the average expected time until a permanent contract is achieved. Most of the literature focuses on understanding whether temporary contracts are a dead-end or a port of entry towards permanent contracts, thus focusing on one specific transition probability, while forgetting potential changes across other states.<sup>1</sup>

We use longitudinal quarterly labour force data for the period 2013-2020 to compute transition rates between five labour market states: inactivity (INACT), unemployment (U), temporary employment (TE), permanent employment (PE) and self-employment (SE). We then calculate the expected hitting times until permanent employment starting from the three states we believe to be more interesting: inactivity, unemployment and temporary employment for the whole time of observation. We find interesting fluctuations in response to the several labour market policies implemented in the period of observation. We also perform some heterogeneous analysis by age, gender, geographical location, education level. We find significant differences across individual types, with women, low-educated and individuals living in the South taking the longest time to transit to a permanent contract. We estimate the difference in expected hitting times across such categories to be large and statistically significant, emphasizing the presence of a remarkable labour market segmentation. We also find sizable asymmetric responses to labour market interventions, suggesting potential unexpected distortion effects.

The paper is organized as follows. Section 2 explains in detail the proposed methodology, which is based on a view of the labour market in terms of flows, as in the search and matching framework. Section 3 illustrates the institutional background, while Section 4 describes the data. Section 5 applies the methodology using Italian data to

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<sup>1</sup>See Filomena and Picchio (2022) for a review of the literature.

illustrate its main advantages and Section 6 concludes the paper. The appendices collect the technical material.

## 2 Methodology

In this section we explain our approach to the study of the properties of the transition to a permanent employment. We take a microeconomic perspective by tracking movements of individuals across labour market states and discuss how these transition rates can summarize the key dynamics of the labour market with respect the transition to permanent employment, i.e. it is sufficiently flexible to deal with ‘realistic and empirically implementable’ scenarios in the labour market (Pissarides, 2000, p.3). In particular, the theoretical (economic) basis of the proposed methodology is the search and matching model, which supplies a meaningful economic interpretation to estimated (instantaneous) transition rates.

### 2.1 Transitions with $K$ states

In a general setting with  $K$  labour market states, the dynamics can be expressed as follows:

$$\dot{\boldsymbol{\pi}} = \boldsymbol{\pi}\mathbf{Q}, \tag{1}$$

where  $\boldsymbol{\pi}$  is a  $1 \times K$  vector collecting the shares of individuals in the working age population in different  $K$  states, and  $\mathbf{Q}$  is a  $K \times K$  matrix, whose elements are the instantaneous transition rates between different states, with the constraint that:

$$\boldsymbol{\pi}\mathbf{1}^T = 1, \tag{2}$$

where  $\mathbf{1}$  is a  $1 \times K$  vector of ones; Equation (2) simply states that the shares of working age individuals in the  $K$  labour market states sum to one.

The matrix of (instantaneous) transition rates  $\mathbf{Q}$  is assumed to satisfy the following

conditions:

$$\begin{cases} q_{ii} \leq 0 \forall i \in \{1, \dots, K\}; \\ q_{ij} \geq 0 \forall i, j \in \{1, \dots, K\}; \text{ and} \\ \sum_{j=1}^K q_{ij} = 0 \forall i \in \{1, \dots, K\}, \end{cases} \quad (3)$$

which amounts to assume that the process governing the labour market dynamics is *conservative* (Cox and Miller, 1972, p. 180), i.e., there are no entries and exits from/to the working age population and, hence, the working age population is constant. Under general conditions (i.e., finite  $K$ ), the matrix  $\mathbf{Q}$  represents a continuous time *honest* Markov process with discrete states (Cox and Miller, 1972, p. 182), i.e.:<sup>2</sup>

$$\mathbf{P}(t) = \exp(\mathbf{Q}t), \quad (4)$$

where  $\mathbf{P}(t)$  is the matrix collecting the transition probabilities from period 0 to period  $t$ , with  $\mathbf{Q}^0 = \mathbf{I}$ . When  $\mathbf{Q}$  is constant over time, the general solution to Equation (1) is (Hirsch et al., 2012, p. 129):

$$\boldsymbol{\pi}(t) = \boldsymbol{\pi}(0)\exp(\mathbf{Q}t), \quad (5)$$

where  $\boldsymbol{\pi}(0)$  is the  $1 \times K$  vector which collects the shares at time 0. A non-trivial equilibrium is characterized by  $\dot{\boldsymbol{\pi}} = 0$ , i.e.,  $\boldsymbol{\pi}\mathbf{Q} = 0$ . Solving Equation (5), using Equation (2), we get that the equilibrium distribution of  $\boldsymbol{\pi}$ ,  $\boldsymbol{\pi}^{EQ}$ , reads as:<sup>3</sup>

$$\boldsymbol{\pi}^{EQ} = \mathbf{1} \left( \mathbf{1}^T \mathbf{1} - \mathbf{Q} \right)^{-1}, \quad (6)$$

where  $\boldsymbol{\pi}^{EQ}$  is a  $1 \times K$  row-vector whose elements are non-negative and sum to 1. Finally, the convergence to equilibrium is exponential and the speed of convergence is measured by the eigenvalues of the  $\mathbf{Q}$  matrix (Hirsch et al., 2012, p. 110).

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<sup>2</sup>The definition of the exponential matrix is the following:

$$\exp(\mathbf{Q}t) = \sum_{r=0}^{\infty} \mathbf{Q}^r \frac{t^r}{r!} = \mathbf{I} + \mathbf{Q}t + (\mathbf{Q}t)^2 / 2! + (\mathbf{Q}t)^3 / 3! + \dots,$$

where  $\mathbf{I}$  is the  $K \times K$  identity matrix (see Chapter 2 in Norris, 1998).

<sup>3</sup>The proof uses  $\boldsymbol{\pi}\mathbf{1}^T \mathbf{1} = \mathbf{1}$ .

### 2.1.1 Seasonality

So far, we have assumed the matrix  $\mathbf{Q}$  to be constant over time, however it might not always be the case, especially with quarter/monthly data of labour market. With high frequency observations we could have seasonality in transition rates, for instance directly related to seasonal fluctuations of employment in specific sectors, such as tourism and agriculture (Shimer, 2012). In this scenario, chosen an appropriate  $\tau$  for the seasonality present in the data (e.g.,  $\tau = 12$  for monthly data or  $\tau = 4$  for quarterly data), from Equation (5) we have that

$$\boldsymbol{\pi}(t + \tau) = \boldsymbol{\pi}(t) \exp(\mathbf{Q}_a(t, \tau)), \quad (7)$$

where:<sup>4</sup>

$$\mathbf{Q}_a(t, \tau) \equiv \log(\exp(\mathbf{Q}(t + \tau - 1)) \exp(\mathbf{Q}(t + \tau - 2)) \dots \exp(\mathbf{Q}(t))) \quad (8)$$

is the matrix of *cumulative transition rates* in the period  $[t, t + \tau]$ . In the time-series of  $\mathbf{Q}_a(t, \tau)$  seasonality has been removed.

## 2.2 Hitting times and absorption probabilities

The distribution of times for which a random process arrives for the first time at state  $j$  starting from state  $i$  is called *the expected hitting time* from state  $i$  to state  $j$ . The expected time of going from state  $i$  to state  $j$  for the first time is called *expected hitting time* from state  $i$  to state  $j$  (Norris, 1998, p. 122).

The expected hitting times are random variables, whose probability distributions depend upon the transition probabilities  $p_{ij}$ . In particular, let  $f_{ij}^{(n)}$  denote the probability that the expected hitting time from state  $i$  to  $j$  is equal to  $n$ . For  $n > 1$ , this expected hitting time is  $n$  if 1) the first transition is from state  $i$  to some state  $k$  ( $k \neq j$ ); and 2) then the expected hitting time from state  $k$  to state  $j$  is  $n - 1$ . Therefore, these

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<sup>4</sup>In Equation 7, the logarithm of matrix is defined such as  $\exp(\log(B)) = B$ . If  $\|B - I\| < 1$ , then  $\log(B) = \sum_{k=1}^{\infty} (-1)^{k+1} (B - I)^k / k$  (see Theorem 2.7 in Hall, 2003).

probabilities satisfy the following recursive relationships:

$$f_{ij}^{(1)} = p_{ij}; \tag{9}$$

$$f_{ij}^{(2)} = \sum_{k \neq j}^K p_{ik} f_{kj}^{(1)}; \tag{10}$$

$$\dots \tag{11}$$

$$f_{ij}^{(n)} = \sum_{k \neq j}^K p_{ik} f_{kj}^{(n-1)}. \tag{12}$$

Thus, the probability of a expected hitting time from state  $i$  to state  $j$  in  $n$  steps can be computed recursively from the transition probabilities  $p_{ij}$ .

Finally, from Eq. (12) the expected expected hitting time from state  $i$  to state  $j$ , denoted by  $\mu_{ij}$ , can be calculated as:

$$\mu_{ij} = \sum_{n=1}^{\infty} n f_{ij}^{(n)}, \tag{13}$$

which is well defined if (Norris, 1998):

$$\sum_{n=1}^{\infty} f_{ij}^{(n)} = 1. \tag{14}$$

## 2.3 Empirical implementation

Since observations on the labour market states of individuals are available at discrete time, a direct estimation of  $\mathbf{Q}$  is not feasible. To circumvent this issue, we first estimate  $\mathbf{P}$  in discrete time and then estimate  $\mathbf{Q}$  using Equation (4). Anderson and Goodman (1957, p. 92) show that each element  $p_{ij}$  of the matrix  $\mathbf{P}$  can be estimated by maximum likelihood as follows:

$$\hat{p}_{ij} = \frac{m_{ij}(t)}{m_i(t)}, \tag{15}$$

where  $m_{ij}(t)$  is the number of individuals in period  $t$  in state  $i$  moving in period  $t + 1$  in state  $j$  and  $m_i(t)$  is the total number of individuals in period  $t$  in state  $i$ . From the estimate of  $\mathbf{P}$ , we then get an estimate of  $\mathbf{Q}$  using Equation (4), under the conditions discussed by Israel et al. (2001). In particular, they argue that under mild conditions,

the matrix  $\tilde{\mathbf{Q}}$ , which is defined by the following geometric infinite series:

$$\tilde{\mathbf{Q}} = \sum_{r=1}^{\infty} -(-1)^r \frac{(\mathbf{P} - \mathbf{I})^r}{r} = (\mathbf{P} - \mathbf{I}) - \frac{(\mathbf{P} - \mathbf{I})^2}{2} + \frac{(\mathbf{P} - \mathbf{I})^3}{3} - \frac{(\mathbf{P} - \mathbf{I})^4}{4} + \dots \quad (16)$$

is such that  $\exp(\tilde{\mathbf{Q}}) = \mathbf{P}$  and its rows sum to zero (Theorem 2 in Israel et al., 2001). A potential drawback of using Equation (16) is that it does not ensure that  $\tilde{\mathbf{Q}}$  is a “valid”  $\mathbf{Q}$ , i.e.,  $\tilde{\mathbf{Q}}$  satisfies all Conditions (3). Specifically, there is no guarantee that all off-diagonal entries of matrix  $\tilde{\mathbf{Q}}$  are non-negative.<sup>5</sup> Finally, Zahl (1955, p. 97) shows that the properties of the maximum likelihood estimate of  $\mathbf{P}$  are inherited by  $\mathbf{Q}$ . We will use bootstrap as an alternative robust approach to inference (see Appendix A).

### 3 Institutional background

In this section we describe the institutional background, with a short description of the several policies which were implemented during the period of observation.

**Poletti Decree** The Decree was approved on 21 March 2014. It removed the obligation for employers hiring temporary employees to justify their choice of hiring a worker with a temporary contract rather than with a permanent contract (Di Porto and Tealdi, 2024). It represented an important change, as in case of incorrectly reported justification the employee is entitled to sue the employer and eventually have her contract converted into a permanent contract. The reform also increased the number of possible extensions from one to five, within the maximum duration of 3 years within the same company.

**Budget Law** The 2015 Budget Law (effective in January 2015) introduced a large hiring subsidy for new hires on permanent contracts. The subsidy was meant for all newly hired permanent workers in the period January-December 2015, provided the absence of any permanent contract in the previous 6 months and of a permanent contract

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<sup>5</sup>In Section 3, Israel et al. (2001) propose two methods to circumvent this issue. The first is to set  $q_{ij} = \max(\tilde{q}_{ij}, 0)$  for  $i \neq j$  and  $q_{ii} = (\tilde{q}_{ii} + \sum_{j \neq i} \min(\tilde{q}_{ij}, 0))$ , i.e. to set to zero all negative off-diagonal elements and change the diagonal elements to make sure the sum of each row is equal to zero. The second method sets the negative off-diagonal values to zero and spans the difference on all positive entries to assure that the sum of each row is equal to zero.



with the same firm in the previous 3 months. The subsidy was a 3-year exemption from social security contributions up to a threshold of €8,060 per year. This amount was considered quite generous, given the average contributions typically paid by firms (Sestito and Viviano, 2018). Subsidies also counted towards the conversions from temporary to permanent contracts within a given firm. The subsidies were extended for the year 2016, but the exemption was reduced to 40% of the social security contributions, with a cap of €3.250 per year for a maximum of two years. The 2017 Budget Law introduced a clause by which employers hiring individuals below the age of 35 on a permanent contract in 2018 were entitled to a reduction of 50% of the payable social security contributions for a maximum of 36 months with a cap of €3000 annually. To be eligible employees should not have been hired ever before on a permanent contract. These incentives were then confirmed also in 2019 and 2020.

**Jobs Act** The Jobs Act was approved in March 2015 and reformed permanent contracts significantly in firms with more than 15 employees (Boeri and Garibaldi, 2019). The new contract is based on graded security, with severance payments steadily increasing with tenure. The payments are flat at 4 months for the first 2 years, and then increase with tenure up to a maximum of 24 monthly wages at a 12-year tenure. The reform also introduced a new type of out-of-court procedure, by which the employer can pay the worker an indemnity equal to 2 monthly wages in the first 2 years of tenure and then an additional monthly wage per year of service, with a cap of 18 monthly wages after 18 years of work. Agreeing on the transaction prevents any further dispute by the worker, i.e., appealing to courts for a unfair dismissal. Thus, both parties have strong incentives to settle the dispute through this procedure, given that the amount paid is not subject to social contributions or taxation. Finally, the reform also replaced the worker reinstatement with a monetary compensation for economic unfair dismissals. The new dismissal rules apply to new hires on permanent contracts, but it is not retroactive.

**Decreto Dignità** The Decreto Dignità was approved in July 2018 (Fiaschi and Tealdi, 2024). It reduced the maximum length of temporary contracts from 36 to 24 months. It also introduced the restriction that any temporary contract longer than 12 months could be utilized only in three circumstances: (i) to replace a worker, (ii)

for temporary reasons, outside the regular business and (iii) in case of a temporary and unforeseeable increase in business. If the contract was not justified by any of these clauses, the contract would be converted into a permanent one. The number of extensions within the 24 months was reduced from 5 to 4, and any renewal of the contract would need to be justified by any of the three reasons listed above. The reform also increased the social security contributions payable by employers for each temporary contract.

**Covid** The first cases of COVID-19 in Italy were registered in January, 2020, but it is on March 10 that the whole country went into a full lockdown. All commercial activity except for supermarkets and pharmacies were prohibited, the movement of people restricted and all non-essential businesses and industries closed. The Italian government implemented also two labour market policies: (i) a COVID-19 furlough scheme and (ii) a ban on layoffs. The former was implemented for an initial duration of 9 weeks. Firms using the COVID-19 furlough scheme could renew temporary contracts, waiving to the norms of the standard regulation. Upon completion of the furlough period, firms were allowed to dismiss employees for redundancy. The ban on layoffs prevented firms to fire workers for 60 days, starting from March 17; this ban could be applied retroactively to pending, but already validated layoffs from February 23. Two later decrees extended the validity of these measures, which were in place until the end of 2021.

## 4 Data

We use Italian quarterly longitudinal labour force data as provided by the Italian Institute of Statistics (ISTAT) for the period 2013 (quarter I) to 2020 (quarter IV).<sup>6</sup> The Italian Labour Force Survey (LFS) follows a simple rotating sample design where households participate for two consecutive quarters, exit for the following two quarters, and come back in the sample for other two consecutive quarters. As a result, 50% of the households, interviewed in a quarter, are re-interviewed after three months, 50% after twelve months, 25% after nine and fifteen months. This rotation scheme allows to

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<sup>6</sup>Data for the period 2013 (quarter I) to 2020 (quarter IV) are available upon request at: <https://www.istat.it/it/archivio/185540>.

obtain 3 months longitudinal data, which include almost 50% of the original sample.

The longitudinal feature of these data is essential for achieving a complete picture of significant economic phenomena of labour market mobility. Per each individual who has been interviewed we observe a large number of individual and labour market characteristics at the time of the interview and three months before. Taking into account the structure of this database, we compute the labour market flows by calculating the quarter-on-quarter transitions made by individuals between different labour market states. Specifically, we estimate the gross flows using a five-state model (permanent employed, temporary employed, self-employed, unemployed, and inactive). The drawback of these data is the point-in-time measurement of the worker's labour market state, which fails to capture transitions within the period (quarter). For instance, if an employed worker becomes unemployed and finds a new job within a quarter, we do not observe those transitions in our data. However, from Section 2.3 we know that, assuming constant (instantaneous) transition rates within the quarter, the latter (**Q**) can be estimated using the transitions at quarterly frequency (**P**).

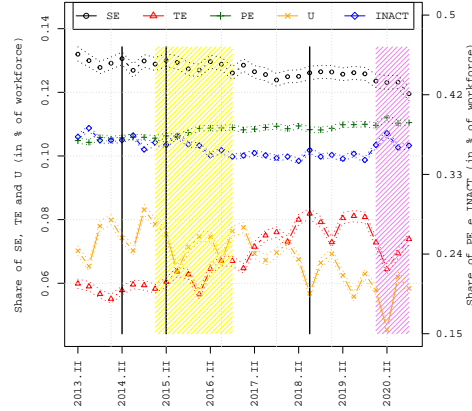
On average approximately 70.000 individuals are interviewed each quarter, of which 45.000 are part of the working age population. The average quarterly inflow of younger individuals in the working age population is 0.3%, while the average quarterly outflow of older individuals from the working age population is 0.4%, backing our hypothesis of a (almost) constant working age population within quarters. We focus on the working age population, i.e., individuals between the age of 16 and 64.

In Figure 1 we report the shares of individuals in the five different states for the time period considered (2013-2020). The share of unemployed fluctuates between 8% and 5%, while the share of inactive is pretty much constant around 34%. Among employed individuals, approximately 40% is hired on a permanent contract, around 13% is self-employed, while the share of temporary workers fluctuates between 6% and 8%.

## 5 Results

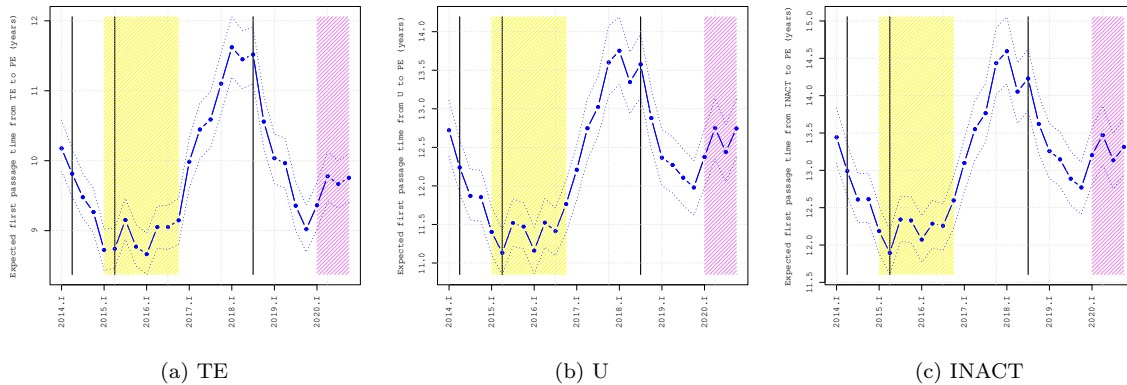
We report in Figure 2 the expected hitting times to get a permanent contract starting from temporary employment (Figure 2a), unemployment (Figure 2b) and inactivity (Figure 2c).

**Figure 1.** Shares of individuals in different states in the period from 2013-Q1 to 2020-Q4.



*Note:* The graph reports the shares of SE, TE, PE, U and INACT in the workforce (age 16-64) in the period from 2013-Q1 to 2020-Q4. The scale on the left is used for SE, TE and U, the scale on the right for PE e INACT. The yellow shaded area identifies the period of subsidies for the hiring of permanent employees, while the pink shaded area represents the Covid period. The vertical lines indicate the timing of the Poletti Decree, Jobs Act, Decreto Dignità, respectively.

**Figure 2.** Expected hitting times from temporary employment, unemployment and inactivity.



*Note:* The yellow shaded area identifies the period of subsidies for the hiring of permanent employees, while the pink shaded area represents the Covid period. The vertical lines indicate the timing of the Poletti Decree, Jobs Act, Decreto Dignità, respectively.

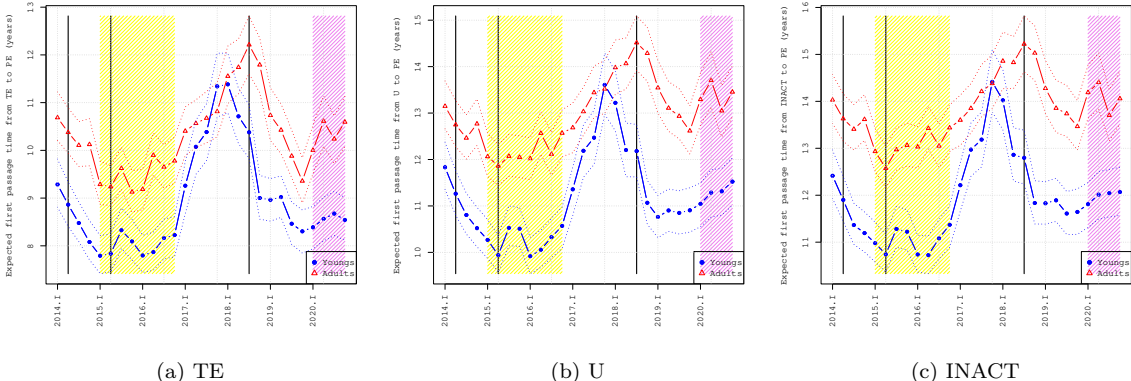
We observe large fluctuations of the hitting times in the period of observation, ranging between 9 and 11.5 years from temporary employment, mainly in response to policy interventions. Specifically, we observe decreasing expected times (from 10 to 8 years) in 2013 and 2014, a period of stability in 2015 and 2016, during the time of firm subsidies, and a large increase (up to 12 years) immediately after the removal of the subsidies in 2017. Finally, after the implementation of the Decreto Dignità in 2018 the average hitting time decreased again to 9 years, with a small increase during the Covid time. The pattern is very similar when we look at the expected hitting time from

unemployment and inactivity to permanent employment. The range of fluctuations is higher as expected, oscillating between a minimum of 11 years to a maximum of 13.5 years from unemployment and between 12 years and 14.5 years from inactivity. Overall, while the Jobs Act and the firm subsidies were not effective at reducing the expected hitting times to permanent employment, the removal of the subsidies had a significant backlash. The Decreto Dignità instead played a substantial role in reducing the expected hitting times from temporary employment, unemployment and inactivity.

### 5.1 Heterogeneity across categories of individuals

In this section we calculate the expected hitting times for different categories of individuals based on age, gender, geographical area of residency, and education. In Figure 3 we split the sample in two categories: young individuals aged 15-34 and adults, aged 35-64.

**Figure 3.** Expected hitting times for individuals aged 15-34 and 35-64.



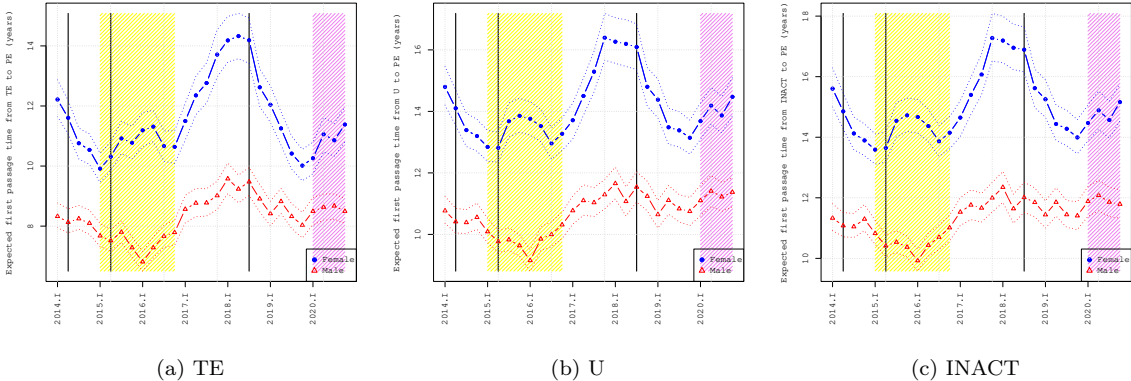
*Note:* The blue line refers to young individuals (age 15-34), while the red line refers to adults (age 35-64). The yellow shaded area identifies the period of subsidies for the hiring of permanent employees, while the pink shaded area represents the Covid period. The vertical lines indicate the timing of the Poletti Decree, Jobs Act, Decreto Dignità, respectively.

We observe some differences in the expected hitting times between the two categories, with young individuals taking less time on average to achieve permanent employment. The gap of approximately 1.5 years when starting from temporary employment is evident in 2014, 2015 and 2016, while it seems to disappear at the expiration of the firm subsidies. It opens up again in the beginning of 2018, with the expected hitting times from temporary employment going down from 11.5 years to 8 years among young individuals and from 12 to 9 years among adults. The expected hitting times among

young workers decreased at the beginning of 2018, likely due to the fiscal incentives for younger workers introduced by the Budget Law, while the one among adults decreased after the implementation of the Decreto Dignitá. The gap is larger when starting from unemployment and inactivity (2 years), with the expected hitting times ranging between 10 and 13 years among young individuals and between 12 and 14.5 among adults when starting from unemployment. Similar patterns are present when starting from inactivity with the range fluctuating between 11 and 14 years among young and between 13 and 15 years among adults.

In Figure 4 we considered females and males separately. The difference in the expected hitting times is impressive: females take on average an additional 4 years to reach permanent employment when starting from temporary employment. Over time we also observe that the expected hitting time did not fluctuate much among men (between 7 and 9 years), while it was very volatile among women (between 10 and 14 years). Although the expected hitting times increased for both males and females after the expiration of the firm subsidies, the gap further increased to 5 years in the beginning of 2018. Only after the implementation of the Decreto Dignitá, the times decreased for both categories, but much more among women, and the gap reduced to 2 years. Specifically, while it took approximately 8 years for men to transit from temporary to permanent employment in 2019, it took approximately 10 years for women.

**Figure 4.** Expected hitting times for females and males.



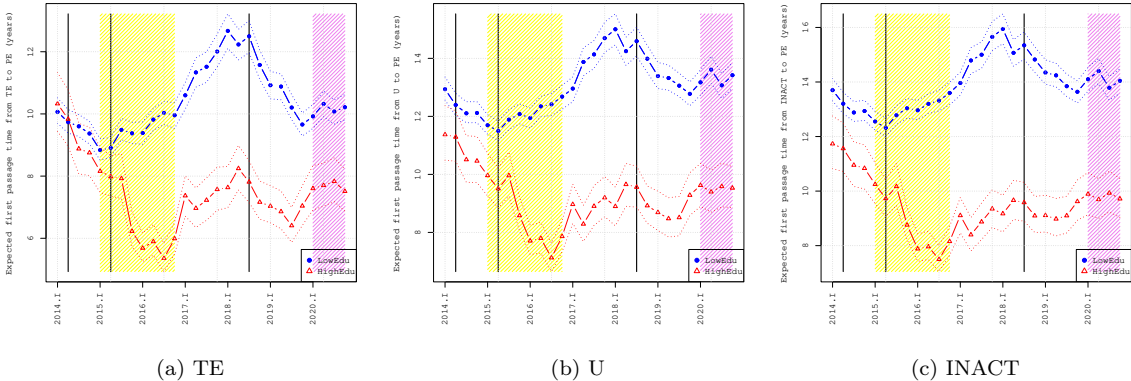
*Note:* The blue line refers to females, while the red line refers to males. The yellow shaded area identifies the period of subsidies for the hiring of permanent employees, while the pink shaded area represents the Covid period. The vertical lines indicate the timing of the Poletti Decree, Jobs Act, Decreto Dignitá, respectively.

We report similar patterns when starting from unemployment and inactivity, with men taking between 10 and 11 years, both when starting from unemployment and

inactivity. For women the range varies between 13 and 16 years when starting from unemployment and between 14 and 17 years when starting from inactivity.

In Figure 5 we consider low-educated (primary and secondary level) and high-educated (tertiary level) separately. As expected low-educated individuals take longer to achieve permanent employment. While the gap was not statistically significant when starting from a temporary position in 2014, it increased suddenly to approximately 4 years during the period of firm subsidies (2015/2016), where the time decreased significantly among high-educated individuals from all three states, while increasing among low-educated individuals. Although the subsidies were opened to all employees, it seems like firms tended to offer disproportionately more permanent contract to high-educated workers. The expected hitting times decreased for both categories after the implementation of the Decreto Dignit , with the gap decreasing to 3 years.

**Figure 5.** Expected hitting times for low-educated and high-educated.



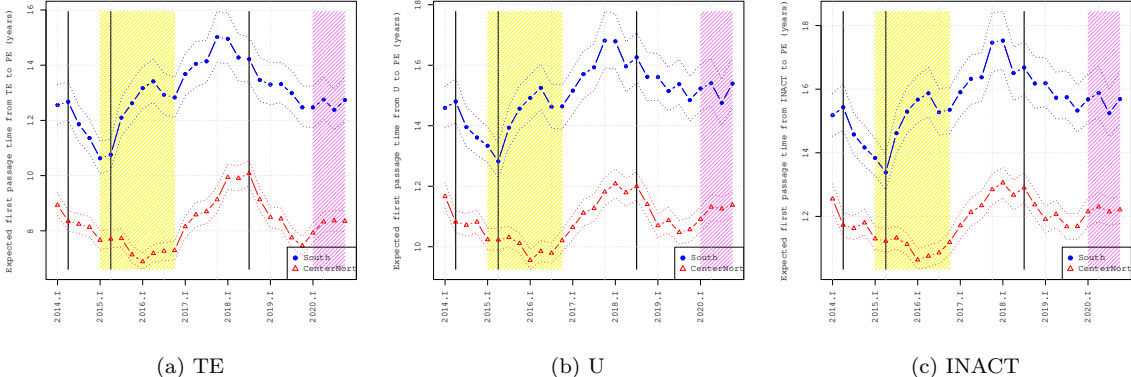
*Note:* The blue line refers to low-educated, while the red line refers to high-educated. The yellow shaded area identifies the period of subsidies for the hiring of permanent employees, while the pink shaded area represents the Covid period. The vertical lines indicate the timing of the Poletti Decree, Jobs Act, Decreto Dignit , respectively.

In 2019 it would take 6.5 years for high-educated individuals to get a permanent job starting from a temporary one, while it would take 9.5 years to low-educated individuals. Similarly, it would take 9 years for high-educated individuals to get a permanent job starting from unemployment or inactivity, while it would take 13 and 14 years to low-educated individuals starting from unemployment and inactivity, respectively.

In Figure 6 we report the expected hitting times for individuals living in the North-Center and in the South of the country. Once again the differences across these two groups are astonishing. While the gap was approximately of 3.5 years in 2014 starting from temporary employment, it increased during the period of firm subsidies to 6 years,

due to an increase in the expected hitting times for workers in the South and a decrease for workers in the Center-North. The subsidies seemed to have benefited disproportionately more workers in the Center-North, whose average time to permanent employment decreased from 8 to 7 years. At the same time, in the South the average time increased from 11 to 13 years. At the expiration of the subsidies the average time increased for both categories, until the implementation of the Decreto Dignitá. Afterwards the average time decreased faster among workers in the Center-North, increasing the gap to 5 years. In 2019 it would take 6 to 7 years for workers in the Center-North to get a permanent job starting from a temporary one, while it would take approximately 10 years for people in the South.

**Figure 6.** Expected hitting times in the Center-North and South.



*Note:* The blue line refers to the South, while the red line refers to the Center-North. The yellow shaded area identifies the period of subsidies for the hiring of permanent employees, while the pink shaded area represents the Covid period. The vertical lines indicate the timing of the Poletti Decree, Jobs Act, Decreto Dignitá, respectively.

Despite the fluctuations over the period of observation, the gap between residents in the Center-North and South has been persistent to 5 years for transitions from unemployment and inactivity. In 2019 it would take 10 and 12 years respectively for people in the Center-North to get a permanent job starting from unemployment and inactivity, respectively. For people in the South it would take 13 and 14 years, respectively.

## 6 Discussion and concluding remarks

We propose the expected hitting time as a novel indicator, which comprehensively embeds the changes in transition probabilities across all states determined by labour



market policies, to assess the effect of the reforms. By providing a single value, it allows policy makers to have an immediate understanding about the effectiveness of the interventions.

When applied to the Italian labour market we find that the multiple reforms implemented in the period 2013-2020 had quite strong effects on the expected hitting times to permanent employment starting from temporary employment, unemployment and inactivity. Moreover, we find large differences in the expected hitting times across categories of workers, with females, low-educated and people living in the South taking significantly longer to achieve permanent employment. Interestingly, we also discovered that the effects of the reforms have been highly heterogeneous across categories of individuals, with firm subsidies having benefited most high-educated and males, while the Decreto Dignitá having benefited more females and low-educated.

Overall these sizable differences in the expected hitting times across categories of individuals point to a very segmented labour market, in which the most vulnerable, i.e., low-educated, women and people living in the South, struggle the most to achieve the dream of a permanent job.

## References

- Anderson, T. W. and L. A. Goodman (1957). Statistical inference about markov chains. *The Annals of Mathematical Statistics*, 89–110.
- Blanchard, O. and P. Portugal (2001, March). What hides behind an unemployment rate: Comparing portuguese and u.s. labor markets. *American Economic Review* 91(1), 187–207.
- Boeri, T. and P. Garibaldi (2019). A tale of comprehensive labor market reforms: evidence from the italian jobs act. *Labour Economics* 59, 33–48.
- Bratti, M., M. Conti, and G. Sulis (2021). Employment protection and firm-provided training in dual labour markets. *Labour Economics* 69, 101972.
- Cox, D. R. and H. D. Miller (1972). *The theory of stochastic processes*. Chapman and Hall Ltd.
- De Paola, M., R. Nisticò, and V. Scoppa (2021). Employment protection and fertility decisions: The unintended consequences of the italian jobs act. *Economic Policy* 36(108), 735–773.
- Di Porto, E. and C. Tealdi (2024, 03). Heterogeneous paths to stability. *Journal of the Royal Statistical Society Series A: Statistics in Society*, qnae019.
- Efron, B. and R. J. Tibshirani (1994). *An introduction to the bootstrap*. CRC press.
- Fiaschi, D. and C. Tealdi (2024). Let’s roll back! the challenging task of regulating temporary contracts. *arXiv preprint arXiv:2401.17971*.
- Filomena, M. and M. Picchio (2022). Are temporary jobs stepping stones or dead ends? a systematic review of the literature. *International Journal of Manpower* 43(9), 60–74.
- Garcia-Louzao, J., L. Hospido, and A. Ruggieri (2023). Dual returns to experience. *Labour Economics* 80, 102290.
- Garibaldi, P. and E. Wasmer (2005). Equilibrium search unemployment, endogenous participation, and labor market flows. *Journal of the European Economic Association* 3(4), 851–882.

- Hall, B. C. (2003). *Lie Groups, Lie Algebras, and Representations: An Elementary Introduction* (1 ed.). Graduate Texts in Mathematics №222. Springer.
- Hirsch, M. W., S. Smale, and R. L. Devaney (2012). *Differential equations, dynamical systems, and an introduction to chaos*. Academic press.
- Israel, R. B., J. S. Rosenthal, and J. Z. Wei (2001). Finding generators for markov chains via empirical transition matrices, with applications to credit ratings. *Mathematical finance* 11(2), 245–265.
- Koranyi, I., J. Jonsson, T. Rönnblad, L. Stockfelt, and T. Bodin (2018). Precarious employment and occupational accidents and injuries—a systematic review. *Scandinavian journal of work, environment & health* 44(4), 341–350.
- Mistrulli, P. E., T. Oliviero, Z. Rotondi, and A. Zazzaro (2023). Job protection and mortgage conditions: evidence from italian administrative data. *Oxford Bulletin of Economics and Statistics* 85(6), 1211–1237.
- Mortensen, D. T. et al. (1970). A theory of wage and employment dynamics. *Microeconomic foundations of employment and inflation theory* 219.
- Mortensen, D. T. and C. A. Pissarides (1994). Job creation and job destruction in the theory of unemployment. *The review of economic studies* 61(3), 397–415.
- Moscone, F., E. Tosetti, and G. Vittadini (2016). The impact of precarious employment on mental health: The case of italy. *Social Science & Medicine* 158, 86–95.
- Norris, J. R. (1998). *Markov chains*. Number 2. Cambridge university press.
- OECD (2019). *Recent trends in the Italian Labour Market*.
- Phelps, E. S. (1968). Money-wage dynamics and labor-market equilibrium. *Journal of political economy* 76(4, Part 2), 678–711.
- Picchio, M. and J. C. Van Ours (2017). Temporary jobs and the severity of workplace accidents. *Journal of safety research* 61, 41–51.
- Pijoan-Mas, J. and P. Roldan-Blanco (2022). *Dual labor markets and the equilibrium distribution of firms*. Centre for Economic Policy Research.

- Pissarides, C. A. (2000). *Equilibrium unemployment theory*. MIT press.
- Prifti, E. and D. Vuri (2013). Employment protection and fertility: Evidence from the 1990 italian reform. *Labour Economics* 23, 77–88.
- Raitano, M. (2018). *Italy: Para-subordinate workers and their social protection*.
- Ritzen, J. (2019). Happiness as a guide to labor market policy. *IZA World of Labor*.
- Sestito, P. and E. Viviano (2018). Firing costs and firm hiring: evidence from an italian reform. *Economic Policy* 33(93), 101–130.
- Shahidi, F. V., D. De Moortel, C. Muntaner, O. Davis, and A. Siddiqi (2016). Do flexicurity policies protect workers from the adverse health consequences of temporary employment? a cross-national comparative analysis. *SSM-population health* 2, 674–682.
- Shimer, R. (2012). Reassessing the ins and outs of unemployment. *Review of Economic Dynamics* 15(2), 127–148.
- Tealdi, C. (2019). The adverse effects of short-term contracts on young workers: Evidence from italy. *The Manchester School* 87(6), 751–793.
- Zahl, S. (1955). A markov process model for follow-up studies. *Human Biology* 27(2), 90.

# Appendix

## A Bootstrap procedure

Given a sample of transitions  $X$  of cardinality  $N$ , the bootstrap procedure is composed of three steps (Efron and Tibshirani, 1994, Chapter 6):

1. Draw  $B$  samples of cardinality  $N$  by sampling with replacement from  $X$ ;
2. For every bootstrapped sample  $b$  estimate matrix  $\mathbf{P}_b$  and the corresponding  $\tilde{\mathbf{Q}}_b$ ;
3. Compute the standard errors of the transition rates  $\tilde{q}_{ij}$ ,  $\sigma_{q_{ij}}$  as:

$$\sigma_{q_{ij}} = \sqrt{\sum_{b=1}^B \frac{(\tilde{q}_{ij,b} - \bar{q}_{ij})^2}{B}},$$

where  $\tilde{q}_{ij,b}$  is the  $(i, j)$  element of  $\tilde{\mathbf{Q}}_b$  and  $\bar{q}_{ij}$  is the average  $(i, j)$  element of all the  $B$  bootstraps.

The test of zero difference between two transition rates and/or between two equilibrium labour market shares is based on the bootstrap procedure suggested in Efron and Tibshirani (1994, Chapter 16).

## B The Italian labour market

Following important labour market reforms in the 1990s and early 2000s, labor market outcomes have improved substantially in Italy: employment and labor force participation rates have increased, and the unemployment rate dropped. But despite these improvements, the Italian labour market is still under-performing compared to those in most other European countries (OECD, 2019). Specifically, the participation rate is still substantially below that in most other European countries, the unemployment rate is higher, and the shares of temporary employment and self-employment are significantly higher compared to the EU average (Table 1). The fast growing share of temporary employment led to the implementation of several reforms over the years with the goal to facilitate the transitions of individuals from temporary to permanent employment, while reducing the unemployment (and inactivity) rate and the growing share of self-employment<sup>7</sup> (Boeri and Garibaldi, 2019; Di Porto and Tealdi, 2024).<sup>8</sup> This evidence provides support for considering five labour market states when applying our methodology: inactive, unemployed, temporary employed, permanent employed and self-employed.<sup>9</sup>

**Table 1.** Labour market characteristics for a select sample of European countries.

Country	Self-employment (% total employment)	Temporary-employment (% dependent employment)	Unemployment (% labour force)	Labour force participation (% working age)
Greece	31.9	12.5	17.5	68.4
<b>Italy</b>	<b>22.7</b>	<b>17.0</b>	<b>10.2</b>	<b>65.7</b>
Portugal	16.9	20.8	6.7	75.5
Spain	15.7	26.3	14.2	75.0
United Kingdom	15.6	5.2	4.0	78.8
Ireland	14.4	9.8	4.5	73.1
Belgium	14.3	10.9	5.4	69.0
France	12.1	16.4	8.5	71.7
Germany	9.6	12.0	3.2	79.2
<b>EU average</b>	<b>15.3</b>	<b>13.2</b>	<b>6.4</b>	<b>74.2</b>

*Source:* OECD, 2019.

<sup>7</sup>The category of para-subordinate workers in Italy, i.e. individuals who are legally self-employed but who are often “economically dependent” on a single employer, is relatively large. These workers are disadvantaged relative to employees in terms of the welfare provisions that they are entitled to receive (Raitano, 2018).

<sup>8</sup>Specifically, in March 2014 a labour market reform (*Decreto Poletti*) increased the flexibility of temporary contracts; in March 2015 the *Jobs Act* changed the regulations of the open-ended contract, by introducing firing costs increasing with tenure; and, finally, in July 2018 the *Decreto Dignità* increased the rigidity of temporary contracts.

<sup>9</sup>Age, gender and education would be further interesting dimensions to explore, but are outside the scope of this paper.