Is there an added worker effect? – European labor supply during the crisis

Aleksandra Riedl,
Florian Schoiswohl[1]

This paper analyzes the responsiveness of an individual's labor supply to the job loss of his or her partner – the so-called "added worker effect (AWE)." While the bulk of empirical studies have utilized discrete choice models to identify its existence, we provide a macroeconomic indicator of the AWE in order to assess its economic significance for the labor force participation rate (LFPR). Our empirical analysis focuses on Europe in the period from 2002 to 2012, revealing that the AWE is negatively related to the business cycle and was particularly pronounced during the global financial crisis. While the LFPR increased by roughly 1 percentage point in Europe from 2009 to 2012, half of the effect is attributable to added workers. As our indicator is based on a rich micro dataset (European Labor Force Survey) we are also able to consistently present individual country results for nearly all EU Member States. Our analysis shows high increases in added workers in euro area countries that were strongly affected by financial market stress and in EU countries that experienced the bursting of housing bubbles. By contrast, we do not find an AWE in most Central and Eastern European countries.

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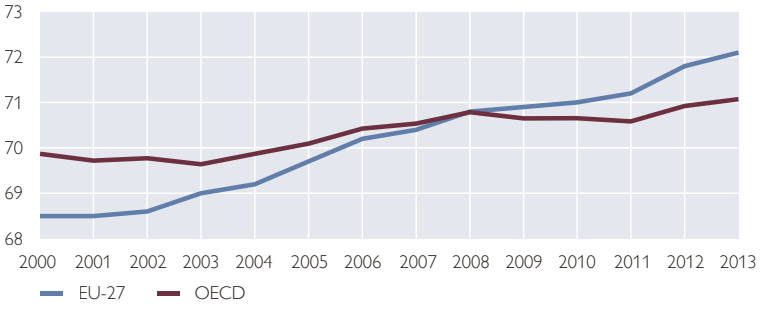
The global financial and economic crisis that started in 2007–08 triggered a large deterioration in labor markets across Europe. Since then, the unemployment rate in the EU-28 has increased by roughly 4 percentage points, reaching a level of 10.8% in 2013. At the same time, and unlike the OECD average, EU labor force participation[2] kept increasing (see chart 1). In a recent report, the European Commission (European Commission, 2013) claims that apart from a higher participation of older people the presence of a so-called "added worker effect" (AWE) has contributed to the overall rise in labor supply. This concept refers to an increase in the labor supply of an individual if his or her partner becomes unemployed. Such an effect would indeed raise the overall participation rate and could therefore explain why labor supply in Europe did not fall during the crisis years. However, empirical results on the presence of an AWE in Europe are scarce and its impact on overall labor force participation has not been evaluated so far. Against this background, the present paper analyzes the responsiveness of an individual's labor supply to the job loss of his or her partner in European countries and tries to assess the magnitude of this effect during the crisis years. This allows evaluating whether the AWE has significantly contributed to

Chart 1

Labor force participation rate

% of the working-age population (aged 15 to 64)



Source: Eurostat, OECD.

[1] *Oesterreichische Nationalbank, Foreign Research Division, aleksandra.riedl@oenb.at (corresponding author) and Vienna University of Economics and Business, florian.schoiswohl@wu.ac.at. The authors would like to thank Peter Backé, Julia Wörz and two anonymous referees for helpful comments and valuable suggestions.*

[2] *The labor force participation rate measures the proportion of a country's working-age population that engages actively in the labor market, either by working or looking for work. Individuals that are without employment, have not been actively searching for a job in the last four weeks or are not available for work within the next two weeks are classified as inactive.*

the upward trend of the labor force participation rate (LFPR) observed in recent years.

The bulk of literature dealing with the identification of an AWE in Europe focuses on individual countries and provides rather inconclusive results (e.g. McGinnity, 2002, and Prieto-Rodriguez and Rodriguez-Gutierrez, 2010).[3] One notable exception is Bredtmann et al. (2014), who analyze the existence of the AWE based on the EU-SILC dataset comprising households in 28 European countries for the years 2004 to 2011.[4] By employing a discrete choice model, they reveal that women whose husbands become unemployed have a higher probability of entering the labor market and becoming full-time employed than women whose husbands remain employed. While this study certainly fills an important gap in the empirical literature on the AWE in Europe, it leaves open three interesting questions which are usually hard to address within a discrete choice framework. First, from the identified AWE one cannot infer the number of persons who are affected by this phenomenon. However, in order to evaluate the economic significance of the observed result it would be necessary to know by how much the participation rate has increased in response to the AWE, i.e. the share of men or women in the total working age-population that became active in the labor market after their partners had lost their jobs. Second, as labor markets across Europe were affected by the crisis in quite different ways, it is reasonable to assume that the magnitude of the AWE varies strongly across countries. This calls for an empirical approach that is able to provide comparable cross-country results. Third, according to theory, the AWE is a counter-cyclical phenomenon. This suggests that the amount of persons switching into the labor force as a response to the job loss of their partners varies largely over time. Hence, one needs to identify the effect on a yearly basis.

While so far most of the empirical studies have utilized discrete choice models to identify the existence of an AWE and therefore do not offer insights into the questions raised above, the European Commission (2011) has made an attempt to assess the macroeconomic impact of the AWE on labor force participation in Europe. More specifically, based on macro data the report reveals that an increase in male unemployment has been accompanied by a 0.2 percentage point increase in the labor force participation of married women with children.[5] However, the approach taken by the European Commission comes with one important drawback. The conclusions are derived under the assumption that the observed correlation is attributable to a substitution effect taking place within the same household and therefore do not necessarily reflect the presence of an AWE. More specifically, one has to assume that those women who have increased their labor supply share the same household with the men who became unemployed. Hence, regardless of

[3] *Empirical studies of the added worker hypothesis mostly focus on the U.S. labor market and find only small magnitudes of this effect (Mincer, 1962; Heckman and MaCurdy, 1980; Lundberg, 1985; Stevens, 1997; Cullen and Gruber, 2000; McGinnity, 2002; Bentolila and Ichino, 2008).*

[4] *Prieto-Rodriguez and Rodriguez-Gutierrez (2003) also analyze the AWE on a cross-country basis. However, their sample is limited to a small set of European countries and spans the period 1994–1996. In line with previous work they find only a negligible AWE.*

[5] *Hence, the impact of the AWE on the overall participation rate would be rather negligible, especially if one bears in mind that the share of married women with children in the overall working-age population is small (21.5% in Germany in 2012).*

whether one wants to derive conclusions on a micro- or macroeconomic level, there is no choice but to consider the household level when analyzing the AWE.

Taking these factors into consideration, we derive a macroeconomic measure of the AWE for each EU Member State on a yearly basis (2002–2012), which we obtain by using micro data at the household level from the European Labor Force Survey (EU-LFS). Hence, we are able to capture the household perspective on the one hand, while assessing the macroeconomic importance of the AWE on the other hand. Applying the idea of synthetic cohorts, we simply count the number of couple households in each year in which one partner becomes active in the labor market after the other one has become unemployed. As we are not able to identify the same household at two different points in time (no panel data dimension), we provide an intuitive measure for the AWE by looking into the changes in the composition of couple households over time. Finally, we propose a rough approximation strategy to estimate the total number of added workers. As the EU-LFS provides the basis for official and harmonized European labor market figures, we can directly relate our measure to the official statistics of labor force participation. Finally, as our approach allows us to control for several individual and household characteristics, we consider not only (married) women as potential added workers, but also men who join the labor force due to their partner's job loss.

1 The added worker theory – macro implications derived from micro-based models

In order to be able to better classify the cross-country results of the AWE in Europe over the period 2002–2012, we derive several macroeconomic hypotheses. They are based on theoretical contributions to the literature on the AWE. Before we will elaborate on these hypotheses in detail, we want to briefly summarize them: the AWE is expected to (1) be negatively related to the business cycle, (2) have been particularly pronounced during the global financial crisis, notably in countries where labor markets were affected by the bursting of housing bubbles, and (3) vary strongly in magnitude across European countries due to e.g. heterogeneous welfare regimes and institutions.

Theoretical considerations of an AWE go back to the early work of Woytinsky (1942), according to whom married women increase their labor supply as a response to their husbands' job loss.[6] Since then several theoretical explanations have been proposed to model the labor supply decision of women within a household context. In the life cycle utility model, household members make their labor supply decisions as an integrated unit. Within such a setting, only permanent and unexpected shocks to the expected income stream (lifetime income) will induce inactive married women to transit back into the labor force (Becker and Ghez, 1975; Heckman and MaCurdy, 1980). Based on an empirically tractable life cycle model with perfect foresight and perfect capital markets, Heckman and MaCurdy (1980) present evidence that is consistent with the permanent income hypothesis. Using micro panel data for the U.S.A. (1968–1975), they show that transitory income shocks do not lead to a response in women's labor supply decisions, as lifetime income (wealth) does not change much. By contrast, permanent income shocks, e.g.

[6] *Note that the added worker theory is also applicable to households with gender role allocations that are not traditional, e.g. to labor supply reactions of men in response to a job loss of their female partners.*

due to a married man's job loss, reduce women's value of leisure[7] and hence increase their labor supply. More recently however, life cycle models of female labor supply have come under criticism as several assumptions they are based on are regarded as unreasonable and responsible for results showing a very small added-worker effect or none at all (Starr, 2014; Martinoty, 2014).

Firstly, the conclusions of Heckman and MaCurdy (1980) rest on the assumptions of perfect foresight and certainty regarding the evolution of future income. This seems quite unrealistic, as unemployment duration and wage prospects in general are mostly unknown to labor market participants. If household members expect that the unemployment spell of the male breadwinner is a signal of worse re-employment and wage prospects in the future, also a transitory income shock due to his job loss might induce his partner to (re-)enter the labor market. In effect, various studies have shown that the income effect of unemployment is quite persistent and increases with the number of job losses (Hall, 1995; Stevens, 1997). Hence, income shocks are likely to induce women to increase their labor supply, even if they consider the shock to be transitory.

Secondly, life-time labor supply models often assume perfect capital markets without any liquidity constraints to households. According to these models, a transitory shock to family income will be completely compensated by borrowing or drawing on household savings. Put differently, the household's ability to smooth the family income on a level which will not cause the household members to change their preferred consumption levels during an unemployment spell of the household's head will not alter the labor supply decision of the partner. If access to additional financial support or government social benefits (e.g. unemployment benefits) offset large parts of the income loss, the partner's labor supply decision will probably remain unaffected by the other partner's unemployment. Bentolila and Ichino (2008) and Cullen and Gruber (2000) focus on the generosity of the welfare system in general and on the unemployment benefit system in particular and conclude that both are responsible for the outcome of a small AWE.

Given the above theoretical considerations, what results can we expect from a cross-country analysis of the AWE in Europe over the period 2002–2012? First, irrespective of whether women react to transitory or permanent income shocks by supplying additional labor units, we would expect to observe a negative co-movement between the business cycle and the AWE.[8] In times of economic downturns, which are usually accompanied by rising unemployment rates, it is likely that the fraction of women that enter the labor market to compensate for the income loss increases. Hence, we expect the AWE to be particularly pronounced during the global financial crisis, as we can presume that many European households were confronted with sudden job losses that significantly affected their household incomes.

Second, although the economic downturn in 2009 was very pronounced in almost all European countries, the impact of the global financial crisis on individual GDP growth rates and labor markets was quite different from country to country.

[7] *This strand of the literature differentiates only between leisure time and paid work. We want to stress that the term leisure subsumes unpaid work, like childcare and housework.*

[8] *If women react to permanent income shocks only, the AWE is likely to be smaller. Either way, our empirical framework is not suited to evaluate the validity of these contrasting assumptions.*

Therefore it is very likely that the magnitude of a potential AWE also varies across countries. The observed differences in labor markets are partly attributable to developments in the real estate sector. Due to the bursting of housing bubbles in some countries, job losses were often concentrated in particular sectors, such as construction and housing service, while employment in market and nonmarket service sectors remained almost stable in all economies.[9] Hence, service sector employment might have provided additional earning possibilities especially for women if their partners lost their jobs. Therefore, it is presumable that the AWE was higher in countries that experienced large downturns in the construction sector.

Third, it is not only due to cyclical reasons that we would expect to see differences across European countries with respect to the magnitude of the AWE. Under the assumption of imperfect capital markets, the AWE is likely to be higher in countries where compensation payments are lower. Hence, the heterogeneity of welfare regimes across Europe strongly suggests a country-wise analysis of the AWE. Moreover, in case of imperfect foresight regarding future income the degree of labor market turnover in an economy might be a relevant macroeconomic determinant of women's decision to enter the labor market. In particular, in countries with very dynamic labor markets (i.e. with high (un-)employment flows) uncertainty concerning the partner's unemployment spell might be lower and therefore could reduce a woman's need to enter the labor market for precautionary reasons.

2 Empirical approach

In order to estimate the economic significance of the AWE we have to provide a measure that can be directly related to official population figures, such as the participation rate. Moreover, in order to assess whether the economic crisis has triggered a significant AWE we need to observe the chosen measure over time. Finally, as we expect the AWE to be quite heterogeneous in its magnitude across Europe, we need to set up a framework that allows a country-wise analysis. For these reasons we need to use a dataset which provides the necessary richness in terms of sample size and representativeness. To discuss the respective methodological issues we have divided this section into three parts: (1) the data, (2) a measure for the AWE, and (3) the estimation of the total number of workers that entered an economy's active labor market.

2.1 Data

We base our analysis on the micro data of the European Labor Force Survey (EU-LFS) provided by Eurostat, as it is the only available dataset that meets the requirements mentioned above. The dataset contains quarterly survey data from all EU Member States for a rich set of core variables that are related to individual and household characteristics and labor market outcomes. As the name already suggests, the survey was designed for the purpose of constructing labor market statistics and therefore forms the basis for all important and harmonized labor market

[9] *According to the European Central Bank (2014, pp. 52), "stressed" economies such as Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia have experienced a much larger drop in construction employment than other economies.*

figures provided by the national statistical offices in Europe. It uses a quarterly address-based household sample and is designed as a repeated cross-section survey representative of several individual and household characteristics. As a result, the dataset is consistent with the population estimate of the participation and the unemployment rate, which is crucial for our analysis. The dataset includes cross-section population weights which allow us to obtain population figures at both the household and the individual level. This is a convenient feature as our analysis includes both dimensions. For the calculation of the added worker rate, we concentrate our analysis on couple households[10] which comprise two adults (aged 15 to 64, with and without children) living together in one residence. After a few data adjustments[11] we are left with an average of roughly 15,000 observations of couple households per year and per country. The dataset covers a group of 25 EU countries (EU-25), i.e. the EU-28 without Malta, Ireland and Sweden. The observation period ranges from 2002 to 2012.

Unfortunately, the EU-LFS exhibits one important drawback as the micro data provided by Eurostat do not include a panel dimension. It is therefore not possible to follow the same household over time. As a result, the identification of the AWE relies on the representativeness of the repeated cross-sections. Fortunately, this condition is met, as the EU-LFS was designed for this purpose. There is one dataset – the EU-SILC panel – that has similar features and includes a panel dimension, which at first sight might seem to be the best alternative data source for our purpose. This, however, is not the case for several reasons, which we want to outline briefly.

The EU-SILC panel comprises a much smaller sample in all European countries compared to the EU-LFS and therefore does not allow us to perform an annual and/or country-wise analysis. In the period 2007 to 2012, the average sample size of "potential added workers" in the whole of Europe (30 countries) in each year amounts to 81 observations in the EU-SILC panel. Hence, we are left with an average of 2.7 observations for each country. In addition, there are often no observations for small countries. Even if there were observations for all country-year pairs in each year, such a low number of observations would critically reduce the precision of population estimates drawn from sample statistics, irrespective of using weights. The "low" number of observations is related to the fact that the EU-SILC is not a survey specifically designed for labor market analysis on a macroeconomic level.[12] It is designed to be the reference source for comparative statistics on income distribution and social inclusion in the EU. Hence, the macroeconomic

[10] *Fortunately, Eurostat differentiates between "couple households" and "other households," which can consist of two adults that are not seen as cohabiting partners.*

[11] *We had to exclude some observations upfront to obtain a consistent data sample. A detailed documentation (including Stata code) is available from the authors upon request.*

[12] *For Austria, for example, the EU-SILC dataset consists of roughly 4,500 observations (households) yearly, while the LFS draws on 88,000 observations (households).*

significance of the added worker phenomenon cannot be assessed from the EU-SILC dataset as it was not constructed for this purpose.[13]

2.2 A measure for the added worker effect

Typically, studies analyzing the AWE utilize panel data within a discrete choice framework (Mincer, 1962; Heckman and MaCurdy, 1980; Lundberg, 1985; Stevens, 1997; Cullen and Gruber, 2000; McGinnity, 2002; Bentolila and Ichino, 2008). This kind of approach is potentially very well suited for identifying a causal relationship between women's labor supply responses and the job loss of their partners. Theoretically, this framework would also allow the researcher to obtain population estimates of the AWE to assess the economic relevance of this phenomenon. However, such an empirical strategy is not yet feasible. First, as mentioned before, the EU-SILC dataset – the only dataset with a panel dimension – is not suited for providing reliable estimates of the number of added workers. Apart from that, using microeconometric methods such as discrete choice models to obtain estimates of macro variables would not be free from strong assumptions as far as the aggregation method is concerned. Although we are convinced that a well-chosen identification strategy to reveal a causal relationship has to involve some sort of panel data, we have to choose an alternative avenue to proceed in order to answer our research questions. As we aim to quantify a potential AWE in terms of its economic impact on the participation rate in each individual country of our sample, we propose a simple and quite intuitive macroeconomic measure at the aggregate level which is very much comparable to the measurement concept of the unemployment rate.

In each year t, the two members in a couple household can have labor market states i and j, which can either be employed (E), unemployed (U), or inactive (I, i.e. inactive, or outside the labor force).[14] Together, the states E and U can be subsumed under the state A (i.e. active, or within the labor force). Within the total number of couple households H_t, different compositions of couple households can be identified and written as fractions of all couples. We define $H_{UA|t}$ as the total number of couple households in which one partner is unemployed and the other is active.[15] Similarly, $H_{AI|t}$ is the number of couples with one active and one inactive partner. The remaining couples are those who are both either employed or inactive ($H_{EE|t}$ and $H_{II|t}$). For the analysis we assume, without loss of generality, that H_t remains constant and is normalized to unity. On the basis of these definitions, we can specify our proposed measure to be the added worker rate R_t, which takes the form:

[13] *Apart from the above mentioned points there are further reasons why the EU-SILC dataset is not appropriate for our analysis: (1) While the EU-LFS is the basis for official labor market statistics, the EU-SILC panel has not fully implemented official labor market definitions (e.g. unemployment), (2) self-defined labor market states in the EU-SILC may induce country differences due to different reporting behavior, (3) labor market transitions are observed only yearly in EU-SILC, which might induce a potential underreporting bias ("time-aggregation bias"), (4) circumventing the aforementioned problem by considering the available monthly labor market variables in the EU-SILC might hide different seasonal transition patterns and is therefore also not suitable for our purpose.*

[14] *Compulsory military service is reported as a separate labor market state. In line with the ILO approach, this state is counted as being in the labor force.*

[15] *In this formal definition, the order of labor market states within the household does not matter. However, we also calculated our results later in a gender-specific format, meaning that the unemployed member in $H_{UA|t}$ is the man, and the inactive member in $H_{AI|t}$ is the woman.*

$$R_t = \frac{H_{UA|t}}{\mathrm{H}_{UA|t} + \mathrm{H}_{AI|t}} = \frac{H_{UA|t}}{\Omega_t} \tag{1}$$

We would find an AWE if a couple household switches from composition *AI* to composition *UA*, meaning that one member transits from an active state to unemployment, while the other member transits from inactivity to activity. In such a case, nothing changes in the denominator, but an additional couple household is counted in the numerator. This interpretation on the household level is similar to the unemployment rate on the individual level, which signals changes between employment and unemployment of an individual over time. Just as the unemployment rate will increase if people lose their jobs (thus transiting from *E* to *U*), we can find evidence for an AWE if the ratio R_t increases. Analogously to the interpretation of the unemployment rate, we can think of these changes in composition within couple households as aggregate evidence for an AWE, irrespective of whether the observed change in composition is really the result of the *same* households undergoing this change (i.e. if we observe the same household in $t-1$ and t). As the annual samples of households within the EU-LFS are random samples with respect to the population household distribution, we can relate these sample changes to changes in the population using the cross-section weights provided in the dataset for household purposes.[16]

Due to the fact that we compare stocks of two consecutive years, we are not able to assume that we identify a *gross* added worker flow between $t-1$ and t. Thus, our estimates for the number of added workers (outlined in the next subsection) have to be read as *net* added worker flows, net of couples flowing in the opposite direction. As a result, we may also report negative estimates for the number of added workers, meaning that fewer couples change from *AI* to *UA* than the other way round.

2.3 Estimation of the total number of added workers

In the previous subsection we proposed a measure to identify the AWE for each individual country. Yet, we still have to assess how many persons are affected by the AWE, i.e. we need to estimate the number of persons that became added workers from one year to the other.

In principle, changes in the couple household distribution can easily be mapped into changes in the number of people participating in the labor market. More specifically, the change in $H_{UA|t}$ from one year to the other would give us an estimate of the number of added workers. Assume, for example, an increase in R_t. This can be interpreted as an increase in $H_{UA|t}$ relative to $H_{AI|t}$ and is therefore related to one additional active person in the labor force per additional $H_{UA|t}$ household. Thus, the change $\Delta H_{UA|t} = H_{UA|t} - H_{UA|t-1}$ is, in principle, an estimate of the number of added workers.

However, this is only true if two issues can be resolved in an appropriate manner: (1) By mapping households into heads, we have to assume that all $\Delta H_{UA|t}$ house-

[16] *Eurostat provides only individual weights, but pursues household analyses with the weights of the reference person.*

holds were in the group $H_{AI|t-1}$ in the year before;[17] and (2) $\Delta H_{UA|t}$ is – as already mentioned above – a net change of *UA* households, as households can flow between the states *UA* and *AI* in both directions. Hence, we only observe the net effect of both flows. Concerning the second issue, this paper leaves the reader without a solution but argues that the presented estimates of the AWE are lower bounds anyhow.

As far as the first issue is concerned we provide the following solution: In general, $\Delta H_{UA|t}$ can only be an estimate of the number of added workers if Ω_t remains constant. Only in this case we can be sure that a change in $H_{UA|t}$ is attributable to a change in $H_{AI|t}$.[18] Unfortunately, this assumption cannot be made as we observe a varying Ω_t over time ($\Delta\Omega_t \neq 0$), i.e. there are net flows between households in Ω_t and households that are not included in Ω_t, namely $H_{EE|t}$ and $H_{II|t}$. Suppose there is an increase in Ω_t ($\Delta\Omega_t > 0$). Hence, some $H_{EE|t-1}$ and $H_{II|t-1}$ households became either $H_{UA|t}$ or $H_{AI|t}$ households. As we are not able to trace individual households over time (no panel dimension), we are not able to allocate $\Delta\Omega_t$ to the respective household group without further assumptions. A simple allocation rule would be to assign $\Delta\Omega_t$ either completely to $H_{UA|t}$ or completely to $H_{AI|t}$. We do not consider these extreme cases as they represent very unrealistic scenarios. Nevertheless, we will deal with this issue in the robustness section. Instead, we propose a proportional allocation rule, which splits $\Delta\Omega_t$ in a $H_{UA|t}$ and a $H_{AI|t}$ part according to the added worker rate in year $t-1$ (i.e. R_{t-1}). Hence, we assume that household flows into Ω_t (from outside of Ω_t) spread according to the relative size of the two household groups ($H_{UA|t-1}$ and $H_{AI|t-1}$) in the previous year. As a result, we propose the following *corrected* estimate of the number of added workers $\Delta\tilde{H}_{UA|t}$

$$\Delta\tilde{H}_{UA|t} = \left(R_t - R_{t-1}\right)\Omega_t = \underbrace{\left(H_{UA|t} - H_{UA|t-1}\right)}_{\Delta H_{UA|t}} - R_{t-1}\Delta\Omega_t \tag{2}$$

$$\tilde{H}_{UA|t-1} = R_{t-1}\Omega_t \tag{3}$$

Expression (2) has an intuitive meaning, as $R_t\Omega_t$ is the number of couple households with an unemployed and an active member ($H_{UA|t}$), whereas $R_{t-1}\Omega_t$ is the number for the respective households in the previous period by holding Ω_t constant (expression (3)). Hence, the difference $\Delta\tilde{H}_{UA|t}$ gives us the additional number of couple households in year t with one unemployed and one active member without chang-

[17] *An equivalent to this assumption can be thought of in terms of the unemployment rate, with a change in the rate being related to a change in employment and unemployment. However, this is only true if one can assume that the net effect of entering or exiting the labor force is negligible.*

[18] *There might be one special situation where Ω_t stays constant but a change in $H_{AI|t}$ does not translate into a change in $H_{UA|t}$. This situation refers to specific shifts on the labor market that might occur most plausibly in an environment of decreasing labor force participation (such as in the U.S.A.). Consider the case where (1) an EE household changes into an UA household, (2) an UA household becomes an AI household and (3) an AI household becomes an II household. In such a case we would observe no AWE (R_t stays constant, $\Delta\tilde{H}_{UA|t} = 0$) although there is one added worker less (because of (2)). Hence, we would overestimate the AWE. Note that at the same time, we would underestimate the AWE when the presented transitions occur in the opposite direction. Although this constellation is logically possible, we do not think that this issue is empirically relevant in our context. If we assume – although it seems very unlikely – that every annual increase in II households since 2009 (in periods in which EE households decrease) has been associated with the above scenario we would overestimate the number of added workers in the EU-25 by less than 10%. Although this issue is empirically less relevant in our setting, it is a very important point that has to be considered when applying our calculation method. Therefore, we want to thank an anonymous referee for making us aware of this issue.*

ing Ω. As we only analyze couple households, one additional couple household directly relates to one additional person in the labor force.

After having estimated the total number of added workers, we are able to obtain an LFPR under the assumption that no AWE has taken place. For this purpose, we correct the observed LFPR by subtracting the added worker flow in each year from the actual observed change of the labor force starting in a specific base year. In this base year – here 2001 – we assume that there is no AWE ($\Delta \tilde{H}_{UA|2001} = 0$), but we can trace the added workers since then. Hence, the labor force L_S and the LFPR l_s for a specific year s *excluding* the added workers may be written as

$$\tilde{L}_s = \tilde{L}_{s-1} + \left(\Delta \mathrm{L}_s - \Delta \tilde{H}_{UA|s}\right) \; for \; s > 2001 \tag{4}$$

$$\tilde{l}_s = \frac{\tilde{L}_s}{WPOP_s} \tag{5}$$

where $WPOP_S$ is the working-age population in year s. In the year 2001, the observed LFPR $l_{2001} = \tilde{l}_{2001}$.

3 The added worker effect in Europe

In chart 2 we plot the calculated added worker rate (R_t) for the EU-25[19] for the period 2002–2012. What becomes immediately apparent is the sharp increase in the added worker rate in 2009, when GDP contracted heavily in nearly all European countries. More specifically, R_t rose by more than 4 percentage points, which is by far the largest increase since 2002. This result implies that in a large number of couple households across Europe, one household member entered the labor force in 2009 while his or her partner was unemployed. Hence, by simply eyeballing the movement of R_t we can conclude that the economic crisis in 2009 has triggered a substantial AWE. Moreover, and beyond that, we observe a counter-cyclical reaction of the added worker rate not only in 2009. The path of R_t over the entire period suggests a negative correlation between the added worker rate and the business cycle.

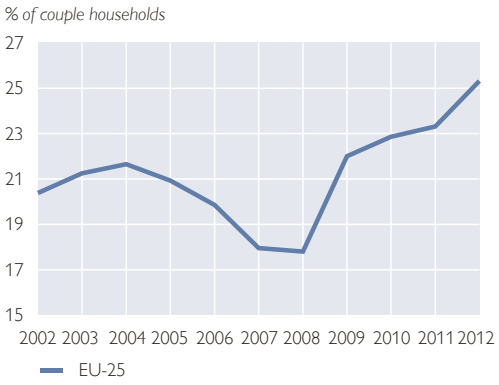
In chart 3 we plot yearly changes of the added worker rate together with yearly GDP growth rates for the EU-25. Obviously, there is a clear relationship between both series as the AWE ($R_t - R_{t-1}$) seems to increase with decreasing GDP growth rates. Conversely, in times of accelerating GDP dynamics we observe a negative AWE. This resembles a situation in which one household member who had been unemployed in the preceding period became employed while the other, formerly active member dropped out of the labor force. The observed link between the AWE and the business cycle is also confirmed by the correlation coefficient, which amounts to –0.9 for the EU-25 aggregate.

In chart 4 we plot gender-specific contributions to the AWE for the EU-25 region. In particular, we want to assess whether the AWE (i.e. the yearly change in R_t) is driven by women entering the labor force due to their partner's job loss or

[19] *EU-28 without Malta, Sweden and Ireland due to data limitations.*

Chart 2

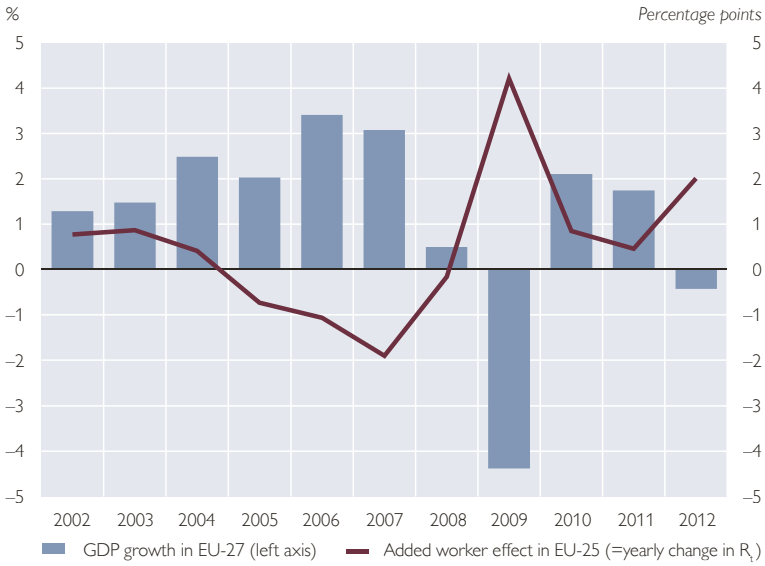
Added worker rate (R_t) in Europe



Source: Authors' calculations.

Chart 3

The added worker effect and GDP growth in Europe

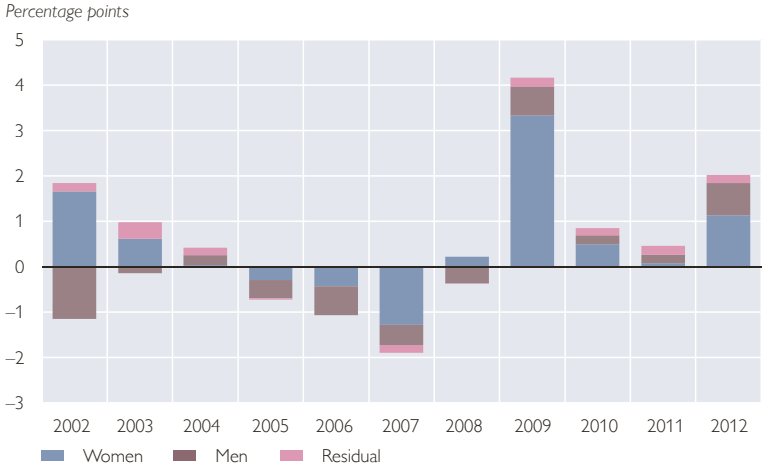


Source: AMECO database, authors' calculations.

rather by men entering the labor market as a response to their partner's job loss.[20] As expected, the observed AWE in 2009 was mostly driven by female workers, which is consistent with the idea that women had to return back to work in order to compensate for the incurred loss in household income. Of the 4.2 percentage point change in the added worker rate in 2009, more than three-quarters are attributable to women (3.3 percentage points), while men's input amounts to less than 1 percentage point. Interestingly, in 2012, when Europe slipped back into recession, women's contribution to the AWE was again larger than men's, but by far less than in 2009. A potential explanation for this pattern might be the different nature of the downturns. While the recession in 2009 was partly accompanied by the bursting of housing bubbles, which mainly affected male workers in the construction sector, the recession in 2012 was the consequence of austerity measures triggered by a debt crisis that had no effect on a particular male- or female-dominated economic sector. This argument is supported by the observation that in 2009 the rise in the unemployment rate in the EU-27 was higher for men (by 1 percentage point), while in 2012 it was similar for men

Chart 4

Contributions to the added worker effect in the EU-25



Source: Authors' calculations.

[20] *The respective contributions are calculated by decomposing ΔR_t using the fact that the gender-specific figures comprise only subgroups of the overall indicator. Thus, we may write* $\Delta R_t = \gamma_t^f \Delta R_t^f + \gamma_t^m \Delta R_t^m + R_t^f \Delta \gamma_t^f + R_t^m \Delta \gamma_t^m - \Delta R_t^f \Delta \gamma_t^f - \Delta R_t^m \Delta \gamma_t^m = \gamma_t^f \Delta R_t^f + \gamma_t^m \Delta R_t^m + \varepsilon_t$, *where f and m indicate female and male values, respectively,* $\gamma_t^i = \Omega_t^i / \Omega_t$ *where* $i \in (f, m)$, *and ε_t the residual, which captures the contributions of $\Delta \gamma_t^i$ and the joint effects.*

and women. Considering the development of the AWE over the entire period, the contribution of women to the overall variation amounts to roughly 70%. Hence, we can conclude that the AWE in Europe is largely a phenomenon that is driven by women switching into and out of the labor force depending on the employment status of their partners.

3.1 The added worker effect across European countries

One of the big advantages of the proposed added worker measure is that it can be calculated for each country in the sample, i.e. for a total of 25 EU Member States. Hence, we are able to compare the already presented results for the EU-25 aggregate with individual country results. First, in order to check the presence of an AWE as a response to the global financial crisis, we calculate the means of R_t for the pre-crisis period as well as for the period since the start of the crisis in 2009 for each country individually. Table 1 presents the figures indicating the difference in means between both subperiods ($\bar{R}_{2009-2012} - \bar{R}_{2002-2008}$) together with a one-sided t-test telling us whether sample means have increased significantly since the beginning of 2009.[21]

In the first column we present the differences between the sample means of the added worker rates irrespective of gender. Before discussing the individual country examples, we want to draw the reader's attention to the test result for the EU-25 aggregate. For the whole region we see a highly significant AWE, which confirms what we have already inferred from eyeballing the time series.

When we turn the focus on individual countries, our results show strong heterogeneity across EU Member States. More specifically, we identify a group of 13

Table 1

Test results for the added worker effect[1]

	Total added worker effect	Female added worker effect	Male added worker effect		Total added worker effect	Female added worker effect	Male added worker effect
EU-25	3.30***	4.08***	–0.53	DE	–4.35	–3.65	–6.16
EA-17	4.86***	5.69***	–0.44	GR	10.81**	10.63**	–0.89
Continental	–0.99	–0.18	–4.31	HU	6.25***	6.11***	5.55***
Mediterranean	12.27***	12.88***	–0.14	IT	2.44**	2.97***	–5.62
CESEE-6	–4.17	–3.10	–4.84	LV	17.13***	19.68***	8.89**
AT	0.37	0.58	–2.54	LT	13.29**	19.16***	3.74
BE	1.48	2.59**	–5.61	LU	6.11***	3.96***	1.47
BG	–2.31	0.44	–6.86	NL	4.17***	3.82***	2.08
HR	–4.24	0.60	–12.52	PL	–10.94	–9.06	–11.91
CY	10.58**	9.33**	4.32	PT	13.35***	15.11**	4.33**
CZ	–0.05	0.15	2.54	RO	0.93	–0.45	7.64***
DK	6.80**	8.31***	1.93	SK	–7.31	–6.77	–6.92
EE	11.41**	11.36**	7.22*	SI	5.01*	7.00**	1.05
FI	0.24	2.52**	–2.56	ES	22.37***	25.65***	1.09
FR	1.14	3.30***	–4.52	UK	5.40***	4.85***	7.03***

Source: Authors' calculations.

[1] *One-sided t-test of equality in means of R_t. H_A: $R_{t1}<R_{t2}$. Asterisks denote significance at ***1%, **5%, *10%.*

Note: Numbers correspond to differences in mean values of R_t ($\bar{R}_{2009-2012} - \bar{R}_{2002-2008}$). MT, SE and IE were dropped due to data problems; data for DK from 2003 onward; EU-25: EU without MT, SE and IE; EA-17: euro area without MT and IE. CESEE-6: BG, HR, CZ, HU, PL, RO. Continental Europe: AT, BE, DE, FR, LU, NL. Mediterranean countries: GR, ES, IT, PT, CY.

[21] *The t-test is a one-sided test where we assume that the variance in both subperiods is different from each other (Welch, 1947).*

countries with significantly different means of R_t. Amongst them there are countries like Spain, the United Kingdom, the Netherlands and the Baltic states, which experienced a sharp decrease in construction sector employment due to the bursting of a housing bubble (European Central Bank, 2014). Hence, as expected we observe a much higher AWE in those countries as compared to the EU-25 average. Moreover, what stands out clearly is that the euro area countries that were most strongly affected by financial market stress and therefore experienced the highest increases in their unemployment rates (i.e., Greece, Spain, Italy, Cyprus, Portugal and Slovenia) show a significant AWE as well. Also, as a result of the sovereign debt crisis, all of these countries slipped back into recession in 2012, which led to further job losses.

The group of countries with no significant AWE is quite heterogeneous. While many European countries with traditional "continental" welfare systems are found in this group,[22] also most of the Central, Eastern and Southeastern European (CESEE) countries have not experienced an AWE. Typically, continental European countries like Germany, Austria and France are characterized by large welfare states and can absorb much of a potential income shock within a household (see Esping-Andersen, 1990; or Bonoli, 1997). This is consistent with the findings of Bredtmann et al. (2014), who group their sample according to different welfare regimes and do not find any response of women's labor supply in the subgroup of continental European countries.[23] Compared to the EU average, the extent of the recession and the number of job losses have been much lower in those countries as well, which might also explain the absence of an AWE in continental Europe.

3.2 Comparing country aggregates: EA-17 versus CESEE-6

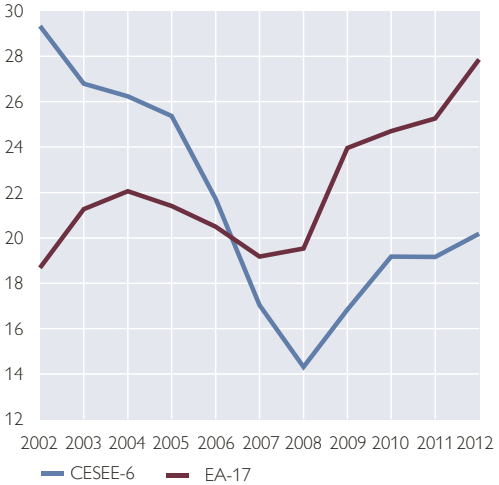
Interestingly, for the entire euro area (EA-17) the AWE is highly significant and even more pronounced compared to that for the EU-25. The reason is that the extent of women's (or men's) labor supply reaction in Mediterranean countries – notably in Spain but also in Portugal, Greece and Cyprus – more than fully compensates the nonexistent labor supply response in continental European countries.

While we observe an AWE for the EA-17, there seem to be no significant labor supply reactions within the CESEE-6 region, i.e. Central, Eastern and Southeastern European countries that are not part of the euro area yet. At first sight,

Chart 5

Added worker rate (R_t)

% of couple households



Source: Authors' calculations.

[22] *For the sake of simplicity, we refer to these countries as "continental European countries" in this article.*

[23] *However, Bredtmann et al. (2014) do find a response at the intensive margin, i.e., women in continental Europe are more likely to change from part-time to full-time employment when their husbands become unemployed. Unfortunately, our measure does not control for this kind of behavioral change.*

this is not surprising, given that Hungary is the only CESEE country experiencing an AWE. However, one might wonder why this is the case, given that, with the notable exception of Poland, all of these countries have undergone deep recessions (some of them double-dip recessions) accompanied by high increases in unemployment rates during the global crisis. Yet, in order to understand this outcome, we have to go back to the 1990s.

As shown in chart 5, the added worker rate was already very high in the CESEE-6 region at the beginning of the 2000s; it came down only gradually until 2008 and started to increase afterward. This pattern is likely to be associated with the economic development of the CESEE-6 countries in the second half of the 1990s. With the exception of Hungary, all countries in this group experienced recessions or at least economic downturns that were accompanied by strong increases in unemployment rates peaking around the turn of the millennium. Indeed, in the Czech Republic and in Romania – the only two countries for which we have data going back to 1997 – we observe that the added worker rate increased until 2000 before it started to decline gradually. Hence, as our statistical test compares the periods 2002–2008 and 2009–2012 it is not able to detect any AWE for the CESEE-6 during the crisis, although the added worker rate has been increasing in all of the countries since 2009. Interestingly, the lowest increase can be observed in Poland, which is the only EU country that did not experience a recession in this period. Again, this is consistent with the observation that the AWE seems to be countercyclical. To sum up, we can conclude that there have been labor supply responses in the CESEE-6 region as a reaction to the crisis. However, the increase in the added worker rate since 2009 was not that high that an AWE could have been detected.

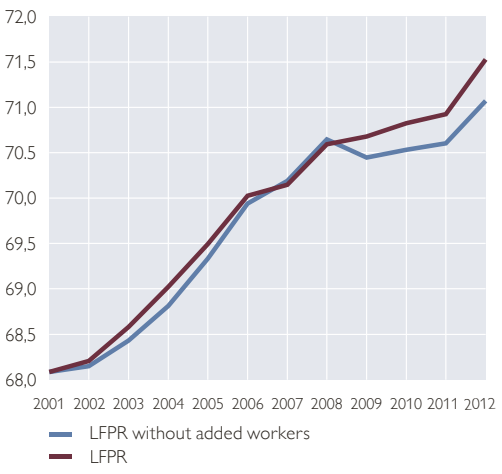
3.3 The gender-specific added worker effect

In the remaining two columns of table 1 we report the results for the gender-specific added worker rates. What clearly stands out is that the AWE occurs primarily in the subgroup of female workers. Hence, what we have observed at the aggregate level is broadly reflected across countries as well, namely that the AWE is driven by women who become active on the labor market in order to compensate for the income loss of their partners. Accordingly, out of 25 EU countries, 17 experienced a significant female AWE.

Chart 6

Labor force participation rate (LFPR) in the EU-25

% of the working-age population



Source: Authors' calculations.

4 The impact of added workers on labor force participation in Europe

Finally, we are left with the task of examining whether the magnitude of the increase in "added workers" is economically meaningful. More specifically, we are interested in the question whether the path of the LFPR would

have been different if the identified added workers had not entered the labor market.

In chart 6, we plot two different LFPRs for the EU-25. The first resembles the actual rate (which follows the official definition by Eurostat), while the second is the LFPR corrected for the estimated added workers ($\tilde{l}_s$), i.e. the official rate from which we subtract (add) the amount of added workers that enter or drop out of the labor force year by year. Hence, the latter shows how the LFPR would have evolved, if there had not been any added workers in the period 2002–2012. What immediately becomes apparent is that in 2009 the plotted lines start moving apart in both regions, while the gap between them is much smaller in the period before. By summing up the yearly numbers of added workers since 2009, we can arrive at an estimate of the total amount of added workers who have entered the labor force as a response to the global financial crisis. According to our results, there were 1.7 million added workers in the EU-25 in the period 2009–2012. Expressed in terms of working-age population, the number of added workers amounted to 0.51%. Hence, while the labor force participation rate increased by 0.94 percentage points between 2008 and 2012, 0.51 percentage points can be attributed to added workers. For the euro area (EA-17) the impact of added workers on labor force participation in this period was even stronger: while labor force participation increased by only 0.81 percentage points, 0.60 percentage points are attributable to added workers (or 1.3 million people). In contrast, we find a much smaller impact for the CESEE-6 region, where out of the 1.78 percentage point change in the LFPR, only 0.35 percentage points can be assigned to added workers.

In table 2 we present cross-country results for the estimated number of total added workers since the crisis. In the previous subsection we have seen that there are large country differences as regards the presence of the AWE. This also applies to the number of added workers, where we observe a large variation across countries. While in Spain and Greece the LFPR would have been lower by more than 2 percentage points had there been no added workers, the impact of added workers on the participation rate in Austria or Finland is virtually absent.

Table 2

Added workers in % of the working-age population in the period 2009–2012

Country	Added workers	Country	Added workers
EU-25	0.51	GR	2.40
EA-17	0.60	HR	0.23
CESEE-6	0.35	HU	0.35
AT	0.11	IT	0.45
BE	0.33	LT	1.31
BG	0.41	LU	0.58
CY	1.38	LV	1.07
CZ	0.58	NL	0.54
DE	–0.45	PL	0.40
DK	0.53	PT	1.37
EE	0.58	RO	0.17
ES	2.74	SI	0.97
FI	0.18	SK	0.29
FR	0.36	UK	0.30

Source: Authors' calculations.

4.1 Robustness analysis

As we cannot observe the gross flows of couple household members between labor market states over time we are not able to identify which parts of $\Delta\Omega_t$ (in equation 2) are related to $H_{UA|t}$ and $H_{AI|t}$. Therefore, we have allocated $\Delta\Omega_t$ at the rate of R_{t-1}. Although it seems intuitive that the gross flows depend directly on the relative size of the two groups in the previous year (R_{t-1}), this section tries to evaluate the sensitivity of our findings with respect to alternative allocations.

For this purpose we propose a simple stochastic simulation, in which the

allocation parameter R_{t-1} is replaced by a stochastic parameter sampled from a known probability distribution. Hence, we redefine equation (2) in the following way:

$$\Delta\tilde{H}^{(r)}_{UA|t} = \Delta H_{UA|t} - \delta^{(r)}\ \Delta\Omega_t, \tag{6}$$

where $\delta^{(r)}$ is the r^{th} random draw from a known probability distribution. Drawing R times, the central limit theorem ensures that the average of $\overline{\Delta\tilde{H}_{UA|t}} = \frac{1}{R}\sum_{r\in R}\Delta\tilde{H}^{(r)}_{UA|t}$ is asymptotically normally distributed with the average as the mean and $\tilde{\sigma}^2 = VAR\,[\Delta\tilde{H}^{(r)}_{UA|t}]$ even if $\delta^{(r)}$ is not drawn from a normal distribution. For simplicity, we assume $\delta^{(r)}$ to be either drawn from a uniform distribution $\mathbb{U}(0,1)$ or a normal distribution $\mathbb{N}(\bar{R},\ SD[R_t])$ using the sample mean and standard deviation of the respective country aggregate under consideration.

Table 3 reports the results of this simulation exercise. Considering the uniform distribution, the simulated mean is lower than our added workers estimate due to the fact that the uniform distribution implies $\bar{\delta}=0.5$ and the actual values for R_{t-1} are always lower. The normal distribution concentrates more probability mass over the sample mean of R_t and is therefore closer. The confidence intervals show that the estimated numbers of total added workers are robust in that the effect on the LFPR remains strong. Even in the lower-bound case of the uniform distribution, considerable numbers of added workers have caused an upshift of the LFPR by 0.35 percentage points in the EU-25.

5 Conclusions

So far, the empirical literature on the AWE has concentrated on the identification of the labor supply decisions made by women as a response to their partners' job loss. This has been typically analyzed by employing discrete choice models. Indeed, the latest results for Europe show that women whose partners become unemployed have a higher probability of entering the labor market. Up to now, however, the economic significance of the AWE has been an open issue. In particular, the question whether the European LFPR has increased in response to the AWE has not been analyzed so far. This is related to the fact that discrete choice models are often not very well suited to assess whether the identified phenomenon is quantitatively meaningful. Hence, in order to address this open issue, we chose a different empirical strategy.

Table 3

Added workers in % of the working-age population in the period 2009–2012: a simulation

	Baseline	Uniform distribution			Normal distribution		
	Mean	Lower	Mean	Upper	Lower	Mean	Upper
EU-25	0.51	0.35	0.45	0.54	0.49	0.50	0.51
EA-17	0.60	0.40	0.52	0.64	0.57	0.59	0.60
CESEE-6	0.35	0.27	0.30	0.33	0.31	0.32	0.32

Source: Authors' calculations.

Note: Simulation with 1,000 draws, normal distribution with sample mean and standard deviation of R_t for the respective country aggregate. 90% confidence interval reported.

In this paper we derived a macroeconomic measure of the AWE for each EU Member State on a yearly basis by using micro data at the household level. Our results revealed a statistically and economically significant AWE within the EU-25 during the crisis period, which contributed considerably to the increase in the LFPR during the period 2008–2012. Moreover, we found strong country heterogeneity with respect to the presence of the AWE across European countries. This came as no

surprise, as we had expected to observe differences not least due to diverging business cycle developments across EU member countries. We presented some reasonable explanations for the cross-country heterogeneity, which, however, are certainly exposed to some limitations. In particular, it would be convenient to estimate the suggested relationships within a panel data model in order to test their statistical relevance. Identifying the potential macroeconomic determinants of the AWE, like GDP dynamics, the generosity of welfare regimes or the degree of labor market turnover, would certainly be an interesting field for future research. We think that the measure of the AWE provided in this paper would be a good starting point for such an analysis.

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