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Modelling sector-specific employment shocks with EUROLAB, a multidimensional behavioural model

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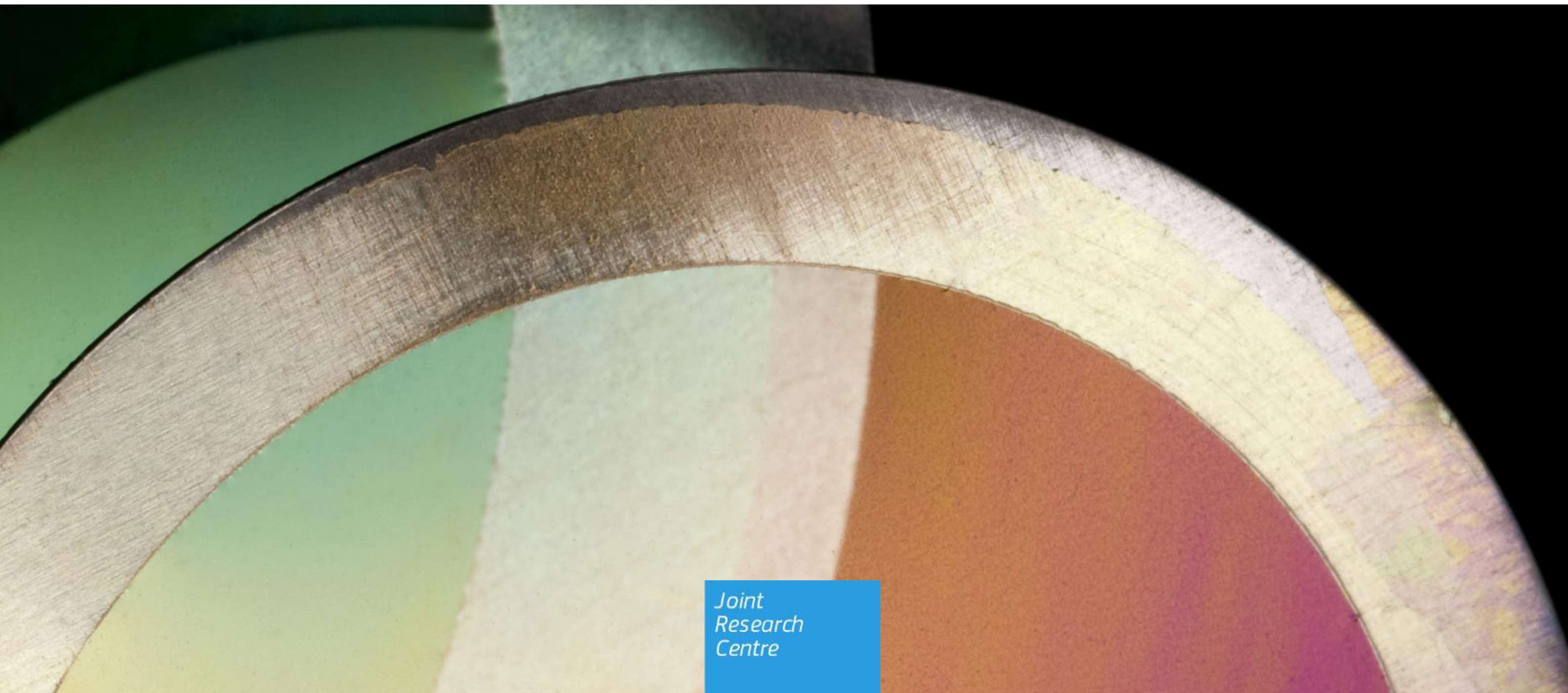

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Executive Summary

The COVID-19 pandemic is having serious consequences for the labour market in all EU countries. To mitigate the pandemic and limit the spread of the virus, EU countries adopted lockdown measures, especially between February and May 2020, which were eased at the beginning of the summer of that year. The cessation of economic activity led to severe job losses in the EU in the second quarter of 2020, and lower, although still substantial losses during the rest of the year. As a result, the labour market has changed dramatically: employment and total hours worked both fell very sharply. The adjustment led to a reduction in working hours followed by important job losses.

EU countries have taken several fiscal measures in order to prevent job and income losses. Job retention schemes (also called short-term work schemes or furloughs) have been more widely used during this period. Although they differ across the EU, these schemes have facilitated the adjustment of the labour market to the pandemic crisis. Firstly, they helped to compensate workers for job losses, providing them with a replacement income, which is often higher than normal unemployment benefit. Secondly, they helped to protect employment in the EU by reducing labour costs for the firms. As a result, the increase in unemployment was much lower than in the 2009 crisis, or than it could have been in the absence of job retention programmes.

The pandemic crisis is still ongoing. Little is known about the impact of the pandemic on household income and labour market vulnerability, as there are still insufficient data to gauge the extent of household income changes. A number of empirical studies have sought to overcome data limitations and to assess the distributional and poverty impact of policy measures taken in EU countries using real time data. However, these approaches rely on assumptions regarding the transition from work to unemployment or inactivity (or vice versa). The behavioural reactions of individuals within the labour market, which depends to some extent on their occupational sector or employment status, are not considered in these approaches.

This paper proposes a new theoretical and empirical approach to modelling the effects of sector-specific demand shocks on the labour market where labour supply reactions are considered endogenously. We develop a multidimensional behavioural model (EUROLAB) taking into account differences between occupational sectors and employment statuses, and allowing for transitions to, and from, unemployment and inactivity status. Our model allows us to analyse the ability of policy reforms (such as job retention schemes) to absorb the impact of these shocks on employment under alternative hypothetical scenarios regarding the timing of reforms, something empirical approaches used in the COVID context cannot do. This feature is especially relevant in order to analyse the effectiveness of job retention schemes in preserving employment. The model extends the standard discrete choice labour supply model, based on a one-dimensional choice set, by considering a multidimensional choice set that allows individuals to choose their working hours, occupational sector and employment status. In addition, we model the unemployment alternative separately from the inactivity alternative, to allow a transition to and from unemployment. After estimating this model, labour market equilibrium conditions are taken into account, using a procedure that is in line with the estimated behavioural parameters and allows for the consistent introduction of sectoral demand shocks and the assessment of COVID-19 reforms under equilibrium.

The paper analyses the impact of short-term wage schemes in presence of exogenous shock to labour demand. The model allows to assess the impact of these schemes on employment in the short-run while reducing the risks of an increase in unemployment or a decline in labour market participation in the long-run. Our approach is relevant for assessing the effects of policies implemented by Member States in order to mitigate the negative effects of the Covid-19 pandemic on employment. However, its use may go beyond COVID and post-COVID analysis. In order to illustrate the use of the model, the effects of a hypothetical wage subsidy are simulated considering the case of Italy. For this purpose, we use the microsimulation model EUROMOD and the Italian version of the European Union Statistics on Income and Living Conditions (SILC, 2018).

Empirical results support the theoretical model, showing in particular how sectoral demand shocks lead to lower wages, lower employment and an increase in inactivity under equilibrium conditions. Furthermore, the results show that the labour market reacts differently to the introduction of the wage subsidy scheme, depending on whether the wage subsidy is allocated to potential beneficiaries before or after labour market equilibrium is achieved. Depending on the timing the subsidies are introduced (or announced), their impact on job preservation may be different. In the short-run, a wage subsidy helps to preserve jobs. From a longer-term perspective, it should contribute to the recovery of the labour market although the return to pre-shock employment levels depends on a number of factors related to the subsidy (such as duration and amount) and the potential of the labour market to create new jobs.

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Abstract

Little is known yet about the impact of the COVID crisis on household income and jobs in absence of real time information on these variables. A recent literature strand has sought to overcome data limitations to assess the distributional impact of policy measures taken in the EU using various empirical approaches. However, despite the importance of behavioural effects, transitions from work to unemployment or inactivity (or vice versa) are considered exogenously in this literature. This paper explains how EUROLAB, a multidimensional discrete choice labour supply model, can be used to take account of behavioural effects in the face of exogenous demand shocks. We show that it is possible to account for behavioural effects endogenously using a procedure permitting a consistent introduction of sectoral demand shocks and the assessment of COVID-19 related reforms under equilibrium conditions. We illustrate the use of our model considering the case of a simplified wage subsidy scheme using Italian SILC. Our empirical results support the theoretical model, showing in particular how sectoral demand shocks lower wages, employment and increase unemployment under equilibrium conditions. Furthermore, the results show that the labour market reacts differently to the introduction of the wage subsidy scheme, depending on whether the wage subsidy is allocated to potential beneficiaries before or after labour market equilibrium is achieved. In the short-run, a wage subsidy helps to preserve jobs. From a longer-term perspective, it should contribute to the recovery of the labour market although the return to pre-shock employment level depends on a number of factors related to the subsidy (such as duration and amount) and the potential of the labour market to create new jobs.

JEL Classification: C35, J22, J23, J33

Keywords: Labour supply, Labour market equilibrium, Short-time work schemes, Covid-19

1 Introduction

The COVID-19 pandemic is having serious consequences for the labour market. To mitigate the pandemic and limit the spread of the virus, EU countries adopted lockdown measures between February and May 2020, which were eased at the beginning of the summer. These measures were partially maintained or re/introduced since then. The cessation of economic activity led to severe job losses in the EU in the second quarter of 2020, and lesser, although still substantial losses for the rest of the year. As a result, the labour market has changed dramatically: employment and total hours worked both fell sharply. The adjustment mechanism was seen first through a reduction in working hours and then through job losses.

The sectoral composition of economic activity and the reactions to job protection seem to determine the impact of the pandemic on the EU labour market. Some sectors of activity, such as non-essential services and production, were more exposed to the lockdown restrictions than others. These sectors have experienced a reduction in working hours and even more critical job losses in countries with a higher presence of these sectors and lower income protection against employment termination. Overall, the COVID-19 pandemic affected the service sectors, in particular face to face services that could not be provided remotely.

EU countries have adopted a variety of fiscal measures to prevent losses of jobs and income.[1] Job retention schemes have been the most widely used in this period. These schemes were classified into two main types, depending on the target unit. The first type concerned employees of companies that ceased their activities, providing them with a salary-related benefit (short-time work schemes, STWs).[2] In the first phase of the pandemic, the share of European workers covered by STWs were estimated as 26.8% of the total workforce (almost 50 million workers) with countries like France, Germany and Italy reaching the highest numbers (11.3, 10.1 and 8.3 million).[3] The second type concerned self-employed workers who suffered loss of income, giving them temporary money transfers.

Job retention schemes, although they differ across the EU, have helped to facilitate adjustment of the labour market to the pandemic crisis. They helped to compensate for job losses caused by the cessation of activity and as a result, the unemployment rate did not change as abruptly as during the 2009 crisis, when such schemes were less developed. Eurostat statistics show that unemployment increased by less than 1.1% between the first and the last quarter 2020. [4] This apparently low impact of the COVID crisis is likely to be largely due to the widespread

[1] To partly cover costs related to the creation or extension of national protection schemes, the EU established an instrument (SURE) that provides loans on favourable terms to Member States. By November 2020, financial support provided under this instrument had amounted to EUR 87.9 billion for 17 EU countries.

[2] See, for example, Hijzen and Martin, 2013; Balleer et al., 2016.

[3] See Müller and Schulten, 2020.

[4] https://ec.europa.eu/eurostat/cache/recovery-dashboard/

adoption of job retention schemes at the onset of the COVID crisis. [5] However, job retention schemes could not absorb all job losses. As the EUROSTAT statistics show, another margin for labour adjustment is the relatively frequent transition from activity to inactivity among workers. Women, young, low earning and low skill workers seem to be the most affected by job losses, as they are more likely to work in a non-essential sector that would be closed during a pandemic or cover non tele workable tasks (Joyce and Xu, 2020). Furthermore, they are more likely to work under temporary contractual arrangements and therefore more at risk of unemployment. [6]

At the time of writing this paper the pandemic crisis is still ongoing. Although the current financial costs of the pandemic are relatively well known, forecasts for the coming months or longer periods remain unknown due to the uncertainty regarding employment outcomes. Even less is known about household income status and labour market vulnerability due to the delay in obtaining sufficient data allowing a more precise assessment of the extent of household income insurance and job losses. A number of empirical studies have sought to overcome data limitations in order to assess the distributional and poverty impact of policy measures taken in EU countries, using different approaches. For example, a reweighting approach is used by Almeida et al. (2020) for an analysis of EU countries, and by Beirne et al. (2020) and O'Donoghue et al. (2020) for Ireland. This approach consists in reweighting the survey micro data in order to mimic the aggregate employment and unemployment forecast. Alternatively, Figari & Fiorio (2020) use an identification approach to identify workers based on aggregate data on the share of employment by activity sectors in Italian data.

Most of the literature uses a modelling approach in which transitions from work to unemployment or inactivity (or vice versa) are considered exogenously. The behavioural reactions of individuals within the labour market, depending on their occupational sector or employment status, are neglected, however. We propose a new theoretical and empirical approach to modelling the effects of labour demand shocks by considering behavioural reactions and external sectoral demand shocks. In addition to considering endogenous reactions to labour demand shocks, our model allows us to assess the effectiveness of policy reforms, such as job retention schemes, in absorbing the impact of these shocks on employment under alternative hypothetical scenarios regarding the timing of reforms. We take into account differences between occupational sectors and employment statuses and allows for transitions to and from unemployment and inactivity status. The model, EUROLAB, is based on the standard discrete choice labour supply model developed by Aaberge et al. (1995, 1999), van Soest (1995) and extends it to various aspects. To improve the predictability of the model, in particular for part-time work, the 'dummies refinement' approach is now commonly used to calculate the probability of choices. This refinement is supposed to reflect a number of factors

[5] Gross and Ounnas (2021) exploit the considerable variations in measures taken among the 50 US states and the 27 member countries of the EU and show that the difference in unemployment responsiveness is most likely due to the widespread use of short-term work schemes in Europe, given that the differences in hours worked are much smaller than for unemployment.

[6] See European Commission report, 2020: Labour Market and Wage Developments in Europe

such as fixed/search costs or availability/density of job types that are not represented by the systematic part of the utility function.[7] Colombino (2013) uses the latter interpretation to link dummies' coefficients to the number of jobs available on the market and to develop a structural model that takes into account labour market equilibrium conditions. The first attempt to model a supply-demand equilibrium using a discrete choice labour supply model can be attributed to Creedy and Duncan (2005) who through a multi-stage procedure simulate labour supply effects of a policy change and aggregate them to construct the demand side of the labour market. Labour market equilibrium is achieved through wage adjustment. However, as argued by Colombino (2013), such a procedure would not be consistent with a matching model that simultaneously includes a representation of both labour supply and demand.

Our paper builds on the approach proposed by Colombino (2013) and extends it in two directions. Firstly, we depart from the standard model of discrete choice labour supply which is based on a one-dimensional choice set usually consisting of working hours. A choice set with a higher degree of dimensionality is needed to model various sizes of shock depending on occupational sector and employment status. For this reason, our model follows Dagsvik and Strom (2006), Dagsvik et al. (2009) and Coda Moscarola et al. (2020), which allow individuals to choose their working hours, occupational sector and employment status.[8] Secondly, we model the unemployment alternative separately from the inactivity alternative, to allow for transition to and from unemployment. After estimating the EUROLAB model, market equilibrium conditions are taken into account using a procedure that is in line with the estimated model and allows for a consistent introduction of sectoral demand shocks and evaluation of COVID-19 related reforms under equilibrium.

The paper shows theoretically how the mechanism of labour market equilibrium works when introducing a new reform and accounting for both labour demand and supply conditions. At a later stage, it shows how this equilibrium evolves when an exogenous shock affects labour demand and short-term wage policies are introduced. The EUROLAB model can be used to assess the short-term and long-term effects of job retention policies and, in particular, to provide differential results depending on whether the job retention policy was implemented before or after the new labour market equilibrium was achieved. To illustrate the theoretical model, the effects of a hypothetical wage subsidy are simulated using the microsimulation model EUROMOD and the Italian version of the European Union Statistics on Income and Living Conditions (SILC, 2018).

Our empirical results support the theoretical model, showing in particular how sectoral demand shocks lead to lower wages and employment and an increase in unemployment under equilibrium conditions. In order to assess the potential impact of a demand shock in the presence of a simplified wage subsidy scheme, we simulate an *ex ante* and *ex post* scenario that differ from each other in the timing the subsidy is allocated to potential beneficiaries – before or after labour market equilibrium is achieved. In the *ex post* scenario, the model predicts a

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[7] See the survey by Blundell et al. (2007) for an example of modelling accounting for fixed costs of working.
8 See Narazani (2021) for an overview on the EUROLAB model.

8.86% increase in employment compared to the equilibrium situation in the absence of the wage subsidy, mainly due to the consideration of the recipients as employed. The ex-ante scenario predicts a 3.3% increase in employment (Fig. 4, Section 3.2) which would correspond to a long term labour market equilibrium. These results imply that the timing of the introduction (or announcement) of the wage subsidy matters when determining the short and long-term impact of such policy. In the short term, a wage subsidy helps to preserve jobs. From a longer time perspective, it contributes to job creation although the achievement of pre-shock employment depends on a range of factors related to the subsidy and the potential of labour market to produce new jobs.

The paper is structured as follows. Section 2 describes the modelling approach and the empirical methodology. Section 3 provides a theoretical framework for understanding the functioning of the labour supply/demand equilibrium. Section 4 examines the microsimulation model and the equilibrium algorithm. Section 5 and 6 present and address an illustration of the theoretical model with the simulation of a hypothetical reform of wage subsidy.

2 Micro-econometric modelling

A standard discrete choice labour supply model is built on a one-dimensional choice set, usually consisting of working hours. However, there may be circumstances that make the work decision also dependent on factors other than working time like occupational sector or contractual arrangements. As a result, the choice set may result in a combination of these factors too. For example, it might be appropriate to model the decision to work in a specific occupational sector, or the decision whether to work under wage employment or self-employment arrangements. In this case, the choice set is considered multidimensional.

2.1 Definition of the multidimensional choice set

We consider three choice sets – H, S and E – with h, s and e elements, respectively. The Cartesian product H×S×E will contain (h,s,e) elements. For example, a choice set based on three dimensions – four alternatives for working hours, four alternatives for occupational sectors and three alternatives for employment status – will have a dimension of 4x4x3. Let D_n^* further define the set of all the elements of the Cartesian product D that are not feasible for all individuals. A multidimensional choice set for individual n is then equal to $D_n = HxSxE - D_n^*$.

We now use these definitions to illustrate the choice set used in our specific multidimensional labour supply model. For example, for a single household and a choice set comprising three ranges of positive working hours ([15-30], [31-45] and [46-60]), three occupational sectors (s1, s2 and s3) and two employment statuses (e1 and e2), the choice set will consist of 3x3x2 elements. In addition to these combinations of choices, individuals also face two distinct choices with zero working hours: one of being inactive and another of being unemployed but active. While under the first scenario, the individual does not receive any income, under the second scenario a certain income may be received in the form of unemployment benefits. Obviously, depending on work history and social security contributions, not everyone can benefit from this unemployment income.

Unemployment (other than non-participation) can also be interpreted as a choice of ‘job’ (Colombino et al., 2010) paying a ‘wage’ (unemployment benefits or some social security support) and possibly requiring some ‘hours’ to look for a job or to confirm willingness to work (e.g. participation in re-training or motivational activities). The number of unemployment ‘jobs’ available and the level of their ‘wages’ can be explicitly represented in the model in the same way as market jobs and wages (i.e. using ‘dummy’ variables). However, such hypothetical `jobs´ are determined by policy decisions. It is also possible to reflect the ‘mixed’ alternative where households hold a market job (possibly in the short-term) and are at the same time unemployed (i.e. looking for another job).

In our model the multidimensional choice set consists of (h,s,e) alternatives (where h represents working hours, s represents occupational sectors and e represents employment statuses), is modelled as follows:
the index h has a value of 0 or from the range [1-5], the indexes s and e assume the value 0;
the index h has a value from the ranges [15-30], [31-45] or [46-60], the index s assumes value 1, 2 or 3 and the index e assumes value 1 or 2.

A value h of 0 corresponds to the alternative of inactivity, while positive working hours of less than 5 correspond to the alternative of unemployment and can be considered to represent hours spent searching for a job. In total, there are 20 alternatives for single-person households and 400 alternatives for couples.

The decision-making unit is the head of unit with or without a partner. In the first case, the decision-making unit consists of one person, while in the second case two people take collective decisions on their participation in the labour market. A head of household is defined as the member with highest earnings from work. We also abstract complex interactions within a household (such as a couple or single head living with own children or other household members), and in these cases we do not model the behaviour of other household members. In other words, their labour supply behaviour is considered as exogenous. The working behaviour of the various categories of students, pensioners and military personnel is not modelled here, as their choice set would be expanded based on other decision-making aspects such as education, pension or early retirement schemes.

2.2 Random Utility Maximization Model

The decision-making unit can choose among packages of jobs characterised by hours of work *h*, chosen within a feasible set of occupational sectors *s* and employment statuses *e*. The utility function of the i-th decision-making unit at job (H, S, E) with wage $w_{i,s,e}$ given the policy regime τ (a vector of parameters characterising the policy regime, including tax and benefits) can be written as the sum of a systematic component and a random component:

$$U = V\left(w_{i,s,e}, H, S, E, \tau; \gamma_i\right) + \varepsilon_i$$

H (hours of work required by the job), S (sector of activity) and E (employment statuses) are scalars or vectors depending on whether the household is a single person or a couple, and their opportunity density is a function $g(H, S, E)$.

γ_i is a vector of parameters (to be estimated) that characterise the preferences of household i. Among the S sectors of activity and E employment statuses there is also 'Non-participation' $(H = 0, S = 0, E = 0)$ and 'Unemployment', i.e. looking for a (different) job. If unemployed, the household might receive a 'wage', i.e. unemployment benefits or social assistance.

Assuming that the random components are independent and distributed according to the Gumbel distribution and adopting a convenient specification of the probability density function $g(H, S, E)$, we can obtain the probability that household i is willing to accept a job (h, s, e) (e.g. Colombino, 2013):

(1)

$$P\left(w_i, h, s, e, \tau; \gamma_{i,} \delta_i\right) = \frac{\exp\{V(w_i, h, s, e, \tau; \gamma_i) + D_i(h, s, e)'\delta_i\}}{\sum_S \sum_E \sum_H \exp\{V(w_i, h, s, e, \tau; \gamma_i) + D_i(h, s, e)'\delta_i\}}$$

As an example, for a single household and an opportunity set containing jobs in two sectors and with three ranges of hours, the vector D_i might be defined as follows (with 1[.] denoting the indicator function):

$$\begin{aligned}
D_{1,0} &= 1[s = 1, h > 5] \\
D_{1,1} &= 1[s = 1{,}16 \leq h < 30] \\
D_{1,2} &= 1[s = 1{,}31 \leq h < 45] \\
D_{1,0} &= 1[s = 1, h > 5] \\
D_{1,1} &= 1[s = 1{,}16 \leq h < 32] \\
D_{1,2} &= 1[s = 1{,}33 \leq h < 42] \\
D_{Un} &= 1[1 \leq h \leq 5]
\end{aligned} \qquad (2)$$

For couples, $D_{s,h}$ contains two analogous sets of variables, one for each partner. The hour ranges $[16 \leq h < 32]$ and $[31 \leq h < 42]$ correspond to part-time and full-time jobs, respectively, in sector s. D_{Un} corresponds to the unemployment alternative, where hours in the range $[1 \leq h \leq 5]$ denote hours of job search.

The coefficients δ_i related to the dummies D_i can be interpreted as functions of the number of jobs available in the market. We provide an exact definition in the following section.

3 Labour supply/demand equilibrium

3.1 Equilibrium simulations of a policy reform

In this section, we consider the case of labour market equilibrium when a policy affects household choices. This section is a simplified summary of the method proposed by Colombino (2013) – with some change in terminology – and applied in two papers (Colombino and Narazani, 2013, and Coda Moscarola et al., 2020). In this subsection, we consider the generic case of a policy change τ (e.g. change in the personal income tax rate) and outline the way our model can be used to assess the corresponding changes in the labour market. In subsection 3.1 we will consider alternative shocks representing by shifts in labour demand.

The observed data show the realised matches given the current policy τ: the households have chosen jobs that were actually available. In the event of a policy change (e.g. a fiscal reform), expression (1) will tell us the probability of a match under the new policy, say τ’. In order for the match to be realised, the chosen job must actually be available. In other words, in order to consistently simulate the effects of the new policy, we must impose an equilibrium constraint. There must be a consistency between available jobs and desired labour supply, taking into account that desired labour supply is affected by the available jobs through the term δ (eq. 1).

Colombino (2013) shows that the dummies’ coefficients δ_i of expression (1) have the following interpretation:

$$\delta_{s,e,0} = \ln\left(A_{s,e,0} J_{s,e}\right), s = 1,2,3, e = 1,2 \qquad (3)$$

$$\delta_{s,e,l} = \ln\left(A_{s,e,l} \frac{J_{s,e,l}}{J_{s,e}}\right), s = 1,2,3, e = 1,2, l = 1,2 \qquad (4)$$

where

$J_{s,e}$ = number of jobs in sector *s* and employment status *e*
$J_{s,e,l}$ = number of jobs in sector *s*, employment status *e* and hour range *l*

and

$A_{s,e,0}, A_{s,e,l}$ are constants that can be retrieved from the data (for the procedure illustrated below they are not needed).

The interpretation of Colombino (2013) allows parameters δ to be expressed as functions of the number of jobs available in the market. To start with, let us consider the simple case with only one dummy (i.e. one type of employment) and with households who have identical γ and δ. According to equation (3) we write

$$\delta = lnJ + a$$

where

α = lnA is a constant
and J = number of available jobs.

The policy reform will induce a change in the desired labour supply. Equilibrium condition requires that the number of available jobs J is equal to the desired labour supply. J depends on the wage rates and δ depends on J. Therefore, the policy will determine a change in the values of J, δ, of the wage rate and labour supply.

Let e^v be the proportional change in J, and $\delta(v)$ the changed value of δ:

$$\delta(v) = \ln(Je^v) + A = \ln J + a + v = \delta + v \quad (5)$$

We can also write the changed value of J as $J(v)$:

$$J(v) = Je^v \quad (6)$$

By assuming $J = Kw^{-\eta}$ or $w = K^{1/\eta}J^{-1/\eta}$ we get the wage rate corresponding to Je^v:

$$w = K^{1/\eta}(Je^v)^{-1/\eta} = K^{1/\eta}J^{-1/\eta}e^{-v/\eta} = we^{-v/\eta} \quad (7)$$

The new values of $\delta(v)$ and $w(v)$ determine new choice probabilities.

Let $\sum_i \sum_{h,s,e>0} P(w_i(v), h, s, e, \tau'; \gamma, \delta(v))$ be the desired labour supply given the policy τ' and the adjustment *v*. Then the equilibrium value *v** is such that

$$\sum_i \sum_{h,s,e>0} P(w_i(v^*), h, s, e, \tau'; \gamma, \delta(v^*)) = J(v^*) \quad (8)$$

The left-hand side represents the total desired labour supply in terms of number of jobs that the households are willing to accept (i.e. it is the sum of expression (1) over all the households and across all job types). The right-hand side represents the available jobs, or labour demand. The equality (equilibrium) determines the effective labour supply. Note that the adjustment in the number of jobs through a change in the level of the wage rates is a movement along the labour demand curve (see Figure 1).

A similar logic applies if we also consider a case with a dummy representing the level of employment and a dummy representing the density of unemployment opportunities.

Let $\delta_{u,g}$ be the coefficient assigned to the unemployment dummy.

We have $\delta_{u,g} = \ln\left(U_g\right) + \beta_g$ where U_g = number of available unemployment slots (or hours) and β_g is a constant. The value of the dummy coefficient after the shock will be:

$$\delta_{u,g}(u) = \ln(U_g e^u) + \beta_g = \ln U_g + u = \delta_{u,g} + u \qquad (9)$$

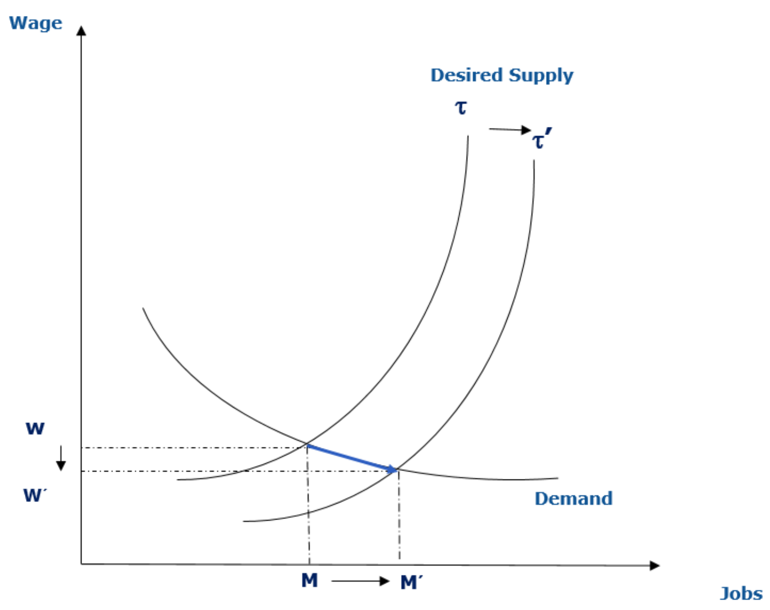
The adjusted total number of unemployment slots (or hours) will be $U(u) = \sum_g U_g e^u$.

If $M(u)$ = number of individuals choosing unemployment (or number of hours spent as unemployed), then the equilibrium value *v** is such that

$$M(u^*) = U(u^*) \qquad (10)$$

Figure 1 provides a visual description of the adjustment mechanism along the labour supply and demand curves.

Figure 1. Adjustment along Labour Demand Curve



The above figure provides a schematic illustration of the adjustment mechanisms. In practice i.e., in the micro data used to estimate (1), we observe different types of households and different types of jobs. For each couple, we have $J_{F,s}$, $J_{F,s,h,}$, $J_{M,s}$, $J_{M,s,h}$ with the corresponding dummies' coefficients $\delta_{F,s}, \delta_{F,s,h}, \delta_{M,s}, \delta_{M,s,h}$ and the wage rates $w_{F,s}$, $\delta_{M,s}$with s = 1, 2 and h = 1, 2. Analogously, for the singles we have $J_{g,s}, J_{g,s,h}$, $\delta_{g,s}, \delta_{g,s,h}, w_{g,s}$ with g = f, m.

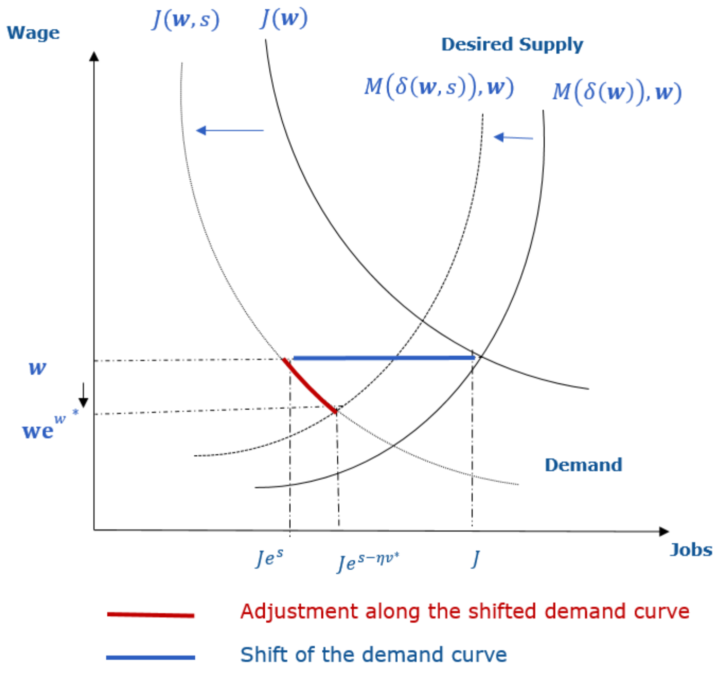
Moreover, in principle we might allow for different equilibrium adjustment $v_{g,s,h}$ for each specific job types. The equilibrium constraint might also identify specific conditions depending on the sector of activity and/or range of hours. The extent to which we can approximate the above general framework depends on data availability and computational constraints. We deal with this issue in Section 4.

3.2 Exogenous changes in the jobs available

Instead of – or together with – reforms directly affecting household choices, we may observe policies or events affecting directly the number and types of jobs available (including unemployment 'jobs'). There are two basic types of policies or events: (a) policies or events that **shift the labour demand curve**, i.e. the relation between wage rates and available jobs (e.g. as a consequence of changes in technology and costs), see Figure 2; (b) policies or events that **impose constraints** on the availability of jobs (Figure 3). The COVID-19 lockdown, depending on the country, the time span and the activity sector, may belong to category (a) or category (b).

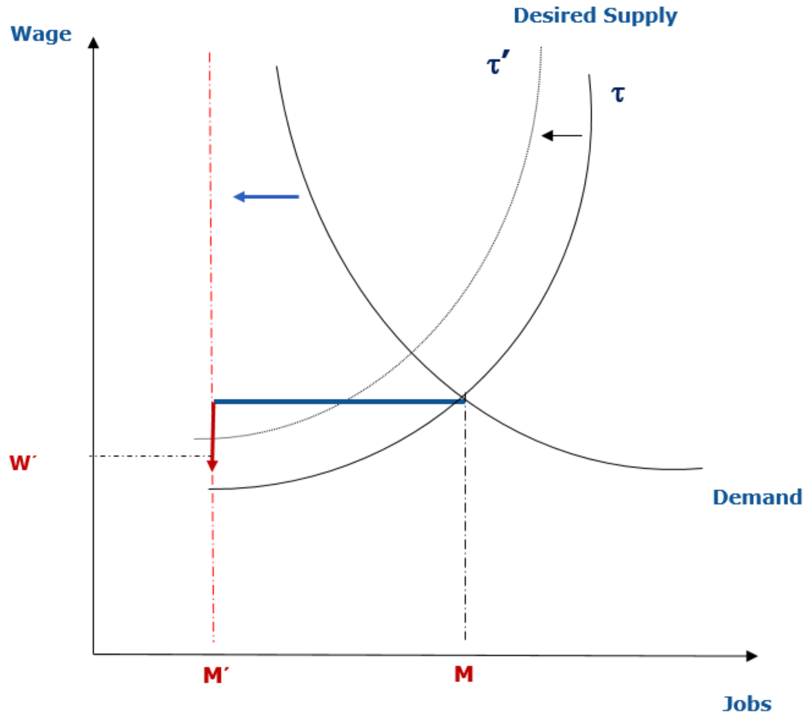
The case treated in Section 3.1 consists of a policy reform that shifts the curve of desired labour supply. A new market equilibrium condition requires that the number of jobs available is consistent with the desired labour supply. This is attained through adjustment of wage rates: the new equilibrium is achieved through a movement along the labour demand curve. Case (a) above is symmetrically opposed to the case in Section 3.1. In this case we observe an exogenous shift in the labour demand curve. However, in our model the shift in the labour demand curve is due to a change in the parameters δ represented by a dummy variable, which in turn may also induce a shift in the desired labour supply curve (see expression (1)). The desired labour supply curve may also shift to the left, because more unemployment 'jobs' are made available or unemployment benefits are made more generous. The new equilibrium can be interpreted as the change in jobs available given the current wage (i.e. the shift in the demand curve) and the change in jobs available due to the equilibrium value of the wage rate (i.e. a **movement along the shifted demand curve)** (see Figure 2). It is important to stress that we use an equilibrium model, which means that choices are made in an equilibrium situation, i.e. consistent with existing opportunities. A similar type of equilibrium adjustment (as represented in Figure 2) holds for unemployment, where unemployment 'jobs' and unemployment benefits, respectively, play the same role as jobs and wage rates.

Figure 2. Shift of Labour Demand Curve



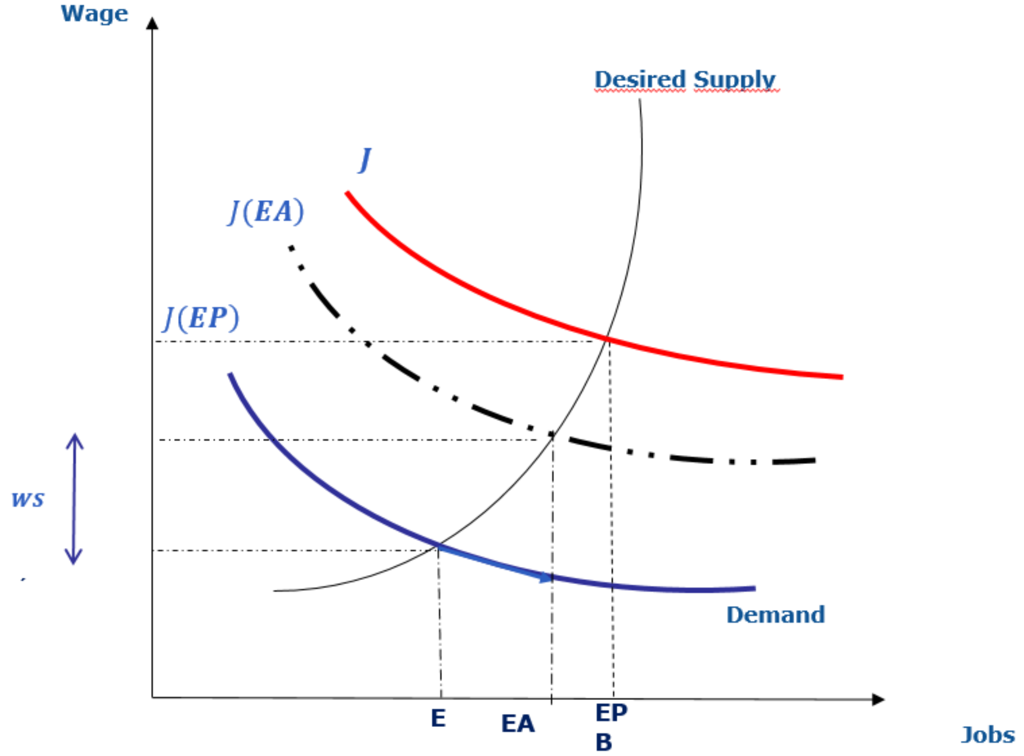
In case (b) above, the exogenous constraint on the availability of jobs is analogous to rationing. In reality, it can be interpreted as a variant of case (a) where the labour demand curve shifts and becomes extremely rigid, i.e. the elasticity of labour demand becomes zero. The exogenous change in the availability of jobs induces a shift in the desired labour supply curve, because it also depends on the parameters δ that in turn depend on the number of jobs available (see equations 3 and 4) and because the unemployment alternative might have become more attractive. Figure 3 represents the situation where the new equilibrium entails an adjustment of the wage rate. It is of course possible that the wage rate is sustained at the initial level, maybe due to a wage subsidy policy. If the government is willing to guarantee relatively high wages for those who hold a job, then it is also willing to accept more unemployment. Therefore, such a policy will typically be accompanied by more unemployment 'jobs' and/or more generous unemployment 'wages'. In this case, the new equilibrium will be attained by a further shift to the left of the desired labour supply curve.

Figure 3. Rationing of Jobs



Depending on the timing when the government intervenes to protect jobs and guarantee high wage levels, we can envisage two basic scenarios: (a) *ex ante* scenario where potential WS recipients can choose to keep their current job (with reduced hours and earnings) or choose another job or labour market status and (b) *ex post* scenario where potential WS recipients have already chosen their job and labour market status and cannot deviate from that choice. In the former scenario, we assign the WS benefit to eligible individuals before the labour market equilibrium is attained. The potential recipients are assuming that potential WS recipients may still change their labour market status after the allocation of WS. In the later, the WS scheme is implemented after a new labour market equilibrium has been achieved. These scenarios can also be interpreted as a short-term (*ex post*) and long-term (*ex ante*) effect of WS policy. Figure 4 represents an illustration of labour market equilibrium under the *ex ante* and *ex post* scenario. The exogenous demand shock shifts labour demand to the left (from J to J(P)). In equilibrium, employment decreases from point B to E which corresponds to the level of employment in *ex-post* scenario. EP represents employment including the potential unemployed who may be eligible for receiving WS. A wage subsidy would shift again the curve of labour demand to the right (J(E)) and employment moves to a new equilibrium (EA) which is the real (long-run) equilibrium. A further possibility is that the supply curve shifts backwards to react to the reduced availability of jobs and therefore the ex-ante equilibrium EA might be somewhat lower than represented.

Fig.4 Labor Market Equilibrium & Wage Subsidy



Note B = EP=employment in baseline equilibrium
EP = employment with ex-post WS (short-run, not an equilibrium) = B
EA = employment equilibrium with ex-ante WS
WS = wage subsidy

Below we explain the procedure to address the case of an exogenous shift to the labour demand curve (Figure 2). To simplify presentation, we again consider the case with only one dummy. We express the dummy coefficient as

$$\delta(w) = lnJ(w) + a \qquad (12)$$

and labour demand as

$$J(w) = Kw^{-\eta} \qquad (13)$$

Then we can derive

$$\delta(w) = ln(Kw^{-\eta}) + a \qquad (14)$$

Now consider a proportional shift in the labour demand curve:

$$J(w,s) = Kw^{-\eta}e^{s} \quad (15)$$

where s is a known exogenous shift parameter (it can be derived from the data on activity reduction).

Therefore:

$$\delta(w,s) = ln(Kw^{-\eta}e^{s}) + a \quad (16)$$

Now write the desired labour supply as $M(\delta(w,s)),w)$.

Note that the wage w affects M both through $\delta(w,s)$ and through the definition of the opportunity set. The equilibrium wage $w*$ must satisfy

$$M(\delta(w^{*},s)),w^{*}) = J(w^{*},s) \quad (17)$$

We specify the equilibrium wage as a proportional change to the current wage, where $v*$ is the parameter that must be determined in equilibrium:

$$w^{*} = we^{v^{*}} \quad (18)$$

Then:

$$J(w^{*},s) = K(we^{v^{*}})^{-\eta}e^{s} = Kw^{-\eta}e^{s-\eta v^{*}} = Je^{s-\eta v^{*}} \quad (19)$$

Notice that $e^{s-\eta v*}$ is the total proportional change in the number of jobs available. The proportional change due to the **shift in the labour demand curve** is e^{s} and the proportional change due to the movement along the (shifted) labour demand curve is $e^{-\eta v*}$.

Analogously:

$$\delta(w^{*},s) = \ln(Kw^{-\eta}e^{s-\eta v^{*}}) + a = \delta(w^{*}) + s - \eta v^{*} \quad (20)$$

4 Microsimulation model, data description and optimisation algorithm

4.1 Microsimulation model and data

The construction of a discrete choice labour supply model requires information on household disposable income under all alternatives in the choice set. This requires the use of a microsimulation model that takes into account the complexity of the tax-benefit system. We use EUROMOD to compute the disposable income earned by households under each alternative in the choice set. EUROMOD is a microsimulation model that simulates cash benefit entitlements, direct taxes and social insurance contributions. The model does this based on the information available in the underlying datasets and in line with tax-benefit rules.[9]

The net disposable income of the household is calculated as follows. For each alternative in the choice set characterised by i) positive working hours, ii) employment status and iii) sectoral choice, a monthly wage is attributed to each individual in the sample eligible for labour supply modelling (Appendix A).[10] To compute the monthly wage, we predict an hourly wage rate for each sectoral choice and employment status using the Durbin and McFadden procedure (1984). This procedure follows two steps: first, run multinomial logit models to compute the selectivity correction factor and next run linear regression models on a selected subset of observations including the selectivity correction. In the case of the unemployment alternative, EUROMOD is used to simulate unemployment benefits according to the rules applied in the country. For example, to simulate unemployment benefits using the Italian spine of EUROMOD, an individual would be entitled to such benefits if he or she was in employment for at least 6 months in the previous year. Moreover, in order to calculate the amount of the benefit, EUROMOD requires information on the monthly wage earned in the previous year. If the wage is reported in the data, we use this information to simulate unemployment benefits. Otherwise, a predicted monthly wage is used. In addition, unemployment benefit is assumed to be received over a period of 12 months. In the case of the inactivity alternative, a monthly wage equal to 0 is allocated to the selected individuals. EUROMOD considers this hypothetical wage of the individual, along with any other source of income of the family, in deriving the net disposable income of the individual and the household under each alternative, taking into account the whole tax-benefit system and the household characteristics.

To empirically examine the equilibrium model described in Section 3, we run the Italian spine of EUROMOD with the underlying data from the Italian SILC 2018. The survey is representative for the national population at regional level, and is the national component of the EU-SILC carried out annually to collect comparable information on income, poverty, social exclusion and living conditions across European countries.

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[9] Institute for Social and Economic Research, University of Essex and Joint Research Centre, European Commission, EUROMOD: Version I3.0+ [software], January 2021. The EUROMOD model is maintained and updated by the European Commission Joint Research Centre, for further information see https://euromod-web.jrc.ec.europa.eu/ and Sutherland and Figari (2013).

[10] Stata command 'selmlog' is used to estimate hourly wages for each sector and employment status. It applies a set of methods reviewed in Bourguignon, Fournier and Gurgand (2007).

4.2 Equilibrium algorithm

This subsection describes the steps taken to build a labour market equilibrium algorithm, as explained in subsection 3.2. First, we consider the case of simulating a new tax-benefit reform. In this case, the algorithm for supply/demand equilibrium will specifically consist of the following steps:

1. Estimate the utility parameters (Appendix B) and the coefficients of in-work sectoral dummies. Compute the baseline labour supply as the total number of working hours predicted under the current system. Use this value to construct the baseline labour demand, assuming that the labour market is in equilibrium in the current situation. Similarly, compute the expected number of unemployment slots under the baseline system.

2. Estimate the parameters for tax function (corresponding to the reform) by regressing net household income on a set of explanatory variables. This set of variables includes gross income, gross square income and interactions of gross income with a range of socio-demographic characteristics (age, number of children and household size), as well as alternative specific dummies. The estimated tax parameters are used to convert the new gross income into net income (variable needed as an explanatory variable in the utility function) within the equilibrium algorithm. Due to the considerable time required to build the hypothetical datasets at each iteration of the equilibrium algorithm, we avoided using EUROMOD to convert the gross income into net income and used instead the estimated tax functions parameters for that purpose.

3. Run the optimisation procedure[11] to find the value of the parameters v and u (see Section 3) that correspond to a new labour market equilibrium status under the reform. The new equilibrium is attained when the total number of jobs matches the total number of individuals willing to work. The same equality conditions hold for unemployment, so the available unemployment slots correspond to the expected number of unemployed. The iterated changes in the parameters v and u affect in-work and unemployment dummies' coefficients (equation 5 and 9), wages (equation 7), total labour demand (equation 6) and unemployment slots (equation 9).

[11] We use the Amoeba, an optimisation routine written in STATA. Amoeba is an efficient (derivative-free) algorithm for optimising a multidimensional function developed by Nelder and Mead. Convergence rules are needed to break the iteration cycle. We set a step size (percentage change in each parameter used to set up Amoeba in the parameter space) equal to 0.1 and a tolerance (the tightness of Amoeba before the algorithm quits) equal to E-06.

In the case of a sectoral shock, the algorithm for supply/demand equilibrium follows the same steps as in the previous case. However, it deviates from it as the iterated changes in parameters v and u affect in-work and unemployment dummies' coefficients (equation 20 and equation 9), wages (equation 18) and total labour demand (equation 19) including shock parameter s. In addition, the parameters for tax function are estimated on the current tax system (policy rules as of 2020, without COVID-19 reforms).

To assess behavioural responses triggered by policy interventions against an exogenous demand shock (such as the COVID-19 crisis), a simplified version of the wage subsidy (WS) scheme implemented in Italy in the second quarter of 2020 is applied. More specifically, the simplified version consists in providing employees with a higher probability of losing job (as predicted by the model) with earning equal to 80% of their previous earnings.

Depending on the timing of the WS scheme to achieve a new labour market equilibrium, we simulate two main scenarios: *ex ante* and *ex post* scenario. The difference between the scenarios is explained in Section 3.2

The *ex ante* scenario follows these steps:

1. select a proportion of potential WS recipients appropriate to the size of the sectoral shocks;
2. allocate to them working hours of 0 and earnings equal to a proportional amount of the baseline earnings;
3. run the equilibrium algorithm.

The *ex post* scenario follows these steps:

1. run the equilibrium algorithm;
2. select a proportion of potential WS recipients appropriate to the size of the sectoral shocks;
3. allocate to them working hours of 0 and earnings equal to a proportional amount of the new equilibrium earnings;
4. keep the choice probability unchanged and predict the changes in working hours.

A more consistent way would be to use the *ex post* scenario procedure and bootstrap the sample of recipients until the equilibrium recipients approximately equal the potential recipients. However, this procedure is computationally cumbersome and we leave it to further research.

5 Results

This section presents the results for the expected effects of sectoral demand shocks on labour supply when considering the demand side. First, it shows how an exogenous sectoral shock would affect labour supply if governments did not intervene through wage subsidy schemes. Second, it presents the impact of the demand shock in the event of a wage subsidy scheme. The results include changes in wages, total employment, unemployment slots and inactivity rate.

Table 1 shows the results of the simulation of sectoral employment shocks in the absence of policy measures to absorb the reduction in employment caused by an exogenous demand shock. In this case, two scenarios are considered, differing in how they take into account equilibrium conditions. By way of illustration, a demand shock calibrated as s = -0.8 is assumed for an aggregate sector (hospitality, wholesale, transportation, construction) which can also be considered as a non-essential sector. A demand shock calibrated as s = -0.8 represents a reduction in labour demand or total jobs by 45% (equal to exponential of s, eq. 15) for the sector concerned.

If equilibrium conditions are not taken into account, a sectoral demand shock is expected to cause total employment to fall by 16.8% that is fully offset by the inactivity margin. This drop in employment is in line with the situation illustrated in Figure 2 where an exogenous shift in the labour demand curve due to a change in the parameters δ leads to a reduction in employment. In turn, the change in the parameters δ would shift the desired labour supply curve to the left, because more unemployment 'jobs' are made available. In fact, assuming a labour demand elasticity of -0.5, the equilibrium condition leads to a 12% reduction in wages (parameter v) and a 14.7% decrease in employment offset by a 46% increase in unemployment. The increase in the unemployment rate is mainly due to the generosity of the amounts of unemployment benefits which, unlike wage rates, were assumed unchanged in this exercise. It is important to stress that in the equilibrium model, although two separate equilibrium constraints are imposed with respect to employment and unemployment, the shock is transmitted only to labour demand. A similar type of shock transmission to unemployment slots as well as the relaxation of equilibrium constraints on unemployment may lead to different results.

Table 1: % Changes in employment, unemployment and inactivity rate, Without Wage Subsidy

	Baseline	No Equilibrium	Equilibrium	No Equilibrium	Equilibrium
Employment	12,979,114	10,798,950	11,065,199	-16.80%	-14.75%
Inactivity	2,682,219	4,862,383	2,796,672	81.28%	4.27%
Unemployment	3,920,415	3,920,415	5,719,877	0.00%	45.90%
Parameters					
v					-0.12
u					0.41

Note: v is the parameter of change in employment and wages, u is the parameter of change in unemployment slots.

% changes in "No Equilibrium" are computed versus the baseline. % changes in "Equilibrium" are computed versus "No Equilibrium" scenario.

Table 2: % Changes in employment, unemployment and inactivity rate, With Wage Subsidy

	Baseline	Ex-post	Ex-ante	Ex-post	Ex-ante
Employment	12,979,114	12,045,649	11,433,982	8.86%	3.33%
Inactivity	2,682,219	2,796,672	3,431,077	0.00%	22.68%
Unemployment	3,920,415	4,739,428	4,716,690	-17.14%	-17.54%
<u>Parameters</u>			1.14E+07		
v			-0.000391815		-0.06
u					0.00

Note: v is the parameter of change in employment and wages, u is the parameter of change in unemployment slots.

% changes are calculated versus the scenario of equilibrium without WS (Table 1).

To assess the impact of the demand shocks in the presence of a simplified wage subsidy scheme, two scenarios are simulated as explained in the previous section: *ex ante* and *ex post* scenario. In the *ex post* scenario, potential WS recipients are assumed to receive an amount of WS but their choices on the labour market remain unchanged. In this scenario, as Table 2 shows, the model predicts 8.86% increase in employment (compared to the equilibrium situation without WS) which is mainly due to the fact that WS recipients, although they do not supply hours of work, are still considered as employed. The increase in employment, as illustrated in Figure 4, corresponds to a leftward shift of labour demand (from J to J(P)). More specifically, it corresponds to the segment EP which represents employment including the potential unemployed who may be eligible for receiving WS.

In the *ex ante* scenario, assuming that potential WS recipients may still change their labour market status after the allocation of WS, the model predicts a 3.3% increase in employment as compared to the equilibrium in the absence of the subsidy. This increase in employment occurs after the wage subsidy shifts the curve of labour demand to the right (J(E)). It corresponds to the new equilibrium (EA), as illustrated in Figure 4.

6 Conclusions

Still little is known about the impact of the pandemic on household income and labour market vulnerability. A number of empirical studies have sought to overcome data limitations and to assess the distributional and poverty impact of policy measures taken in EU countries using real time data. However, these approaches rely on assumptions regarding the transition from work to unemployment or inactivity (or vice versa) and do not consider the behavioural reactions of individuals in the labour market.

This paper proposes a new theoretical and empirical approach to modelling the effects of sector-specific demand shocks on the labour market considering as endogenous the reactions in labour supply. We develop a multidimensional behavioural model, EUROLAB, taking into account differences between occupational sectors and employment statuses, and allowing for transitions to, and from, unemployment and inactivity status. Our model allows us to analyse the impact of policy reforms, such as job retention schemes, in absorbing the impact of these shocks on employment under alternative hypothetical scenarios regarding the timing of reforms, something empirical approaches used in the COVID context cannot do. After estimating this model, labour market equilibrium conditions are taken into account, using a procedure that is in line with the estimated behavioural parameters and allowing for the consistent introduction of sectoral demand shocks and the assessment of COVID-19 reforms.

We illustrate the usefulness of our model considering the case of Italy and using SILC data and the Italian module of the EUROMOD microsimulation model. Our empirical results support the theoretical model, showing in particular how a 45% shock in an aggregate occupational sector would lead to a 16.8% reduction in the employment rate, which would be fully absorbed by the inactivity margin. Assuming a labour demand elasticity of -0.5, the equilibrium in the labour market leads to a reduction of around 12% in wages and 14.7%% in employment that would be almost fully compensated by the unemployment margin, due to the generosity of unemployment benefits.

Furthermore, we assess the potential impact of a demand shock in the presence of a wage subsidy scheme, and simulate an *ex ante* and *ex post* scenario. The main difference between these scenarios is the timing with which the wage subsidy is allocated to potential beneficiaries – before or after labour market equilibrium is achieved. In the *ex post* scenario, the model predicts an 8.86% increase in employment compared to the equilibrium situation in the absence of the wage subsidy, and this is mainly due to the fact that we consider as employed the recipients of such subsidy. On the other hand, in the *ex-ante* scenario the model predicts a 3.3% increase in employment as compared to the equilibrium outcome in the absence of wage subsidy. This increase would correspond to a long term equilibrium of the labour market.

These results provide some indication on the importance of considering labour market equilibrium dynamics when assessing the short-term and long-term impact of policies that subsidize employment. Depending on the timing the subsidies are introduced (or announced), their impact on job preservation might be different. In the short-run, a wage subsidy contributes to preserve jobs. In a longer time perspective, such scheme contributes to job creation although the attainment of the pre-shock employment depends on a range of factors related to the subsidy (like duration and amount) and the potential of labour market to generate new jobs.

The analysis presented in this paper aims to illustrate the usefulness of the EUROLAB model in assessing the effectiveness of job retention schemes for safeguarding employment and workers´ income. One should note however, that our analysis rests on a simplistic representation of both the policy and the demand shock. Future research will consider actual policies and more recent statistics in order to analyse the extent to which the existence and design of such schemes matter in order to strengthen the resilience of labour markets to economic shocks.

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Appendix A

Summary statistics

Table A1. Distribution of LS flexible sample by employment status, gender and marital status

Labour Market Status	gender_couple				
	Married Men	Married Women	Single Men	Single Women	Total
employee	3515.933	1964.586	1426.212	1332.126	8238.857
	62.07	30.75	53.50	55.77	48.16
selfemployed	1102.427	390.861	432.2078	201.6742	2127.171
	19.46	6.12	16.21	8.44	12.44
inactive	99.59257	2874.431	66.28305	241.5225	3281.829
	1.76	45.00	2.49	10.11	19.19
unemployed	946.1229	1158.012	740.9149	613.0928	3458.143
	16.70	18.13	27.80	25.67	20.22
Total	5664.076	6387.89	2665.618	2388.416	17106
	100.00	100.00	100.00	100.00	100.00

First row has *frequencies* and second row has *column percentages*

Table A2. Distribution of LS flexible sample by employment status, occupational sector, gender and marital status

occ_ls	gender_couple				
	Married Men	Married Women	Single Men	Single Women	Total
Employee in non-essential sector	1200.729	400.8465	533.1789	331.1372	2465.891
	23.95	15.69	26.42	19.96	21.93
Selfemployed in non-essential sector	2616.032	1729.937	1015.502	1109.604	6471.075
	52.17	67.73	50.32	66.90	57.55
Employee in essential sector	590.5769	157.6348	212.5868	77.35244	1038.151
	11.78	6.17	10.53	4.66	9.23
Selfemployed in essential sector	606.6543	265.8671	256.789	140.5719	1269.882
	12.10	10.41	12.72	8.48	11.29
Total	5013.992	2554.285	2018.057	1658.666	11245
	100.00	100.00	100.00	100.00	100.00

First row has *frequencies* and second row has *column percentages*

Table A3. Average working hours of LS flexible sample by employment status, occupational sector, gender and marital status

	Married Men	Married Women	Single Men	Single Women	Total
Employee in non-essential sector	41.058	36.516	40.513	37.899	39.647
Selfemployed in non-essential sector	39.742	36.493	39.427	37.929	38.474
Employee in essential sector	45.406	41.012	43.537	43.045	44.112
Selfemployed in essential sector	43.688	39.268	42.599	40.379	42.161

Appendix B

Table B1: Conditional Logit results

	Couples	Single Women	Single Men
ls			
Part-time dummy x sector 1 - Male	-1.616***		-1.131***
	(-7.07)		(-4.84)
Full-time dummy x sector 1 - Male	1.284***		1.413***
	(12.72)		(10.99)
In-work dummy x sector 1 - Male	-4.313***		-2.319***
	(-15.06)		(-7.29)
Part-time dummy x sector 2 - Male	-0.513**		-0.497*
	(-3.16)		(-2.47)
Full-time dummy x sector 2 - Male	1.924***		1.981***
	(20.14)		(16.01)
In-work dummy x sector 2 - Male	-4.180***		-2.230***
	(-14.57)		(-6.95)
Unemployment dummy - Male	1.490***		2.090***
	(9.44)		(13.35)
Part-time dummy x sector 1 - Female	1.647***	0.902***	
	(6.51)	(3.42)	
Full-time dummy x sector 1 - Female	2.010***	2.265***	
	(10.68)	(12.28)	
In-work dummy x sector 1 - Female	-8.383***	-3.854***	
	(-29.75)	(-11.84)	
Part-time dummy x sector 2 - Female	2.149***	1.049***	
	(9.54)	(4.59)	
Full-time dummy x sector 2 - Female	2.765***	2.595***	
	(17.17)	(16.62)	
In-work dummy x sector 2 - Female	-7.833***	-2.962***	
	(-28.94)	(-9.22)	
Unemployment dummy - Female	-1.263***	1.055***	
	(-20.96)	(11.07)	
Leisure - Male	0.331***		0.174***
	(8.17)		(5.82)
Leisure square - Male	-0.00307***		-0.00151***
	(-16.87)		(-7.47)
Leisure x age - Male	-0.00377**		-0.00385***
	(-2.79)		(-4.51)
Leisure x age square - Male	0.0000512***		0.0000441***
	(3.60)		(4.47)
Leisure x #children - Male	-0.0172***		-0.0302***
	(-9.49)		(-4.38)
Leisure x #children < 3 year - Male	0.00554		-0.0294
	(1.25)		(-0.24)
Leisure x #children 3-6 year - Male	0.0129***		0.0241
	(3.62)		(1.31)
Leisure x Mortgage - Male	-0.00745*		-0.0286***
	(-2.14)		(-4.12)
Leisure x Migrant - Male	0.000963		0.00590

	(0.19)		(1.37)
Leisure - Female	0.203***	0.114***	
	(5.46)	(3.31)	
Leisure square - Female	-0.00143***	-0.000263	
	(-6.42)	(-1.14)	
Leisure x age - Female	-0.00554***	-0.00780***	
	(-5.63)	(-8.67)	
Leisure x age square - Female	0.0000644***	0.0000876***	
	(5.89)	(8.67)	
Leisure x #children - Female	-0.00853***	-0.00539*	
	(-6.19)	(-2.00)	
Leisure x #children < 3 year - Female	0.00626	-0.00148	
	(1.95)	(-0.19)	
Leisure x #children 3-6 year - Female	0.00539*	-0.000967	
	(2.08)	(-0.15)	
Leisure x Mortgage - Female	-0.0142***	-0.0299***	
	(-6.41)	(-5.39)	
Leisure x Migrant - Female	0.0267***	-0.000212	
	(6.28)	(-0.05)	
Leisure Male x Leisure Female	0.000104		
	(0.81)		
Net income	0.00482**	-0.00440**	-0.000118
	(2.85)	(-3.07)	(-0.10)
Net income square	0.00000324***	0.00000278**	0.00000270***
	(6.33)	(3.27)	(4.03)
Net income x household size	-0.00165***	-0.00166***	-0.00214***
	(-14.54)	(-8.05)	(-9.09)
Net income x Leisure - Male	-0.0000260*		0.0000152
	(-2.34)		(1.38)
Net income x Leisure - Female	0.0000276**	0.0000265	
	(2.70)	(1.87)	
Observations	853384	39074	41678
ll	-16726.5	-5587.5	-5973.7
r2_p	0.272	0.241	0.240
aic	33529.0	11214.9	11987.5
bic	33972.0	11386.4	12160.2

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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