EXTENDED ABSTRACT

Title: The Effects of Income Support Benefits on Aggregate Labour Supply: A Synthetic Control Approach

Authors and e-mail of all:
Ángel L. Martín-Román
angellm@eco.uva.es

Javier Martín-Román
jmartin@cee.uned.es

Department:
Ángel L. Martín-Román
Fundamentos del Análisis Económico e Historia e Instituciones Económicas

Javier Martín-Román
Economía Aplicada y Gestión Pública

University:
Ángel L. Martín-Román
Universidad de Valladolid (UVa)

Javier Martín-Román
Universidad Nacional de Educación a Distancia (UNED)

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Abstract:

1. Introduction

The raising inequality in the last decades in developed countries has encourage governments to pass legislation to support low-income earners (Carrillo and Rothbaum, 2016; Commendatore et al., 2018). Among the policies used to improve living conditions of the latter, we might highlight the so-called minimum living income (MLI) and a set of special (and more generous) unemployment benefits (SUB). This kind of policies are often linked to a specific behaviour regarding labour supply decisions. Particularly, in some cases, active job search is required in order to be eligible to receive the allowance.

At the same time, there is a growing concern about regional unbalances, with thriving regions coexisting together with lagging territories within the same country. This, in turn, triggers central governments to transfer large amounts of financial resources to their lagging regions to compensate such differences. These financial resources are channelled through pensions, education, national health care, and unemployment protection systems that are funded through taxes collected mainly by the central administration. The Italian Mezzogiorno, East Germany, and the southern Spanish region of Andalucía are well studied cases of heavily subsidized regions (Boltho et al., 1997; Sinn and Westermann, 2001; Jofre-Monseny, 2014). Some of the social programs may modify the labour supply behaviour of the persons living in the targeted territories (e.g. more generous SUB in specific territories).

The aim of the paper is to examine the effects of one of these SUB, the Agrarian Unemployment Benefit (AUB), on the aggregate labour supply at the extensive margin. The AUB was intended to help unemployed workers in the agrarian sector of two Spanish regions, Andalucía and Extremadura. We take advantage of the fact that the AUB was not implemented in all Spanish regions to set up a quasi-experimental design by constructing a counterfactual Andalucía and comparing it with the real one.

Thus, we investigate two research questions that are interrelated. The first one is whether significant income support programs such as the AUB have encouraging or discouraging effects on the labour supply at the macro level. More precisely, we attempt to ascertain whether the labour force participation rate increases or decreases as a consequence of the enactment of this income support program. The second research question is conditional on having obtained a positive result in the first one. Put differently, if the participation rate rises after the implementation of the policy, we seek to determine whether the number of "new active persons" outweighs the number of benefit recipients or not. If the former is the case, it would be possible to state that there exist spill-over effects associated to the policy, whereas discouraging effects would be an issue otherwise.

Our approach to addressing these research questions is twofold. First, we build a theoretical model of labour supply decisions, following the lines set up in Martín-Román et al. (2020) and Martín-Román (2022), but adapted to tackle the main questions of interest in this research. Equipped with this theoretical background, we are able to identify the incentives and disincentives that the AUB creates among the individuals regarding their labour supply choices. Moreover, it allows us to determine the major channels through which such a set of incentives operates and to differentiate among them between microeconomic and macroeconomic effects affecting the working-age population. Second, we test two hypotheses arising straightforwardly from the two research questions by means of the Synthetic Control Methods (SCM) approach. We make use of this empirical methodology since the focus in this research is on the aggregate labour force participation rates. Thus, since we wanted to take into account not only the microeconomic factors but also those other effects operating at the macro level, we adopt a macroeconomic perspective instead of using a microeconometric approach.

As regards the results, we obtain evidence indicating that the implementation of the AUB increased the participation rate in Andalucía by about 2 percentage points during the years immediately following the law's approval. This is a rather significant finding because it is often stated that income support benefits tend to discourage active job search, dropping labour force participation rates.

Anyhow, when computing whether this increase in labour force exceeds the total number of AUB beneficiaries, the answer is negative. In other words, we found that the number of "activated" individuals as a consequence of the AUB implementation is positive but less than the number of AUB recipients. This finding entails that what could be called the labour-enhancing effects on the workforce only partially offset the discouraging effects created by that income support program.

The paper contributes to the literature in three ways. First, it adds a macroeconomic perspective to the previous works on the effects of income support programs on labour supply, which mainly adopt a microeconomic approach. This is important since, as will be shown later, even non-beneficiaries might be affected by the AUB. Second, it explores the different theoretical channels through which the AUB might encourage or discourage the labour supply. Hence, our theoretical framework allows us to clearly set up the two hypotheses to be tested. Third, it makes use of the SCM approach to address the issue, which is a novelty within this topic to the best of our knowledge. Moreover, this methodology enables us to test whether or not the spill-over effects offset the abovementioned discouraging effects, which is not possibly when using a microeconometric framework.

2. A theoretical model

2.1. Basic theoretical setting

We construct a labour market participation model in order to identify the theoretical channels through which the AUB affects the LFPR. As we are focused on the extensive margin of the labour supply, we assume a fixed working week. Thus, labour supply choices coincide with participation decisions (e.g., Martin-Roman et al., 2019; Martin-Roman 2020). Furthermore, the model developed here is extended to account for the effects of unemployment and the AUB on the LFPR.

According to the distinction made by Rodrik (2015) between critical and non-critical assumptions, the structure of the model comprises of three critical assumptions (i.e., the mechanisms driving our results) and a set of other non-critical assumptions (discussed in Appendix 1).[1] The three critical assumptions are listed below:

> **Assumption 1.** *Persons are eligible to receive the AUB if they live and work in the agricultural sector. To be entitled to collect the benefit, in principle, they need to be unemployed too. Thus, there are three types of individuals, those eligible and entitled, those eligible and not entitled, and those not eligible. All are potentially affected by the implementation of the AUB, though. The variable indicating whether the AUB is effectively implemented is denoted by* r*. This variable could be thought of as a dummy variable taking the value 1 when the AUB is effectively applied and 0 otherwise.*

[1] In Appendix 1 some variables are defined too.

Assumption 2. *A positive unemployment rate* u *exists. That rate determines the likelihood* p *of finding a job, which is the same for all individuals. This probability also depends positively on the implementation of the AUB. Therefore,* $p(u,r)$ *with* $[\partial p(u)/\partial u] < 0$ *and* $[\partial p(r)/\partial r] > 0$*. Taking into consideration the discrete nature of the variable:* $p(u_0, r = 1) > p(u_0, r = 0)$.[2]

Assumption 3. *The AUB allowance consists of an unemployment benefit amounting to* b*, in principle, conditional on looking for a job. However, even though labour agencies attempt to enforce that requirement, they cannot always monitor the entire population rightly. With probability* q*, an individual who is not effectively looking for a job is caught and loses the entitlement to receive the AUB, and, with probability* $(1 - q)$*, he or she is able to obtain the AUB without looking effectively for a job. The AUB is an increasing function of the variable* r*,* $[\partial b(r)/\partial r] > 0$ *or, in discrete terms:* $b(r = 1) > b(r = 0) = 0$.[3]

In Figure 1, the set of alternatives for the three types of workers is shown. The levels of consumption and leisure have been replaced, within the utility function, by the corresponding values associated with each decision. Thus, we are already accounting for the budget constraints within the decision-making framework. In Figure 1, y is the real non-labour income. Total time has been normalized to 1.

[Figure 1]

To better understand the theoretical channels through which the AUB influences the aggregate LFPR, we analyse sequentially the three groups mentioned above and then aggregate them.

2.2. Effects of the AUB on non-eligible persons

To begin with, let us analyse an individual who is not eligible to receive the AUB. The individual has two options (see panel A in Figure 1). Each option is associated with a

[2] Therefore, unemployment is primarily involuntary. Obviously, the higher the unemployment rate, the lower p. On the other hand, the positive relationship between the AUB and the probability of finding a job may be based on the grounds of macroeconomic considerations. In this vein, if the AUB is effectively implemented, the overall economic activity in the area will be stimulated, and, consequently, the job search will produce better results.

[3] Here, for the sake of simplicity, we are abstracting from other types of unemployment benefits or social allowances. Including those elements into the model would add complexity without providing much insight.

level of utility, either certain or expected: (1) not participating and (2) participating, which can be formalized, respectively, as:

$$U(y,1) \tag{1}$$

$$p(r)U\left(w\bar{l}+y,1-\bar{l}-s\right)+(1-p(r))U(y,1-s) \tag{2}$$

The reservation wage for an individual (w_0^R) may be defined, as usual, as the value of w equalizing both options:

$$p(r)U\left(w_0^R\bar{l}+y,1-\bar{l}-s\right)+(1-p(r))U(y,1-s)=U(y,1) \tag{3}$$

It is easy to calculate from expression (3) that when $b=0$, then w^R is positive ($w^R>0$). Focusing first on leisure time, we have that $1>(1-s)>(\,1-\bar{l}-s)$. This would entail that $w^R\bar{l}+y>y$ in order to attain an equality in (3), which in turn implies that $w_0^R>0$.

It is worth mentioning, though, that even those workers not eligible for the benefit are affected by the enactment of the AUB law. The reason for that is that the AUB changes the likelihood of finding a job. Thus, even those not directly affected by the AUB are indirectly influenced as a consequence of the fiscal stimulus caused by such an allowance. Taking equation (3) and making use again of the implicit function theorem, it is straightforward to compute the effects of changes in p on w_0^R:

$$\frac{\partial w_0^R}{\partial p}=-\frac{U\left(w_0^R\bar{l}+y,1-\bar{l}-s\right)-U(y+b,1-s)}{p\bar{l}U_C\left(w_0^R\bar{l}+y\right)}<0 \tag{4}$$

The negative sign of (4) is the result of the definition given in (3). First, it is evident that $U(y,1)>U(y,1-s)$. Second, to achieve equality in (3), $U\left(w_0^R\bar{l}+y,1-\bar{l}-s\right)>U(y+b,1)>U(y,1-s)$ must be fulfilled. In other words: when p rises (drops), w_0^R decreases (increases).

Following the aggregation process described in Appendix 1, it is easy to conclude that the AUB has an encouraging effect on the participation rate for non-eligible workers. Let us denote PR^{NE} to such a rate. Holding constant the rest of determinants of w_0^R, the effect can be formalized through expression (5):

$$\frac{\partial PR^{NE}(r)}{\partial r}=\underbrace{\frac{\partial PR}{\partial w_0^R}}_{(-)}\cdot\underbrace{\frac{\partial w_0^R}{\partial p}}_{(-)}\cdot\underbrace{\frac{\partial p}{\partial r}}_{(+)}>0 \tag{5}$$

We can state that $\partial p/\partial r > 0$ (by definition), that $\partial w_0^R/\partial p < 0$ (from the discussion in this section), and that $\partial PR/\partial w_0^R < 0$ (from the concept of reservation wage).

2.3. Effects of the AUB on eligible and entitled persons

The analysis of individuals eligible to receive the AUB is more complex, Furthermore, it depends on if the requirement to be considered job-seekers is enforced or not, as mentioned in Assumption 3. In this case, the expected utility level associated with the option of not participating is given by expression (6):

$$qU(y,1) + (1-q)U(y+b,1) \tag{6}$$

It will prove to be useful to study separately the cases of perfect monitoring (i.e., $q = 1$), no monitoring (i.e., $q = 0$), and partial monitoring (i.e., $0 < q < 1$). Thus, we can define a different reservation wage for each case. Equations (7), (8), and (9) define the reservation wages for perfect monitoring (w_1^R), no monitoring (w_2^R), and partial monitoring (w_3^R), respectively:

$$p(r)U\left(w_1^R\bar{l} + y, 1 - \bar{l} - s\right) + \left(1 - p(r)\right)U(y + b, 1 - s) = U(y,1) \tag{7}$$

$$p(r)U\left(w_2^R\bar{l} + y, 1 - \bar{l} - s\right) + \left(1 - p(r)\right)U(y + b, 1 - s) = U(y+b,1) \tag{8}$$

$$p(r)U\left(w_3^R\bar{l} + y, 1 - \bar{l} - s\right) + \left(1 - p(r)\right)U(y + b, 1 - s) = qU(y,1) + (1-q)U(y+b,1) \tag{9}$$

It can be established a relationship among the three and relating them to w_0^R. First, notice that when $b = 0$, both expressions (7) and (8) coincide with expression (3) and, as a consequence, $w_0^R = w_1^R = w_2^R$. Then, we can examine how w_1^R and w_2^R change when b varies. By using the implicit function theorem with (7) and (8), respectively, it is quite straightforward to calculate that:

$$\frac{\partial w_1^R}{\partial b} = -\frac{(1-p)U_C(y+b)}{p\bar{l}U_C\left(w_1^R\bar{l} + y\right)} < 0 \tag{10}$$

$$\frac{\partial w_2^R}{\partial b} = \frac{U_C(y+b)}{\bar{l}U_C\left(w_2^R\bar{l} + y\right)} > 0 \tag{11}$$

The sign of (10) is evident. The positive sign of expression (11) is due to the additivity of the utility function (Assumption A5), which implies that

$U_C(y+b,1-s)=U_C(y+b,1)$. Thus, it can be concluded that $w_2^R > w_0^R > w_1^R$ for $b>0$.[4] These relationships are shown in Figure 2.

[Figure 2]

To account for how w_3^R is related to the other three reservation wages, first note that equation (9) predicts that when $q=0$ then $w_3^R=w_2^R$, and when $q=1$ then $w_3^R=w_1^R$. Moreover, it is easy to compute how w_3^R evolves when q varies:

$$\frac{\partial w_3^R}{\partial q}=-\frac{U(y+b,1)-U(y,1)}{p\bar{l}U_C\left(w_3^R\bar{l}+y\right)}<0 \tag{12}$$

The negative sign of (12) is due to the decreasing marginal utility of income. In addition, it can also be established that there is a linear relationship between w_3^R and q (i.e., the slope is constant) as depicted in Figure 3, since $(\partial^2 w_3^R/\partial q^2)=0$. Finally, it is possible to compute a critical value for q (that we denote q^*) that equals w_3^R and w_0^R.[5]

[Figure 3]

The relevance of Figure 3 is that it reveals that the AUB encourages or discourages labour participation depending on the level of monitoring. Thus, for a given amount of b, if the level of monitoring exceeds q^*, the worker is incentivised to participate in the labour market, compared to the situation with no AUB since $w_3^R<w_0^R$. Otherwise, when $q<q^*$, the individual is discouraged, compared to a scenario with no AUB, since $w_3^R>w_0^R$. The economic rationale is based on a comparison between the known without uncertainty loss of leisure time linked to labour participation and the expected gain of receiving the AUB. Specifically, the likelihood of losing the AUB entitlement, if caught not looking for a job, determines such assessment. When $q>q^*$, the expected gain outweighs the loss and does not compensate otherwise.

[4] Besides, it is straightforward to prove that w_1^R is a convex function of b and w_2^R a concave function of b:

$$\frac{\partial^2 w_1^R}{\partial b^2}=-\frac{(1-p)U_{CC}(y+b)}{p\bar{l}U_C\left(w_1^R\bar{l}+y\right)}>0;\ \frac{\partial^2 w_2^R}{\partial b^2}=\frac{U_{CC}(y+b)}{\bar{l}U_C\left(w_2^R\bar{l}+y\right)}<0$$

[5] From the definitions in equations (3) and (9) and assumption A5, when $w_0^R=w_3^R$, then:

$$U(y,1)-(1-p)U(y,1-s)=qU(y,1)+(1-q)U(y+b,1)-(1-p)U(y+b,1-s)\Leftrightarrow p=q^*$$

Expression (13) shows this ambiguity formally:[6]

$$\frac{\partial w_3^R}{\partial b} = \frac{(p-q)U_C(y+b)}{p\bar{l}U_C\left(w_3^R\bar{l}+y\right)} \lessgtr 0 \qquad (13)$$

Therefore, the sign of (13) depends on the difference between the likelihood of finding a job and the likelihood of being caught without searching for a job when claiming for the AUB. It is also evident from (13) that, for relatively high values of q, the sign is negative (i.e., $(\partial w_3^R/\partial b) < 0$). Hence, the level of monitoring becomes key to account for the encouraging or discouraging effect that the AUB has on the labour supply. The higher the q, the greater the incentives for an individual to participate in the labour market.

Let us now analyse the influence of the AUB on the PR, at the aggregate level, through the first theoretical channel (i.e., changes in b holding constant p). We dub the participation rate for those eligible to receive the benefit as PR^E. Following the aggregation process described in Appendix 1, the effects of the AUB on the LFPR may be summarized by means of expression (14):

$$\left.\frac{\partial PR^{EE}(r)}{\partial r}\right|_{\bar{p}} = \underbrace{\frac{\partial PR}{\partial w_3^R}}_{(-)} \cdot \underbrace{\frac{\partial w_3^R}{\partial b}}_{(?)} \cdot \underbrace{\frac{\partial b}{\partial r}}_{(+)} \lessgtr 0 \qquad (14)$$

In (14), $\partial p/\partial b > 0$ by hypothesis and $\partial PR/\partial w_3^R < 0$ from the concept of reservation wage. However, as has been discussed, $\partial w_3^R/\partial b$ does not have a definite sign. It can be stated, though, that the higher the level of monitoring, the more likely the PR increases as a result of the AUB.

The second theoretical channel through which the AUB can yield effects on PR^{EE} is via changes in the probability of finding a job. At the individual level, from the definition of w_3^R in (9), the reservation wage varies as expression (15) shows:

$$\frac{\partial w_3^R}{\partial p} = -\frac{U\left(w_3^R\bar{l}+y, 1-\bar{l}-s\right) - U(y+b, 1-s)}{p\bar{l}U_C\left(w_3^R\bar{l}+y\right)} \lessgtr 0 \qquad (15)$$

[6] This ambiguity affects the concave or convex profile of w_3^R as a function of b too:

$$\frac{\partial^2 w_3^R}{\partial b^2} = \frac{(p-q)U_{CC}(y+b)}{p\bar{l}U_C\left(w_3^R\bar{l}+y\right)} \lessgtr 0$$

Unlike the case of non-eligible individuals shown in (4), expression (15) does not have an unambiguous sign. The utility index $U\left(w_3^R\bar{l}+y,1-\bar{l}-s\right)$ can be greater or less than $U(y+b,1-s)$, and, thus, the numerator may be positive or negative. This is so because $U(y+b,1-s)$ can be greater or less than the option of not participating $qU(y,1)+(1-q)U(y+b,1)$, depending on individual's income-leisure preferences. At the aggregate level we have:

$$\left.\frac{\partial PR^{EE}(r)}{\partial r}\right|_{\bar{b}} = \underbrace{\frac{\partial PR}{\partial w_3^R}}_{(-)} \cdot \underbrace{\frac{\partial w_3^R}{\partial p}}_{(?)} \cdot \underbrace{\frac{\partial p}{\partial r}}_{(+)} \lesseqgtr 0 \qquad (16)$$

Expression (16) confirms that this second theoretical channel (i.e., changes in p holding constant b) also generates a mixed set of incentives for eligible persons.

2.4. Effects of the AUB on eligible but not entitled persons

The last case is that of individuals who are eligible to receive the AUB (i.e., they work in the Andalusian agricultural sector) but are not entitled since they have not contributed the minimum number of days yet. In this case, the reservation wage is defined formally by (17):

$$p(r)U\left(w_4^R\bar{l}+y+b(r),1-\bar{l}-s\right)+(1-p(r))U(y,1-s)=U(y,1) \qquad (17)$$

In (17), we assume that when the individual finds a job, he/she earns the labour income (i.e., $w\bar{l}$) and also receives the AUB in the same period. In other words, we consider a time span that comprises the contribution period and an additional period to receive the benefit. The rest of the terms in (17) may be interpreted as before. From (17) and (7), it is easy to prove that $w_4^R < w_1^R$. The analysis of the effect of the AUB is quite straightforward from the previous discussion. In mathematical terms, expression (18) and (19) shows how the reservation wage varies when the AUB and the likelihood of finding a job change, respectively:[7]

$$\frac{\partial w_4^R}{\partial b} = -\frac{U_C(y+b)}{\bar{l}U_C\left(w_4^R\bar{l}+y\right)} < 0 \qquad (18)$$

[7] It can also be proved that w_4^R is a concave function of b:

$$\frac{\partial^2 w_4^R}{\partial b^2} = -\frac{U_{CC}(y+b)}{\bar{l}U_C\left(w_4^R\bar{l}+y\right)} > 0$$

$$\frac{\partial w_4^R}{\partial p} = -\frac{U(w_4^R\bar{l} + y + b, 1 - \bar{l} - s) - U(y, 1 - s)}{p\bar{l}U_C(w_4^R\bar{l} + y)} < 0 \qquad (19)$$

The unambiguous negative sign in both expressions highlights the strong incentive to participate in the labour market for this group. As both effects reinforce each other, at the aggregate level, the participation rate for those eligible but not entitled (PR^{ENE}) ought to increase when the law establishing the AUB is passed. Formally:

$$\frac{\partial PR^{ENE}(r)}{\partial r} = \underbrace{\frac{\partial PR}{\partial w_4^R}}_{(-)}\left(\underbrace{\frac{\partial w_4^R}{\partial b}}_{(-)} \cdot \underbrace{\frac{\partial b}{\partial r}}_{(+)} + \underbrace{\frac{\partial w_4^R}{\partial p}}_{(-)} \cdot \underbrace{\frac{\partial p}{\partial r}}_{(+)}\right) > 0 \qquad (20)$$

2.5. From theory to empirics

Adding up the participation rate of eligible and non-eligible persons, we obtain the total participation rate (PR). If we denote the percentage of non-eligible population by θ, the percentage of eligible and entitled population by π, and, consequently, the share of eligible and but not entitled population by $(1 - \theta - \pi)$, we can write the total PR as a linear combination of the three groups:

$$PR(r) = \theta \cdot PR^{NE}(r) + \pi \cdot PR^{EE}(r) + (1 - \theta - \pi) \cdot PR^{ENE}(r) \qquad (21)$$

From the definition given in (21) and the outcomes obtained in (5), (14), (16), and (20), it follows:

$$\frac{\partial PR(r)}{\partial r} = \underbrace{\theta \frac{\partial PR^{NE}(r)}{\partial r}}_{(+)} + \underbrace{\pi \frac{\partial PR^{E}(r)}{\partial r}}_{(?)} + \underbrace{(1 - \theta - \pi)\frac{\partial PR^{ENE}(r)}{\partial r}}_{(+)} \gtrless 0 \qquad (22)$$

In other words, the effect on the labour supply of the AUB for the entire population is not defined without ambiguity from a theoretical standpoint. The group of non-eligible persons is incentivised by the AUB law as the perspectives of finding a job after the search process improve. The group of eligible but not entitled persons is incentivised by the same theoretical mechanism too, and, in addition, they are also incentivised to participate since the financial reward for the participation option is greater. Nevertheless, the group of eligible and entitled persons can be encouraged or discouraged to participate, as argued above. It is clear that there are theoretical reasons to expect that the LFPR may be affected by the law approving the Agrarian Unemployment Benefit (AUB), either positively or negatively. The sign of such effect is an empirical matter.

To account for the effects of AUB on LFPR, first, we define the Activated Population to Beneficiaries Index (APBI) as the estimated number of persons entering the labour force as a consequence of the AUB divided by the number of AUB receivers (AUBR) in each moment of time. To compute the number of Activated Persons (AP), we need to calculate the counterfactual labour force participation rate ($LFPR^C$) in the case in which the law of the AUB had not been enacted. To do so, we make use of the Synthetic Control Method (SCM) approach, discussed later. Then we calculate de difference between the real labour force participation rate ($LFPR^R$) and $LFPR^C$ and multiply this result by the working-age population (WAP) in each moment of time t. Formally:

$$AP_t = (LFPR_t^R - LFPR_t^C) \cdot WAP_t \tag{23}$$

Thus, $APBI$ can be defined formally in the following way:

$$APBI_t = \frac{AP_t}{AUBR_t} \tag{24}$$

By examining how this index evolves after passing the law, it is possible to assess the effects of AUB on the LFPR. More precisely, we are interested in establishing whether the LFPR increases or decreases after AUB was approved, on the one hand, and, conditional on an increase in APBI, whether such an increase was more proportional or less proportional than the growth in the AUBR.

Let us write two formal hypotheses in order to better understand the implications of the enactment of the law approving the AUB.

> **Hypothesis 1**: *The enactment of the law approving the AUB caused an increase in the LFPR. In other words,* $APBI_t > 0\ \forall t = 1984\ to\ 2000$.

This hypothesis implies that AP is positive since AUBR is always positive by definition after the law enactment. Put differently, it indicates that the encouraging effects (i.e., the incentives to enter the labour force) exceed the discouraging effects (i.e., the incentives to quit the labour force) for the whole working-age population at the aggregate level.

> **Hypothesis 2:** *Conditional on APBI being positive, the enactment of the law approving the AUB caused an increase in AP more than proportional than the increase in AUBR (which is just the number of AUBR since before*

passing the law, there were no beneficiaries). In other words, $APBI_t > 1\ \forall t = 1984\ to\ 2000$.

This second hypothesis attempts to unveil whether there is a multiplier effect within the labour force. It is important to know whether the labour force growth is greater than or less than the rise in AUBR from an economic policy standpoint. If so, that would mean that these types of policies generate economic activity beyond the group of beneficiaries. On the contrary, if there is an increase in the labour force, but less than proportional than that of the AUBR, we should conclude that, even though the encouraging effects above mentioned outweigh the discouraging effects, these second ones are still playing a role and they should be monitored by the employment agencies.

3. The Synthetic Control Methodology (SCM)

3.1. Intuition

To assess the effects of passing the RD 323/1983 on the activity rate in Andalucía, we apply the Synthetic Control Methodology (SCM). The comparison unit in the SCM is selected as the weighted average of all potential comparison units that best resembles the characteristics of the case of interest during the preintervention period. This technique was originally proposed by Abadie and Gardeazabal (2003) as a means to analyze the effects of terrorism in the Basque Country on GDP per capita, and with Abadie et al. (2010) the generalized application of the methodology was established. Since this work, the method has been widely used to examine effects caused by a broad variety of specific events – see Craig (2015) for a review.

The SCM has been applied in numerous studies ranging from the evaluation of the economic impact of natural disasters (Cavallo et al., 2013) to the assessment of the effect of institutional interventions on a population's consumption and welfare (Abadie et al., 2010), among others. Within the framework of public policy evaluation, the SCM has been consolidated as one of the most powerful methodologies for conducting impact evaluations in the last decade.

The most important advantages associated with the SCM are the following. (1) A number of public policy interventions affect aggregate units. The management of and access to macro-level data are more common and simple than the treatment of micro-level data, and there are many series available at that level of aggregation. (2) Regressions applied to samples of countries have been frequently questioned. Such regressions involve carrying out comparisons of entities with potentially different characteristics. In applying the SCM methodology, we resort to data-driven procedures that reduce the discretion in the choice of comparison control units and that allow us to create appropriate comparison groups. (3) The SCM does not involve making strict hypotheses to make precise estimations as with other quantitative techniques such as those of the difference-in-differences approach.[8] (4) Finally, the standard results inform us of the individual contributions of each *donor* units that form the synthetic control group.

Among restrictions applied, it is important to point out the following. (1) Some units in the *donor pool* should present both higher and lower values in predictor variables in comparison to that affected by the intervention. Otherwise, it would be impossible to appropriately recreate the unit of treatment. (2) In the preintervention period, units of control should have predictor values comparable to those of the treated unit.[9] In addition, these variables should have an approximately linear effect on the result. (3) It has been recommended that using all preintervention outcomes together with covariates as predictors be avoided (Kaul et al., 2018). Otherwise, one would restrain the predictive power of the remaining covariates. (4) Finally, the statistical inference procedure is much less formal than those implemented by other quantitative methods and more traditional techniques.

3.2. Formalization

Initially, let us assume that there are $J+1$ regions where $j=1$ denotes the region treated (Andalucía, in this case) and $j=2,\ldots,J+1$ denote untreated or control region (the rest of the *Spanish Comunidades Autónomas*, with the exception of Extremadura). It is thus assumed that a single region is affected by the event considered and that J units are available to contribute to the synthetic control (*donor pool*).

Let us assume that Y_{it}^{N} represents the outcome (activity rate in the main results) that would be noticed for region i at time t without the passing of the RD 323/1983, for units $i=1,\ldots,J+1$, and time periods $t=1,\ldots,T$. We also suppose that T_0 is the number of pre-intervention periods, with $1 \leq T_0 < T$, and Y_{it}^{I}, the outcome that would

[8] See Abadie (2021) for a more detailed explanation.
[9] We proceed this way to avoid interpolation bias and overfitting (Abadie et al., 2015; Grier and Maynard, 2016).

be checked for unit i at time t if unit i is exposed to the event investigated in periods T_{0+1} to T.[10]

Let us consider as well that $\alpha_{it} = Y_{it}^{I} - Y_{it}^{N}$ stands for the effect of the RD 323/1983 for unit i at time t, and imagine that D_{it} is an indicator taking value one when unit i suffers the effects of its passing, and value zero otherwise. Then, the observed outcome for unit i at time t could be described as follows:

$$Y_{it} = Y_{it}^{N} + \alpha_{it} D_{it} \tag{25}$$

Bearing in mind that the only the first region is affected by the legislative norm analyzed, and only when $t > T_0$, we can state that:

$$D_{it} = \begin{cases} 1 & if\ i = 1 \quad and\ t > T_0 \\ 0 & otherwise \end{cases} \tag{26}$$

Ultimately, we intend to estimate α_{1t} for $t > T_0$. Thus, reordering terms in (1) we get:

$$\alpha_{1t} = Y_{1t}^{I} - Y_{1t}^{N} = Y_{1t} - Y_{1t}^{N} \tag{27}$$

For the region affected by the Law passed (treated unit), Y_{1t}^{N} cannot be observed in the post-treatment periods. Data are available for the actual path of the outcome (Y_{1t}^{I}), but it is unknown what would have happened with that trajectory if it had not suffered the effects of the event under study. Therefore, we look for an estimate of Y_{1t}^{N} that, following Abadie et al. (2010), is given by a linear factor model. This is necessary to quantify the effect of the event by calculating the difference specified in (27).

To find optimal weights, Abadie and Gardeazabal (2003) defined a $(K \times 1)$ vector X_1 of the preunemployment shock values of K predictors of the outcome variable and a $(K \times J)$ matrix X_0, which measures the values of the same variables for the *donor pool*. The vector of optimal weights referring to the control countries, W^*, is the one that minimizes the following problem:

$$\| X_1 - X_0 W \|_v = (X_1 - X_0 W)' V (X_1 - X_0 W) \tag{28}$$

where $W^* = (w_1^*, w_2^*, \ldots, w_{J+1}^*)'$ is a $(J \times 1)$ vector of non-negative weights that sums to one, and V is a symmetric, diagonal matrix of non-negative components that represents the relative importance of the selected predictors. Once we have obtained the matrix $W^*(V^*)$ formed by the estimated optimal weights that each region of the control group

[10] We presuppose that there is no effect of the passing of the Law on the outcome of interest before its occurrence, that is, $Y_{it}^{I} = Y_{it}^{N}$ when $t \leq T_0$.

receives for the design of the synthetic control unit, it is enough to apply these weights in (3) to obtain the estimate of the effect of the RD 323/1983:

$$\hat{\alpha}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \tag{29}$$

3.3. Inference

With the SCM methodology, neither confidence intervals nor statistical significance parameters are calculated, which are typical procedures in an inference analysis. Alternatively, the SCM offers complementary options also known as *falsification* tests. With “in-space” placebos, each region integrating the original *donor pool* is separately conceived as a treated entity and the SCM is applied as if all these regions, individually, were affected by the pass of the Law (Abadie et al., 2010; Abadie et al., 2015).

By applying this iterative mechanism, we obtain a distribution of estimated placebo treatment effects for all regions in which no event occurred. Considering that none of these control regions has been influenced by the Law studied, we should only observe great disparities between these *placebo* countries and their corresponding synthetic control randomly and in sporadic cases. A more accurate mechanism for identifying the significance of the results is based on the Root Mean Squared Prediction Error (RMSPE), which is the index typically used to assess the goodness of fit when applying the SCM. It measures for a given unit of analysis the fit – or lack thereof – between the actual outcome variable and its synthetic counterpart. In other words, it represents the distance or discrepancy between the path drawn by each variable. Formally, it is defined as follows:

$$RMSPE = \sqrt{\frac{1}{T_0} \sum_{t=1}^{T_0} \left(Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \right)^2} \tag{30}$$

Ultimately, we must calculate the ratio between the postintervention RMSPE (the average for 1984q1–2020q1) and preintervention RMSPE (the average for 1980q1–1984q1) and determine how many control regions present an effect as large as that observed in the treated one (Andalucía).

4. Data

We use quarterly regional-level data (1980q1–2000q1) from the Spanish Statistical Office (INE) for the 17 Spanish regions (*Comunidades Autónomas*). The region considered to be affected by the event analyzed is Andalucía. The rest stand as possible candidates to take part in the control group (*donor pool*). The successful use of the SCM requires an important assumption to be fulfilled: it is essential to dispense with all units suffering the effects of a similar event in some years of the preintervention period – in our case: 1980q1 to 1984q1. If these units were included, they could interfere with and condition the true effects of the intervention examined (Abadie et al., 2010). Taking this into account, Extremadura is excluded from the group of potential controls for being affected by the same Law as Andalucía.

Regarding the predictors included in the estimates, we use the following: males in active population (%), actives aged 25-54 years over total actives (%), agricultural employment over total employment (%), construction employment over total employment (%), long-term unemployment (1-2 years) (%), very long-term unemployment (> 2 years) (%), and the lagged outcome variable for several periods preceding the pass of the examined Law – activity rate (1981q2), activity rate (1982q2) and activity rate (1983q2).

With respect to the number of predictors used, it should be underscored that increasing their number does not always improve the fit, and similarly eliminating some of them does not necessarily worsen the fit (McClelland and Gault, 2017). Additionally, regarding the predictors considered, one of the most common practices in the application of this methodology involves the use of the lagged outcome variable (Abadie et al., 2010). By including several lags of the outcome variable, we measure the effect of other predictors. This strategy somehow mitigates the effects of not incorporating relevant predictors into the analysis. However, there is no consensus on what a suitable number of lags is. Some authors have drawn attention to the desirability of encompassing all outcome lags available as predictors. Furthermore, they believe that including other covariates has hardly any influence on the final estimates (Athey and Imbens, 2006). On the other hand, other scholars claim that only using the lags of the outcome variable is not the best solution (Kaul et al., 2016).

Without any additional predictor, the estimated model cannot be supported by economic theory and does not have any justification. Ferman et al. (2016) recommend working with different specifications, using several combinations of lags and generating all possible results. This latter option is the one we use in this investigation (see Table A.1 in Appendix 2). We determined which models provides a better fit – the ones that present the lowest RMSPE – when selecting a maximum of three lags of the outcome variable from the set of predictors.[11] The three best models are those whose RMSPE is highlighted in bold: specification [1], [3] and [8].

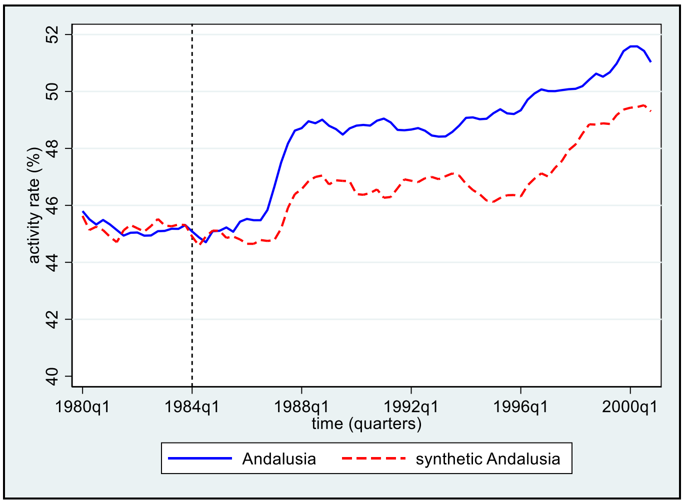
5. Results

We are interested in determining how the activity rate of Andalucía would have evolved in absence of the Law passed in 1984. For this purpose, we use a combination of different Spanish regions to construct a synthetic control unit that resembles as much as possible the actual evolution of the actual activity rate in Andalucía before 1984. The subsequent track of this counterfactual Andalucía, without effects of the "treatment", is then compared to the actual path.

5.1. Main results

Regarding what constitutes a good fit or how to appraise similarities, the most direct and immediate option is to resort to the *eyeball test* by comparing the evolution of the activity rate in the treatment region (Andalucía) to that of the control group.

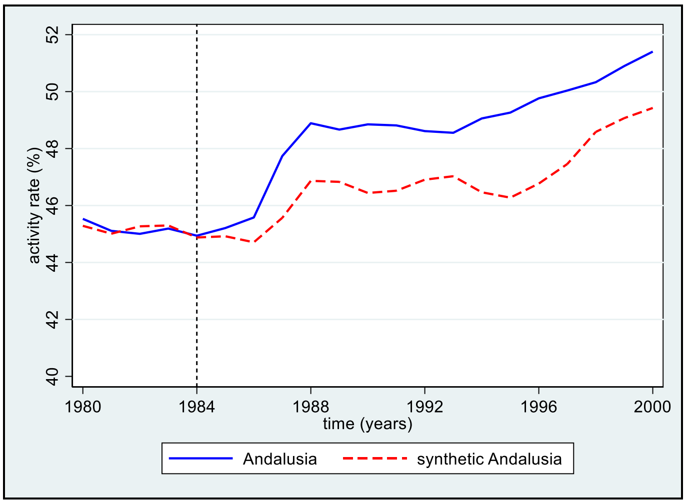
a) "Eyeball test" (quarterly data):



Source: Own elaboration.

[11] We rule out using more lags for the reasons stated above.

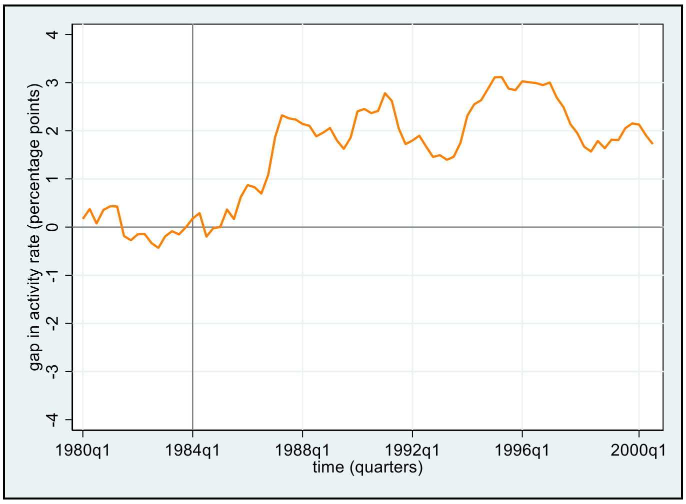
b) "Eyeball test" (yearly data):



Source: Own elaboration.

Our first result is that the evolution of actual Andalucía and its synthetic counterpart practically overlap in the three models analyzed[12]. This is the first requirement to be met if we want to rely on estimates of causal impact.

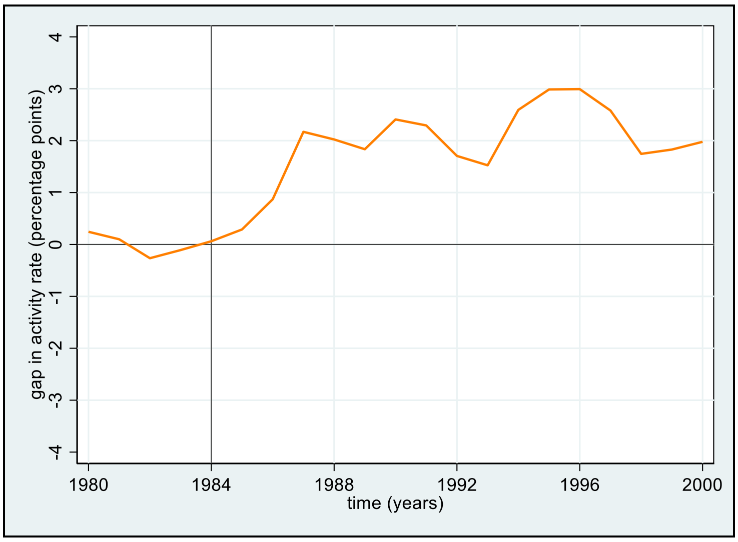
c) Impact / effects (quarterly data):



Source: Own elaboration.

[12] We only include the figure corresponding to specification [1], the model we follow henceforth for presenting the most significant results in the post-treatment periods. The other figures are available upon request.

d) Impact / effects (yearly data):



Source: Own elaboration.

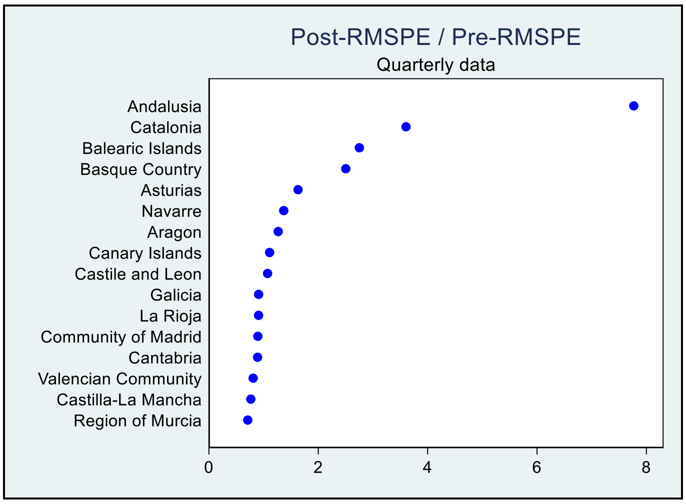
The gap between the actual rate and that of the synthetic unit reports and quantifies the impact in percentage points. On average (1984-2000), the impact is close to 2 percentage points using both quarterly data and annual data.

5.2. Inference

We are interested in measuring similarities between the actual trajectory of the activity rate and the path described by the same variable for the synthetic unit. The ratio between the post-event RMSPE and the pre-event RMSPE in the treated regions allows us to evaluate the significance of the results.

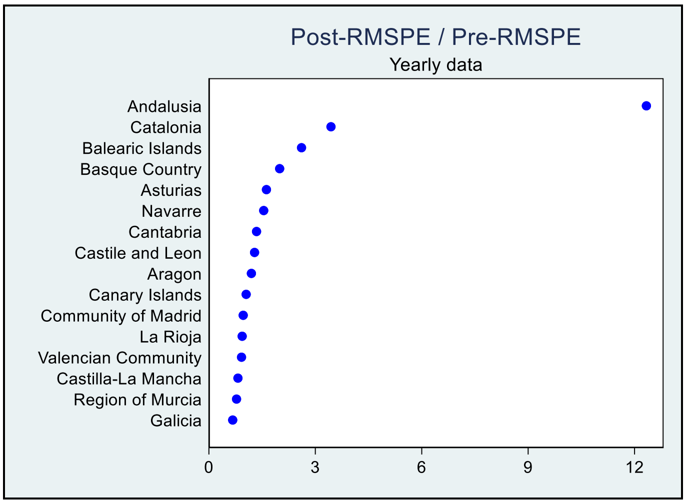
When considering Andalucía as the unit of treatment, it emerges in first position with a ratio around 8 (with quarterly data). If we manage annual data, the post-event RMSPE is roughly 12 times the RMSPE of the pre-event period. This information confirms that the good fit shown by the *eyeball test* is not at all a product of chance.

e) Quarterly data:



Source: Own elaboration.

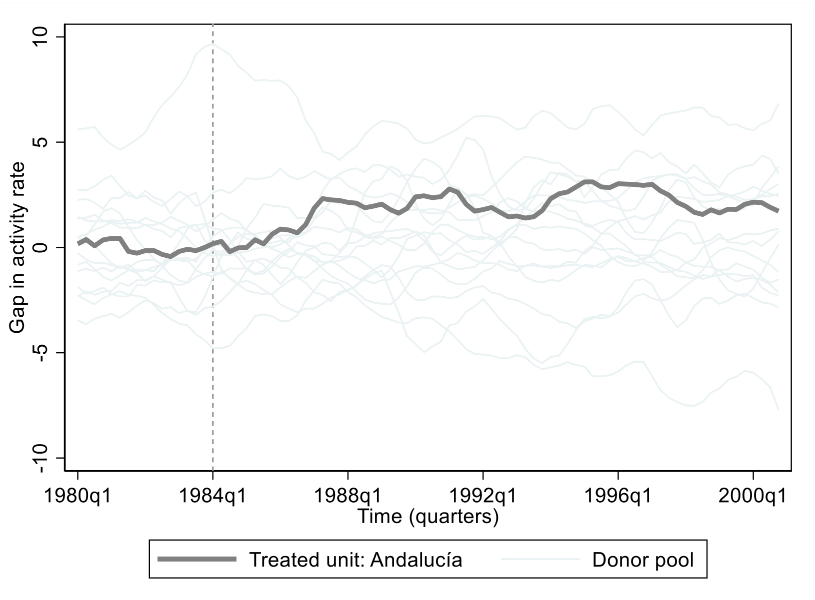
f) Yearly data:



Source: Own elaboration.

This quotient is the analytical result of one of the most well-known resources in the analysis of synthetic controls: the *placebo runs* – an iterative method showing the distribution of the estimated gaps for the regions in which no event occurred (see Figure below).

g) Placebo runs:



Source: Own elaboration.

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Appendix 1

Non-critical assumptions:

Assumption A1. *Labour is homogeneous. This supposition entails that the wage, denoted by w, is identical for all workers.*

Assumption A2. *Labour contracts last one period. To sign a new contract, an individual needs to spend a fixed amount of time in job-search activities, as specified in the next assumption.*

Assumption A3. *Before signing a contract, the worker has to devote s units of time to job-search. Here, s is considered to be a fixed and exogenous sum of time.*[13]

Assumption A4. *The size of the working week, which we denote by $\bar{l}$, is fixed and exogenously determined.*[14]

Assumption A5. *The utility function is additive. In other words, if we denote the consumption (or the total income because there is no saving) by C and the leisure time (i.e., total time minus hours of work) by H, this assumption establishes that $U(C,H) = \Lambda(C) + \Omega(H)$. As usual, marginal utilities are supposed to be positive and decreasing.*[15]

The aggregation process:

If workers have different preferences over consumption and leisure and different non-labour incomes, they will also have different reservation wages. This variety of reservation wages $w^R \in [0, +\infty)$ might be represented by a cumulative distribution function $\Phi(w|Z)$, with Z being the rest of the PR determinants. If those determinants do not change, the aggregate labour supply could be expressed in formal terms according to (A1):

$$L = N \cdot \Phi(w) \qquad (A1)$$

[13] Considering s as an endogenous variable is out the scope of the paper. That is the subject of the job-search theory. See Tatsiramos and van Ours (2014).

[14] As we are interested in the extensive margin of the labor supply, this assumption allows us to focus on the participation decision.

[15] This assumption is less restricting than it seems at first glance. Firstly, it is well known that this sort of utility function generates indifference curves that, typically, decrease and are convex to the origin. Secondly, within the ordinal utility theory, a logarithmic transformation of the very well-known Cobb–Douglas utility function is additive, representing an identical set of preferences.

where L stands for the labour force, and N stands for total working age population. Therefore, the PR is simply $\Phi(w)$, as expressed in equation (A2):

$$PR = \frac{L}{N} = \Phi(w) = \int_0^w \phi(v)dv \qquad (A2)$$

Inasmuch as $\Phi(w)$ is a cumulative distribution function, by definition, that proportion is increasing in its argument, $\Phi_w = \phi > 0$, i.e. the density function is positive. Nevertheless, in order to study the role of the AUB, it is necessary to analyse the influence of other determinants on PR. To incorporate this idea, let us call w_M^R the reservation wage for the median individual within the cumulative distribution. In this way, a stylized PR function can be described by means of expression (A3):

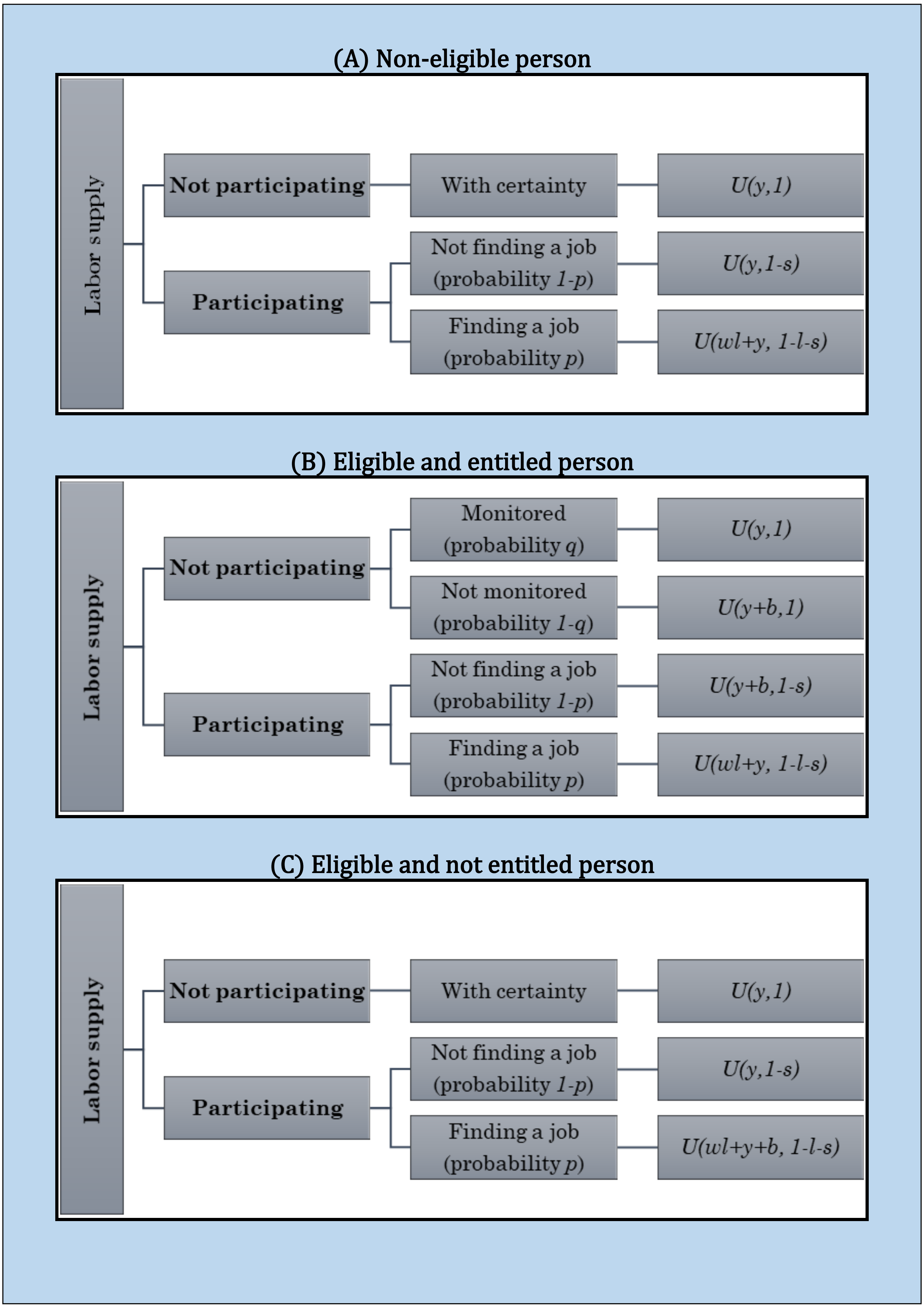
$$PR = \Phi(w, w_M^R) \qquad (A3)$$

As pointed out before, $(\partial PR/\partial w) > 0$, by definition. Furthermore, consistently with the concept of reservation wage, we have that $(\partial PR/\partial w_M^R) < 0$. Finally, it is worth bearing in mind that w_M^R is, in turn, a function of some additional arguments. Due to the objective of this paper, we emphasize the dependence of w_M^R on b and p. In addition, we must point out that both $b(r)$ and $p(r)$ are regarded as functions of the AUB. Thus, we may rewrite expression (A3) as follows:

$$PR(r) = \Phi(w, w_M^R[b(r), p(r)]) \qquad (A4)$$

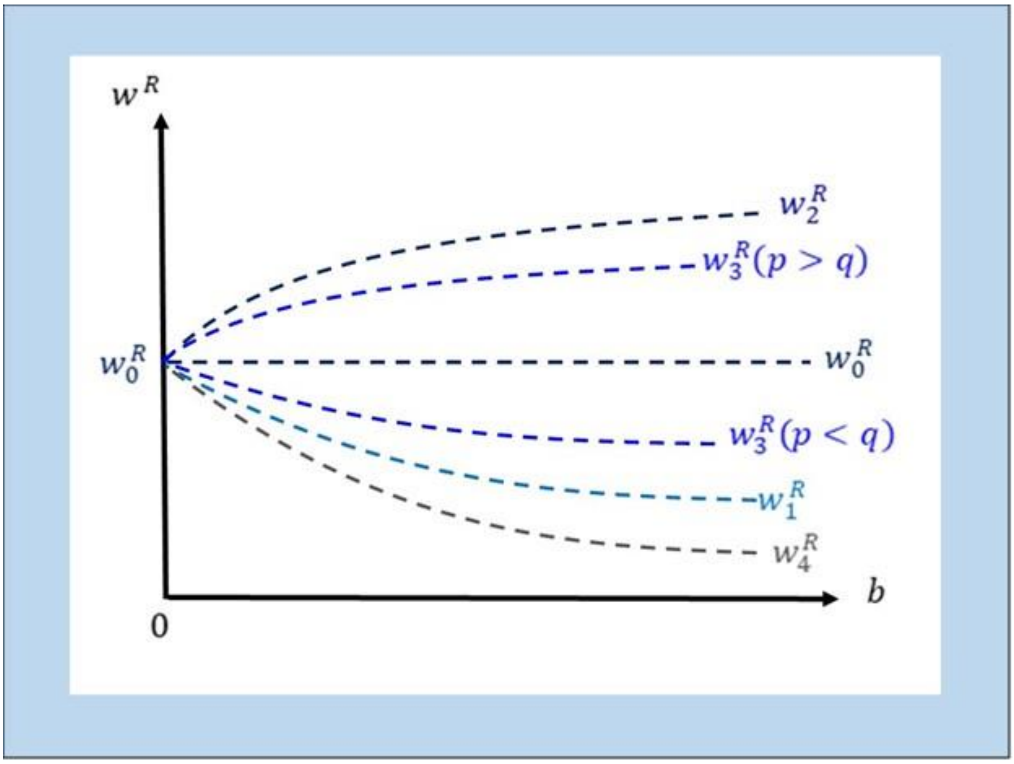
Equation (A4) reveals that PR depends on the AUB through a double channel. The first channel operates via the likelihood of finding a job, which affects not only those eligible to collect the AUB, but also the non-eligible population. Second, the channel working directly through the AUB, b, which modifies the behaviour of the eligible population.

Figure 1. Set of alternatives regarding labour participation



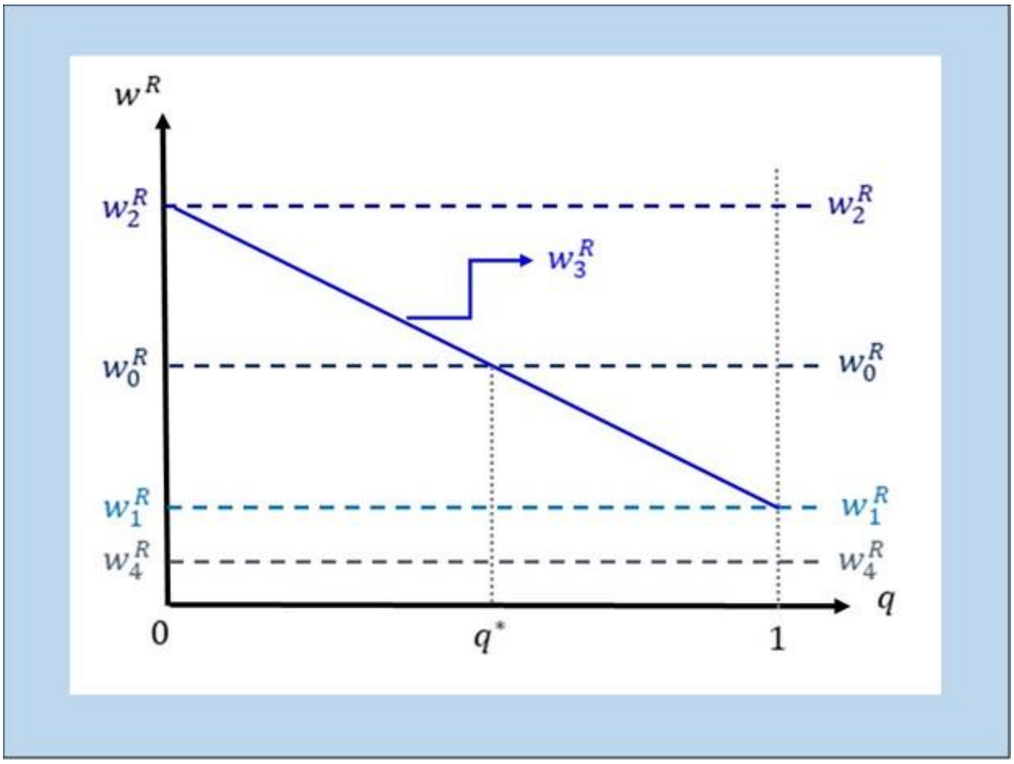
Source: Own elaboration.

Figure 2. Reservation wages as a function of b



Source: Own elaboration.

Figure 3. Reservation wages as a function of q



Source: Own elaboration.

Appendix 2

Table 1. Different specifications

Predictors	Specification							
	[S1]	[S2]	[S3]	[S4]	[S5]	[S6]	[S7]	[S8]
Males in active population (%)	✓	✓	✓	✓	✓	✓	✓	✓
Actives aged 25-54 years over total actives (%)	✓	✓	✓	✓	✓	✓	✓	✓
Agricultural employment over total employment (%)	✓	✓	✓	✓	✓	✓	✓	✓
Construction employment over total employment (%)	✓	✓	✓	✓	✓	✓	✓	✓
Long-term unemployment (1-2 years) (%)	✓	✓	✓	✓	✓	✓	✓	✓
Very long-term unemployment (> 2 years) (%)	✓	✓	✓	✓	✓	✓	✓	✓
Activity rate (1981q2)	–	✓	–	–	✓	✓	–	✓
Activity rate (1982q2)	–	–	✓	–	✓	–	✓	✓
Activity rate (1983q2)	–	–	–	✓	–	✓	✓	✓
RMPSE	**0.268**	0.811	**0.258**	0.816	0.307	0.334	0.509	**0.292**

Source: Own elaboration.

Table 2. Weights in the synthetic Andalucía (W*)

Spanish regions	Composition of the *donor pool* (synthetic Andalucía)							
	[S1]	[S2]	[S3]	[S4]	[S5]	[S6]	[S7]	[S8]
Aragon	0	0	0	0	0	0	0	0
Asturias	0	0	0	0	0	0	0	0
Balearic Islands	0	0	0	0	0	0	0	0
Basque Country	0	0	0	0	0	0	0	0
Canary Islands	0	0	0	0	0	0	0	0
Cantabria	0	0	**0.019**	**0.010**	**0.050**	**0.060**	**0.107**	**0.044**
Castile and Leon	0	0	0	0	0	0	0	0
Castilla-La Mancha	**1**	**0.706**	**0.981**	**0.692**	**0.950**	**0.940**	**0.893**	**0.956**
Catalonia	0	0	0	0	0	0	0	0
Community of Madrid	0	**0.019**	0	0	0	0	0	0
Extremadura*	—	—	—	—	—	—	—	—
Galicia	0	0	0	0	0	0	0	0
La Rioja	0	0	0	0	0	0	0	0
Navarre	0	0	0	0	0	0	0	0
Region of Murcia	0	**0.275**	0	**0.298**	0	0	0	0
Valencian Community	0	0	0	0	0	0	0	0
RMSPE	**0.268**	0.811	**0.258**	0.816	0.307	0.334	0.509	**0.292**

Notes: (1) (*) Conflicting region excluded. (2) The autonomous cities of Ceuta and Melilla have not been included in the analysis.
Source: Own elaboration.