OECONOMIA
COPERNICANA

VOLUME 12 ISSUE 3 SEPTEMBER 2021

p-ISSN 2083-1277, e-ISSN 2353-1827
www.oeconomia.pl

ORIGINAL ARTICLE

Citation: Congregado, E., Gałecka-Burdziak, E., Golpe, A. A., & Pater, R. (2021). Separating aggregate discouraged and added worker effects: the case of a former transition country. *Oeconomia Copernicana, 12*(3), 729–760. doi: 10.24136/oc.2021.024

Contact to corresponding author: Ewa Gałecka-Burdziak, eburdz@sgh.waw.pl

Article history: Received: 26.01.2021; Accepted: 18.08.2021; Published online: 30.09.2021

Emilio Congregado
University of Huelva, Spain
orcid.org/0000-0001-7409-0799

Ewa Gałecka-Burdziak
Warsaw School of Economics, Poland
orcid.org/0000-0001-9020-8486

Antonio A. Golpe
University of Huelva, Spain
orcid.org/0000-0003-0360-1541

Robert Pater
University of Information Technology and Management in Rzeszów, Poland
orcid.org/0000-0001-7619-9843

Separating aggregate discouraged and added worker effects: the case of a former transition country

JEL Classification: *C32; J21; J22*

Keywords: *discouraged worker effect; added worker effect; vector autoregression; sign restrictions*

Abstract

Research background: We analyse the added worker effect (AWE) and the discouraged worker effect (DWE) from an aggregate perspective. The first effect refers to an increase in labour force participation in response to a decrease in the wage rate. The second effect refers to the decision by workers who have been unsuccessful in their job search to leave the labour market or to decrease

Copyright © Instytut Badań Gospodarczych

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

their labour force participation. For our analysis, we use the case of Poland, a country with a persistently low labour force participation rate.
Purpose of the article: While previous studies focused on the net of the two effects, we aim to analyse the two effects both separately and simultaneously. We propose a new approach for analysing the two effects. We generalise and model them as resulting from different shocks: (i) the AWE as the result of a negative wage income shock, and (ii) the DWE as the result of a positive job search time shock. The underlying assumption is that both shocks have at least a transitory effect on the labour force participation rate. However, we also track the potential long-lasting effects of these shocks, and we analyse the reactions of gender and age groups to them. While this approach demonstrates the robustness of our results, it also provides the range of the sensitivity, as it shows that there are large differences in the magnitude of the AWE and the DWE for different labour market cohorts.
Methods: We use the multivariate unobserved component model to extract the AWE and the DWE, and we then use VAR models, applying sign and exclusion restrictions to model the underlying shocks. We use quarterly data for Poland in 1995–2019. Most of these data come from the Labour Force Survey, while the rest come from Statistics Poland.
Findings & value added: In contrast to previous literature, which analysed only the net effect of the two effects, we model the AWE and the DWE separately. Contrary to the findings of previous research, our approach seems to confirm that both effects are simultaneously present in the labour market, and both effects influence the labour force participation rate. Thus, we find that both effects are significant. Specifically, we show that the AWE is stronger, but transitory; while the DWE is weaker, but long-lasting.

Introduction

In this study, we attempt to disentangle the potential and simultaneous presence of the discouraged worker effect (DWE) and the added worker effect (AWE). These effects imply that the cyclical behaviour of labour force participation rates can differ. Most of the existing literature on this topic has found that the discouraged worker effect plays a larger role than the added worker effect (Euwals *et al.*, 2011), and most of these studies have observed that labour force participation rates are procyclical with respect to economic activity (Finegan, 1981). Other research has confirmed that there is an added worker effect for groups of secondary workers (Filatriau & Reynes, 2012), and that the AWE is linked to countercyclical labour force participation rates in response to overall economic activity changes. As most of these studies examined the cyclicality of the labour force participation rates, only one of the effects could have prevailed. Thus, the net effect could have been identified from an aggregate perspective (see Congregado *et al.*, 2020 for a literature review).

If we assume that labour markets are flexible and perfectly competitive, we may treat the AWE and DWE as, respectively, income and substitution effects of a decrease in wage income. A decrease in income may cause workers increase their labour supply through the AWE (see Lundberg, 1985); whereas the DWE may cause households to decrease their labour

supply in response to a decline in real wages (see Schweitzer & Smith, 1974). However, European labour markets, and the Polish labour market in particular, are more sticky and far from perfectly competitive, especially compared to labour markets such as that of the US (see Agell, 1999). This suggests that the shocks that lead to the AWE and the DWE should differ. Even though the income effect (leading to the AWE) may be voluntary, the shock leading to the DWE might not result entirely from the voluntary decisions of individuals, or from wage level changes. In Poland, workers often spend a very long time searching for a job, and the sense of hopelessness they feel after such a prolonged period may lead them to give up their job search (regardless of potential changes in the wage rate). In addition, the workers who are affected by the AWE and the DWE may come from different subpopulations. That is why we believe that testing and modelling the two effects separately is important, especially in a less competitive market.

Discouraged and added worker effects have been previously analysed from macroeconomic and microeconomic perspectives. These articles may be divided into those that considered one of the effects and those that considered both of them at once. Our analysis is situated in the latter group. Still, we identify some gaps in the literature, which we try to address in our research.

First, we contribute to the literature by analysing the AWE and the DWE in a single model, even though we assume that they result from different shocks. From an aggregate perspective, both effects are typically traced back to a cyclical shock (Evans, 2018), and only the net effect of these contradictory labour force participation movements is usually, if at all, observable (Tansel & Ozdemir, 2018). In order to analyse the AWE and the DWE from an aggregate perspective, we generalise both effects. In our approach, we assume that the AWE results from short-run decreases in income, and that the DWE results from the worsening of an individual's labour market situation (although we also explicitly trace the effect of a long average job search duration). This approach is new in the literature. Up to now, analysing the two effects at one time, but separately, was possible only with experiments (see Ehrenberg & Smith, 2006, p. 173; Battalio *et al*., 1981). In order to apply our approach, we generalise the added worker effect, which enables us to test and model its existence from the macroeconomic (aggregate) perspective.

Second, in addition to the general model, we examine the reaction to particular shocks of certain age and gender groups. Specifically, we investigate to what extent the AWE and the DWE differ across labour market cohorts. Our study develops previous approaches (see, for example, Öster-

holm, 2010) with more accurate shock identification schemes, and considers the two effects in one model. We also prove that the results are significant for some cohorts, but are small or insignificant for others. We extract the AWE and the DWE historically, and formally test for the existence of both effects. This approach enables us to simultaneously distinguish between added and discouraged worker effects.

In this study, we examine the discouraged and the added worker effects in the labour market in Poland, an underexplored country which suffers from low labour market participation rates, but which currently enjoys low unemployment rates. In order to extract the added and the discouraged worker effects, we first use the unobserved component model. We then model the two effects with a Bayesian vector autoregressive model. In our analysis, we use quarterly data for Poland for the 1995–2016 period. The paper proceeds as follows. In the next section, we provide a literature review. In the following section, we present our methods and data. We then outline and discuss our results. In the last section, we present our conclusions.

Literature review

The empirical literature on the relationship between the labour force participation rate and the unemployment rate has evolved. Traditionally, discouraged and added workers' effects have been perceived through certain cyclical properties of the labour force participation rates (Finegan, 1981). An alternative approach is the invariance hypothesis, which refers to the lack of evidence of pro- or countercyclicality (Tansel & Ozdemir, 2018). Cyclical properties allow researchers to identify the net effect, and the DWE is usually found to prevail for particular age and sex groups (females and older workers). Some analyses have focused on certain sex and age groups, and have shown how their participation changed over the years (see, for example, Coglianese, 2018; Guner *et al*., 2020). Still, some general macroeconomic analyses have been conducted. For example, Evans (2018) analysed the likelihood of workers transitioning between the three states (employment, unemployment, and non-participation) in different phases of the business cycle, while Lee and Parasnis (2014) explored the AWE and the DWE across country groups (developed vs. developing). Narayanan *et al.* (2017) and Martín-Román (2020) examined the effects of labour market policies on the AWE and the DWE.

Over time, researchers have addressed various dimensions of the issue of potential non-linearities in the studied phenomenon. For example,

a number of studies have investigated the effects broken down by age and sex (Altavilla *et al.*, 2005; Altuzarra *et al.*, 2019; Congregado *et al.*, 2011, 2014; Darby *et al.*, 1998; Emerson, 2011; Fuchs & Weber, 2013; Kakinaka & Miyamoto, 2012; O'Brien, 2011; Tansel & Ozdemir, 2018), while others have looked at whether the effects were time-varying (Congregado *et al.*, 2012, 2014).

Some of these analyses were conducted at the micro level. For example, some studies investigated the determinants of the labour market status and the indicated phenomena (Dagsvik *et al.*, 2006, 2013; van Ham *et al.*, 2001), while others explored the labour supply model at the household level (Baslevent & Onaran, 2003; Bredtmann *et al.*, 2018; Karaoglan & Okten, 2015; Mankart & Oikonomou, 2016; Stephens, 2001)

The labour market in Poland has also been studied quite extensively. Gałecka-Burdziak and Pater (2016) found a significant and time-varying added worker effect, as well as a discouraged worker effect for both sexes, for the 1994–2014 period. The AWE was shown to be considerably stronger in recessions than in economic expansions. Congregado *et al.* (2020) found that the labour force participation rates were non-linear; and that the changes between the DWE and the AWE were rapid, and were connected to the stable value of the cyclical unemployment rate. Moreover, they showed that an unemployment rate higher than 13% led to a discouraged worker effect. Congregado *et al.* (2021) further examined potential non-linearities in the AWE and the DWE (they allowed the relationship to be time-varying, and to differ by gender groups).

To summarise, previous research has produced a range of results indicating that there is volatility across age-sex groups, and that there are non-linearities in certain perspectives. The disadvantage of these previous studies is that they considered both the AWE and the DWE as effects of one shock. Thus, only the net effect could be identified. There have been no analyses that distinguished between the shocks that led to the AWE and the DWE. We try to fill this gap in the literature.

To analyse labour force participation cyclicality and the AWE/DWE, various time series models have been used. Benati (2001) applied band spectrum regression and band-pass filtering techniques to analyse the cyclicality of the magnitude of the labour force at the macroeconomic level. Gałecka-Burdziak and Pater (2016) developed this approach, and analysed both effects in time and in the frequency domain. Filatriau and Reynes (2012) estimated an unobserved component model with a Kalman filter to investigate the impact of the unemployment rate on the labour market participation rate, broken down by age and sex. Fuchs and Weber (2013) also applied an unobserved components approach to assess the impact of unem-

ployment on the labour force participation rate. Euwals *et al.* (2011) used a binary age–period–cohort model to study Dutch women. Guner *et al.* (2020) based their approach on the flows between various states in the labour market. Altavilla *et al.* (2005) tested for non-linearity in the relationship between the female labour force participation rate and the female employment rate using a VEC model and a multivariate Markov-switching model. Congregado *et al.* (2011, 2014, 2020, 2021) applied a series of non-linear models, testing different hypotheses of effects asymmetry. Evans (2018) estimated a SVAR model, and showed the effects of a business cycle (output) shock on the labour market participation rate.

All of the above approaches were appropriate for analysing one of the effects: the AWE, the DWE, or the net effect. The net effect is actually the sum of mutually counteracting fluctuations — i.e., the procyclical DWE and the countercyclical AWE. The aim of our approach is to analyse the two effects separately. We do so by assuming that the reasoning behind the labour supply decisions that leads to these two effects is different. We will explain our approach in the next section.

Methods: UCM and Bayesian VAR

We built a model that allows us to identify the AWE and the DWE separately. This is achieved by treating each effect as resulting from a different kind of shock that affects the labour market, and, in turn, the labour force participation rate. In general, the labour supply, which is expressed in a model by means of the labour force participation rate, depends on the level of wage income. This level reflects the incentives to enter the labour force in the long run. In the short run, the wage income level influences the decision to participate in the labour market through income and substitution effects. The income effect implies that a loss in income will make workers more willing to increase their labour supply to compensate for the income loss. If wages decrease, the substitution effect should lead workers to reduce their labour force participation, as a decrease in the wage rate will lower the price of labour, and will increase the demand for leisure (Ehrenberg & Smith, 2006, pp. 171–172). While it is generally observed that the income effect prevails at higher wage rates (the reverting individual labour supply), if we assume that workers are reluctant to accept volatility in their wage income over the life course, we may hypothesise that the income effect is crucial here (with respect to the AWE). The wage income level tends to fluctuate over the business cycle, but we can expect that other types of income do not have strong effects on labour force participation in

the short run. Thus, having a lower income over the business cycle encourages people to enter the labour market to compensate for the loss of income, which is a direct added worker effect. From the aggregate perspective, we define the AWE broadly. We assume that the main breadwinner losing his/her job is not the only potential cause of the AWE. We further assume that the AWE is present in situations in which (compare McConnell *et al*., 2006, p. 75):

1. the income of a household member is diminished, but not completely lost; or
2. any household member loses his/her income.

Both assumptions are necessary from a macroeconomic perspective in which aggregate data are used, and household members are not observed or differentiated. We observe only aggregate incomes and their cyclical fluctuations, and test whether they lead to labour force changes that are in line with the added worker effect. If the loss of income leads to increased labour force participation, we infer that the added worker effect occurred.

When the substitution effect prevails, a lower permanent wage rate results in lower wage income. This should encourage people to search for alternatives to income from work, rather than to increase their job search activity[1]. However, one of the Kaldor facts of growth indicates that the number of hours worked (an equivalent of participation) has changed relatively little, even though wages have increased sharply over the centuries (Kaldor, 1957). This could indicate that substitution and income effects cancel each other out to a large degree (while neglecting the institutional settings of the labour market), and that most macro models impose a balanced growth path, whereby only transitory wage changes lead to changes in the labour supply. In this case, labour market participation would not be correlated with wage income over the long run. Subject to these findings, we argue that the AWE may be only transitory.

The LFPR also depends on the labour market situation (approximated by the unemployment rate). It reflects the probability of finding a job, which depends among other things on the job search duration. If an unemployed individual searches for a job unsuccessfully for a certain period of time, s/he may become discouraged and leave the labour market. This exit, like the DWE, may be transitory or permanent.

The third shock that can affect the labour force participation rate is an exogenous population shock. This type of shock reflects demographic changes, and influences long-run shifts in the population. Thus, it is not

[1] Another option would be, for example, for workers to invest in their human capital and increase their employability, and then to look for a better paid job.

directly applicable in our setting. However, if we account for migration, we can actually treat it as a significant short-run population shock. Migration processes can affect the labour supply in different ways. Immigration should increase the labour supply, as most immigrants are of working ages. Emigration should have the opposite effect[2].

An individual's income depends on her/his labour input in both the short and the long run. Income is also connected to the unemployment rate in the short run by Okun's Law. We expect to observe a negative relationship between the components of income and the unemployment rate. The unemployment rate may also be an indicator of the short-run labour market bargaining power of workers and employers. An exogenous shock to income (an income shock) may represent both a wage income effect and a wealth effect, which may come from the accumulation of capital. The wealth effect should work in the opposite direction of that of the wage income effect. However, since people tend to get most of their income from wages, we expect to find that the wage effect dominates over the wealth effect (we also test the sole wage effect in the robustness analysis).

The labour market situation (represented by the unemployment rate) depends on the size of the labour force, and, in the short run, on wage income levels. A population shock, or rather an immigration shock[3], instantaneously increases the unemployment rate, as it causes more people to enter the labour market (and the job matching process is time-consuming). An increase in wage income tends to decrease the demand for labour and to increase the unemployment rate, thereby worsening the labour market situation. An exogenous shock to the labour market situation can show how hard it is to find a job. We call this a job search duration shock.

Before modelling, we start our empirical study by supplementing our descriptive analysis of the cyclicality of endogenous variables. In order to do this, we use the multivariate unobserved component model (MUCM, Harvey, 1989):

$$\boldsymbol{y_t} = \boldsymbol{\mu_t} + \boldsymbol{\psi_t} + \boldsymbol{\varepsilon_t}, \quad \boldsymbol{\varepsilon_t} \sim \mathrm{NID}(\mathbf{0}, \boldsymbol{\Sigma_\varepsilon}), \boldsymbol{t} = \mathbf{1}, \ldots, \boldsymbol{T}, \qquad (1)$$

[2] But the accession to the European Union is an exception here. Since 2004, there has been a substantial wave of emigration by long-term unemployed workers. It can be argued that because these workers were discouraged in the labour market, their emigration would diminish the size of this effect. If so, our results for the DWE would be underestimated.

[3] By "population shock" we mean a situation in which the working-age population (people aged 15–74) increases. This might be caused by an increase in the birth rate in the past or by an inflow of migrants.

where $\boldsymbol{y_t}$ consists of endogenous variables. $\boldsymbol{\mu_t}$ is a local linear trend that may consist of a stochastic level and slope (drift) of signal that represent the long-run trend in the following way:

$$\boldsymbol{\mu_t} = \boldsymbol{\mu_{t-1}} + \boldsymbol{\beta_{t-1}} + \boldsymbol{\eta_t}, \boldsymbol{\eta_t} \sim \mathrm{NID}(\mathbf{0}, \boldsymbol{\Sigma_\eta}), \tag{2}$$

$$\boldsymbol{\beta_t} = \boldsymbol{\beta_{t-1}} + \boldsymbol{\xi_t}, \boldsymbol{\xi_t} \sim \mathrm{NID}(\mathbf{0}, \boldsymbol{\Sigma_\xi}), \tag{3}$$

and $\boldsymbol{\psi_t}$ is a stochastic cycle of the form:

$$\begin{bmatrix} \boldsymbol{\psi_t} \\ \boldsymbol{\psi_t^*} \end{bmatrix} = \left\{ \rho_\psi \begin{bmatrix} \cos\lambda_c & \sin\lambda_c \\ -\sin\lambda_c & \cos\lambda_c \end{bmatrix} \otimes \boldsymbol{I_N} \right\} \begin{bmatrix} \boldsymbol{\psi_{t-1}} \\ \boldsymbol{\psi_{t-1}^*} \end{bmatrix} + \begin{bmatrix} \boldsymbol{\kappa_t} \\ \boldsymbol{\kappa_t^*} \end{bmatrix}. \tag{4}$$

In the above model irregular $\boldsymbol{\varepsilon_t}$, level $\boldsymbol{\eta_t}$ and slope $\boldsymbol{\xi_t}$ multivariate normal disturbances are mutually uncorrelated and $\boldsymbol{\Sigma}$s represent $N \times N$ variance matrices. Cycle disturbances are assumed to have the same matrix, i.e., $E(\boldsymbol{\kappa_t}\boldsymbol{\kappa_t'}) = E\left(\boldsymbol{\kappa_t^*}\boldsymbol{\kappa_t^{*\prime}}\right) = \boldsymbol{\Sigma_\kappa}$ and $E\left(\boldsymbol{\kappa_t}\boldsymbol{\kappa_t^{*\prime}}\right) = \mathbf{0}$. $N = 2$, λ_c is a cycle frequency in radians with a period of $2\pi/\lambda_c$ and ρ is a damping factor, where higher values represent sharper spectrum peak of the cycle. They are the same for all time series. With $\rho \neq 1$ and $\sigma_\kappa^2 \neq 0$ the cycle is stochastic with changing amplitude and phase.

The results of this model provide us with estimates of possible relationships between the cyclical components of labour force participation rates (LFPR) and other macroeconomic aggregates. We now impose a common cycle restriction on the multivariate unobserved component model (1), that is $\boldsymbol{\Theta_\psi}\boldsymbol{\psi_t}$, where $\boldsymbol{\Theta_\psi}$ is $N \times K_\psi$ and contains factor loadings for the cycles, including common cycle restrictions. The resulting disturbance variance matrices become $\boldsymbol{\Sigma_\kappa} = \boldsymbol{\Theta_\psi}\mathbf{D_\kappa}\boldsymbol{\Theta'}_\psi$, with $\mathbf{D_\kappa}$ being a diagonal matrix. By imposing this restriction, we test the common cycle hypothesis (Koopman *et al*., 2009, p. 174). Our results show whether the variables of interest share a common component that resulted from cyclical fluctuation and the estimate of this component. The estimated common cycle provides us with the cyclical fluctuations that all endogenous variables share. This serves as a preliminary analysis for modelling the results of underlying shocks that lead to the cyclicality of the labour force participation.

We used a vector autoregressive (VAR) model to disentangle the shocks that lead to added and discouraged workers effects influencing the labour force participation rate. We considered a reduced-form VAR:

$$A(L)\begin{bmatrix} L_t \\ \ln Y_t \\ U_t \end{bmatrix} = \begin{bmatrix} \epsilon_{L,t} \\ \epsilon_{Y,t} \\ \epsilon_{U,t} \end{bmatrix}, \tag{5}$$

where: L_t is the relative size of the labour force, measured by the labour force participation rate; Y_t is aggregate income, measured by the log real GDP, U_t is the labour market situation, measured by the LFS unemployment rate; $A(L)$ is a lag polynomial matrix: and ϵ's are error terms with a covariance matrix Σ.

GDP is as a rather crude indicator of the income of workers. However, our main aim is to analyse the short-run relationships between income and labour force participation. In this sense, GDP is a typical business cycle indicator. Nevertheless, the lack of a cointegrating relationship between GDP and the LFPR may impair the long-run analysis. This is why we also test and suggest an explicit measure of wage income: real wages. Likewise, the rate of unemployment is only an implicit measure of job search duration. In the repeated estimation, we use job search time from the LFS, as well as real wages, as a direct measure. The results of both models with the same identification schemes, but different variables, are compared for robustness purposes.

Our modelling procedure takes into account different specifications and identification schemes of the model in order to ensure the robustness of the results. These specifications are as follows:

1. VAR model in differences with Cholesky decomposition. We apply this model because the main objective of our article is to analyse the short-run relationships between chosen aggregates. We assume that an income shock can instantaneously affect all aggregates. A population shock can affect the LFPR and the UR in the period in which it occurs, but it would take more time for it to influence income. The job search duration shock may affect the UR as soon as it hits the economy, but it does not necessarily affect income and the LFPR instantaneously. Polish data show that the mean job search duration was very long, especially during the late 1990s and the early 2000s. Thus, this shock might not have rapid consequences for the Polish economy. However, the results do not change significantly if we use different identification scheme. We avoid imposing long-run restrictions, since our hypotheses are connected to short-run dynamics. We also do not find such restrictions plausible. The theory does not support cointegrating relations between endogenous variables. We performed a Johansen trace test, but we did not obtain any significant and reliable results.

2. Bayesian VAR model with sign restrictions such that $\epsilon_t = B\theta_t$, where θ_t are structural shocks. We randomly draw an orthogonal impulse vector $\alpha = \widetilde{B}a$, where $\widetilde{B}\widetilde{B}' = \Sigma$ is a matrix decomposition of Σ and $||a|| = 1$. To decompose Σ, we use the rejection method based on a QR-decomposition of Rubio-Ramirez *et al.* (2010). We also apply Fry and Pagan's (2011) median target method to confirm the model results. To track the impact of the AWE and the DWE, we analyse the effects of the two shocks. As our analysis is focused on the short-run dynamics, we do not have to and do not impose any long-run restrictions.

2.1. A negative income shock that triggers the added worker effect is formulated as follows:

$$response_1 = \begin{matrix} \\ L \\ \ln Y \\ U \end{matrix} \begin{matrix} \begin{matrix} \theta_L & \theta_Y & \theta_U \end{matrix} \\ \begin{pmatrix} * & +SR & * \\ * & -SR & * \\ * & +SR & * \end{pmatrix} \end{matrix}. \tag{6}$$

We track the short-run (SR) effects of the shock by restricting the response of the LFPR to being positive (+) for six quarters after the shock to account for the potential cyclical reaction of the variables to the shock. It was set to ensure the minimum persistence of the business cycles of given variables (see Table 2), while not being too restrictive. After six quarters, the reaction of the variables is not restricted in any way.

2.2. A positive job search duration shock that leads to the discouraged worker effect is formulated as follows:

$$response_2 = \begin{matrix} \\ L \\ \ln Y \\ U \end{matrix} \begin{matrix} \begin{matrix} \theta_L & \theta_Y & \theta_U \end{matrix} \\ \begin{pmatrix} * & * & -SR \\ * & * & -SR \\ * & * & +SR \end{pmatrix} \end{matrix}. \tag{7}$$

We track the short-run (SR) effects of the shock by restricting the responses of the LFPR to being negative (-), again for six quarters after the shock for the same reasons as for the previous shock.

2.3. A positive population shock does not have effects on the AWE and the DWE:

$$response_2 = \begin{matrix} \\ L \\ \ln Y \\ U \end{matrix} \begin{matrix} \begin{matrix} \theta_L & \theta_Y & \theta_U \end{matrix} \\ \begin{pmatrix} +LR & * & * \\ +LR & * & * \\ -LR & * & * \end{pmatrix} \end{matrix}. \tag{8}$$

We assume that an increase in the number of labour market participants has a positive effect on the LFPR and on production capacity starting with the seventh quarter after the shock. The idea is that the shock has positive long-run effects, while its possible short-run behaviour is unrestricted. This also differentiates the population shock from the previous two cyclical shocks. This shock will also lead to more competition in the labour market, and will tend to decrease wages.

3. We perform a robustness analysis by using different measures of endogenous variables. We use an explicit measure of job search duration, and measure wage income by average monthly real wages.

4. We perform the analysis for particular age-sex groups. This gives us more detailed results, and we observe whether their reactions differ in comparison to the baseline model, and whether more accuracy increases the significance of the results.

In modelling, we used the following software: STAMP (Structural Time Series Analyser, Modeler and Predictor, Koopman *et al.*, 2009) for the UCM model, and VARsignR R package (Danne, 2015) for the Bayesian VAR model.

Data

We used quarterly data for Poland for the 1995–2016 period. The data on the labour force participation rate (LFPR), the unemployment rate (UR), and the job search duration are from the Labour Force Survey (LFS). The data on average monthly gross wages and salaries in the national economy are from Statistics Poland, and have been CPI-deflated (reference year 2005). The data come from the Statistical Bulletins[4]. The information on the gross domestic product is from chained-linked volumes (reference year 2005) published by Eurostat (encoded namq_gdp_k).

The results of unit root tests show that the null hypothesis of a unit root was not rejected at p=0.05 (Table 1) when all of the specified time series were used. However, the null hypothesis was on the verge of being rejected for the unemployment rate.

The total LFPR decreased almost linearly during 1995–2006 (Figure 1). Starting in 2007, it began to increase, albeit at a diminishing rate. In the age and sex breakdown, we see that for people aged 25–44, the time series of the LFPR were more stable than they were for younger and older workers

[4] https://stat.gov.pl/en/topics/other-studies/informations-on-socio-economic-situation/statistical-bulletin-no-72021,4,127.html

(Figure 2). We also observe visible fluctuations without any trends for both sexes. The LFPR for 15–24-year-old workers decreased during 1995–2006, and stabilised thereafter. During the latter period, the participation rates of young males increased slightly, while the participation rates of young females gradually declined. Older workers (aged 45+) displayed the opposite pattern of behaviour. While their activity levels did not decrease substantially during the first 12 years of our study period, their labour market participation levels started increasing in 2007. Generally, women and men behaved similarly, but the rate of participation grew more among females than among males. Migration outflows, especially of younger workers, have increased since 2004, and may have affected the differences between the younger and the older population.

The AWE and the DWE lead to the cyclicality of LFPR. That is why it is worthwhile to look at the cyclical components of potential endogenous variables, and to show their basic properties. After extracting the cyclical components, we calculated their basic properties (Table 2). GDP can be characterised by short cycles (on average, 3.8 years long). The cycles of the labour force participation rate were slightly longer than the GDP cycles, lasting an average of 4.9 years. These results confirm the previous research of Gałecka-Burdziak and Pater (2016). Other indicators, including unemployment, job search duration, and wages, fluctuated with higher periodicity, of around 10 years. In line with previous research (Pater, 2014), we have also found that the rate of unemployment underwent strong, persistent fluctuations that lagged the business cycle.

Table 2 does not show whether the cyclical components of the presented variables are related in any way; that is, whether it is valid to consider their relationships. Does the cyclicality of the labour force participation rate depend on the cyclicality of the reference variables? The MUCM results are shown in Table 3. The cycle disturbance correlation coefficient between the labour force participation rate and both the GDP and the UR was about -0.4. The finding of a negative visible correlation may support the presence of both an AWE and a DWE. If the labour force participation decreases as the unemployment rate increases, it may be assumed that the DWE is present in the labour market. On the other hand, when a decrease in wage income is accompanied by an increase in labour market participation, an added worker effect may appear. Moreover, the cycle disturbance variance matrix was not of a full rank. This may mean that there is a common cycle between the variables. The estimated common cycle had an average periodicity of 3.6 years and a coefficient of cyclical variation of 0.11% (Figure 3). This cycle was slightly smaller than the LFPR cycle estimated in a univariate model.

When we looked at the cyclical relationships between the labour force participation rate and real wages and job search duration (Table 3), we saw long-lasting common cycles of about 10 years; in line with the univariate estimates. However, this model did not support the hypothesis that a long job search duration discouraged labour force participation.

Results

We analysed the effects of three shocks — namely, income shock, job search duration shock, and population shock — on the labour force participation rate, the unemployment rate, and the GDP. We started our analysis by identifying the shocks with exclusion restrictions and then with sign restrictions, as described in Section 2: Methods. We estimated a VAR(3) model in differences on the basis of information criteria. Figure 4 displays the effects of all of the analysed shocks on the labour force participation rate.

Around 90% of the variance of the LFPR was explained by the population shock. The income shock was shown to have a negative effect on the LFPR lasting up to eight quarters. This finding was consistent with the added worker effect. The income shock explained up to 10% of the LFPR variance, and its influence then decreased. In the short run, the contribution of the job search duration shock to the LFPR variance was smaller than the contribution of the income shock. As expected, this shock did not have instantaneous effects on the economy. However, the effects of the job search duration shock were more persistent and more stable over time. The job search duration shock explained 5% of the LFPR variance. This means that the AWE was transitory, as workers who entered the labour market out of necessity left it when they were able to do so. The DWE was found, by contrast, to be persistent, as workers who became discouraged often remained so for very long periods of time, as they were not offered sufficient incentives to return to the labour market.

To justify the qualitative implications of these findings, we used the BVAR method to improve the statistical inference power of the quantitative results. We used sign restrictions and identified the effects of both shocks on endogenous variables. Sign restrictions seemed to be more useful in identifying the effects of underlying shocks, because we were dealing with contradictory effects of the AWE and the DWE on the LFPR. We did not want to exclude any effects. Instead, we wanted to test whether the signs imposed based on theory were reflected in real data. We used 200 Markov Chain Monte Carlo sampling replications, 200 sub-draws over the rejection

routine, and 1000 desired draws that met the imposed sign restrictions. Figures 5 and 6 present the impulse-response functions for these shocks. We can see that this identification scheme generally confirmed the previous results, although the effects of both shocks on the LFPR were slightly higher in this case. The application of Fry and Pagan's (2011) median target method confirmed the results. As 1000 draws were accepted in every procedure, it is clear that the sign restrictions we imposed did not represent an unusual pattern of behaviour for the LFPR.

The BVAR model was used to estimate the historical patterns of the added and the discouraged worker effects. The results are shown in Figure 7. The AWE accounted for 0.56% of the LFPR, while the DWE accounted for 0.64% of the LFPR. Even though the initial effects of the income shock were larger, the persistence of discouragement became a very important variable in explaining the changes in the labour force participation rate. Eventually, labour force outflows slightly exceeded labour force inflows. The AWE was more symmetric, with a mean that was close to zero (0.01). The DWE was visibly negative, with a mean of -0.06. The dominance of labour force outflows due to discouragement over subsequent inflows (returns to the labour market) was more visible in the 2000s than in the 1990s. Moreover, the share of labour market re-entrants (after discouragement) was especially low during the 2005–2016 period.

The net effect of the AWE and the DWE combined was mostly negative, with a mean of -0.05 and a contribution to the LFPR of 0.6%. This means that globally, the DWE dominated more often than the AWE did. In this context, the contribution to these effects was greater than it would be for the estimated cyclical components of the LFPR (MUCM results in Section 3: Data). The net labour force flows resulting from the two effects combined were mostly positive in 1995–2001, but were mostly negative after 2001. A notable exception to this trend was the 2009–2010 period. However, this was only a short episode, after which the net AWE/DWE again became negative.

We performed a robustness check of the results by using the same modelling strategy, but different measures of income and the labour market situation (Figures 8 and 9). We took wages as measures of wage income and an explicit measure of the job search duration. The linear correlation between the unemployment rate and the job search duration was found to be 0.64, but the latter value mimics the changes in the former with a visible lag of about six quarters. If we include this lag, the correlation becomes 0.94. The results for this set of variables were very similar to those for the baseline model.

Accounting for the quite poor statistical properties of the VAR model estimates (though they were generally confirmed by BVAR estimates), we investigated the AWE and the DWE broken down by age and sex groups (Figures 10 and 11 in the Appendix). Looking at the impulse response functions, we can see heterogeneity in the effects of shocks between the age groups and the sex groups. Generally, the effects of the shocks faded faster for younger workers and slower for older workers. These effects were also significant for some age and sex groups, and insignificant for others, but with no visible pattern.

We can also see that the two shocks affected males and females similarly in terms of direction and magnitude. The longevity of the effects of the shocks differed slightly, as females were in the labour market for longer periods mostly due to the AWE, while males were out of the labour market for longer periods mostly because of the DWE.

In another breakdown, we looked at the AWE and the DWE for young workers (aged 15–24), prime-age workers (aged 25–44), and immobile-age workers (aged 45 and over). We found that prime-age workers were least affected by the shocks; and that if they were affected, their reaction was brief, and there was no "hysteresis" in the discouragement effect. The magnitudes of the effects of both shocks were similar for younger and older workers, and were greater than they were for prime-age workers. However, the persistence of these effects differed across these groups.

A negative income shock affected the participation rates of younger and older workers about twice as much it affected the participation rates of prime-age workers. However, the reactions of younger and older workers to these shocks differed. Although the resulting AWE lasted for a similarly long period of time for both groups — that is, about 15 quarters (in line with the baseline model) — its effects faded more quickly for younger than for older workers. For older workers, this pace was more evenly distributed over time. Moreover, only older workers were found to be positively motivated to (re)-enter the labour market in the long run if their income increased. However, we observed more dispersion in the reaction to an income shock across older workers, as the impulse response function confidence intervals were the widest in this group.

The impact of a positive job search duration shock was about one-third greater on younger and older workers than on prime-age workers in the quarter when it occurred. The effect of this shock was much more persistent for younger than for prime-age workers, but it still faded more quickly for younger than for older workers. For older workers, the effect of the shock did not decrease at all in the following three years, and then started declining at a very slow pace. Thus, older workers were the most susceptible to

discouragement, and the effects of a job search duration shock were the most uncertain for this group.

Discussion

We examined how changes in economic conditions affected the labour force participation behaviour of workers. As well as responding to business cycle fluctuations, workers may either enter the labour market out of necessity (added worker effect), or leave it following a prolonged and unsuccessful job search (discouraged worker effect). The literature usually indicates whether any of these effects prevails (Congegado *et al.*, 2020), or whether there is a cyclical pattern of labour force participation; that is, whether the invariance hypothesis applies[5] (Congregado *et al.*, 2021). However, this approach is a simplification, as these effects tend to play out differently for different fractions of the population. Our aim in this study was to examine these two effects, both separately and together. While both effects refer to workers who are marginally attached to the labour market, the differences between them imply that the cyclical behaviour of the labour force participation rates can differ. And while the magnitude of these effects may be relatively small, they still reflect non-negligible flows of workers into and out of the labour force and the potential labour supply (Evans, 2018). These effects may be especially important given the ageing of and the decline in the population in Poland. We used various approaches to increase the robustness of the results, and conducted the analysis for the Polish labour market in the 1995–2016 period.

We found that the DWE was persistent, and that workers became discouraged for very long periods of time. This may explain why a long-run relationship between the labour force participation rate and the unemployment rate was found in Poland by Congregado *et al*. (2021), and in Sweden by Österholm (2010). This finding may be explained in part by the relatively long mean job search duration in Poland (i.e., 13.7 months with sd. dev. 2.5 months in 1995–2016). If we also consider that wages in Poland were lower than in other countries in the region, we may conclude that the discouraged worker effect was connected to the migration outflow of Poles. A non-negligible number of emigrants were recruited from the long-term unemployed who were in fact inactive. Polish accession to the European Union enabled Poles to legally work in other EU countries; and there was

[5] Martín-Román (2020) proposed also a new effect related to the cyclical behaviour of the labour supply: the Entitled-Worker Effect (EWE). It differs from the AWE and the DWE, and is a consequence of the unemployment benefit.

substantial emigration through the end of 2016. The emigration flow led to increases in the participation rate, and could have weakened the DWE in the labour market.

The persistence of the discouraged worker effect leads to a "hysteresis" effect, whereby people leave the labour force permanently, even though the shock that initiated their exit was only temporary[6]. This extends the previous finding of Gałecka-Burdziak and Pater (2016) of a strong DWE effect in low business cycle frequencies. Among other reasons for the high levels of discouragement among workers in Poland in the 2000–2004 period were very high unemployment and fierce competition between job seekers. According to data from Public Employment Offices in Poland[7], an average of 40 to 65 unemployed workers were competing for each vacancy during this period. The cohorts from the demographic boom of the early 1980s entered the labour market during this difficult period, which started with a recession, and was followed by a jobless recovery. Moreover, at that time Polish companies were attempting to improve their productivity by investing in physical capital rather than human capital. These economic disruptions led to prolonged periods of unemployment, although the Polish labour market has been improving since 2004.

The added worker effect proved to be transitory, which confirms its strong cyclicality, as reported in Gałecka-Burdziak and Pater (2016). Thus, workers who entered the labour market in response to a decrease in income remained active for a relatively short period of time, and then exited the labour market when they were able to do so.

The net effect of the AWE and the DWE combined was mostly negative. On balance, the DWE was more dominant than the AWE. A notable exception was during the 2009–2010 period, when the labour market conditions in many EU countries worsened considerably because of the lagged effects of the worldwide crisis. By contrast, the Polish labour market remained in fairly good condition. This situation encouraged some emigrants to return to Poland and start looking for a job. The BVAR method accounted for the hysteresis effect in permanent exits from the labour market in response to temporary shocks. In the cyclical components analysis, this effect was not included. This may explain why the contributions of the effects to the LFPR were higher in the BVAR estimates. It is, however, also possible that this was a flaw in many previous studies on the AWE and the DWE. Our analysis indicates that it is important to take into account the

[6] With the duration of unemployment, an individual's employability decreases, which can further hinder the person's successful return to the labour market.

[7] Full statistics are provided at https://psz.praca.gov.pl/rynek-pracy/statystyki-i-analizy/bezrobocie-rejestrowane#

long-lasting consequences of these effects, and especially of the discouraged worker effect.

A robustness analysis generated more detailed findings broken down by age and sex. The results show that there were distinct reactions to shocks by particular labour market cohorts. These results present more detailed evidence of the labour force participation heterogeneity that was previously analysed for Poland in Congregado *et al*. (2020). This narrowed the error bands of the results, especially for prime-age workers. Our findings are largely consistent with previous results published in the literature[8]; that is, a secondary group of workers with a cyclical, marginal attachment to the labour market was identified. The AWE was greater and longer-lasting among women than among men. Younger and older workers responded more than prime-age workers to both effects. Among younger and older workers, the AWE was twice as large and the DWE was about one-third larger than among prime-age workers. The AWE, which is transitory in general, faded even more quickly among younger workers than among older workers. Older workers experienced the most persistent effects, and they were the most susceptible to discouragement. In addition, men were especially likely to experience prolonged periods of discouragement, which confirms previous research conducted for Poland by Congregado *et al.* (2021) using different methods.

Our findings indicate that Poles are susceptible to exiting the labour market. Poles tend to enter the market when they have to (the added worker effect), but do not stay for long. Thus, this effect is only transitory. Moreover, Poles tend to become discouraged, and to remain outside of the labour market for long periods of time. The persistence of the DWE underlines the significance of this phenomenon. Our results therefore indicate that incentives for workers to stay in the market are needed. Some of these incentives should be designed to encourage workers who have entered the market temporarily to remain for longer periods of time, as working longer may be especially beneficial for these individuals. These programmes may address the flexibility of the labour market, or the flexibility of the employment contracts in particular. The eligibility criteria for unemployment benefits should also be reviewed. Other potential policy interventions may be di-

[8] Darby *et al.* (1998) found evidence of the discouraged worker effect, especially among females aged 45–54. Their findings also indicated that the decreases in labour force participation during recessions were larger than the increases during expansions. The results of Altavilla *et al*. (2005) implied that female labour force participation was time-varying. Congregado *et al*. (2011, 2014) found a linear discouraged worker effect for males and a non-linear added worker effect for females. Fuchs and Weber (2013) found that both discouraged and added worker effects exist, but that members of different age groups respond differently to permanent and transitory changes in the unemployment rate.

rected at workers who are currently in the labour market, but who may become discouraged. These policy measures should seek to convince workers to remain in the market by improving their employability chances through, for example, broadening the perspective of employment offices' intermediation efforts, or targeting active labour market policy programmes more effectively. The latest round of labour market policy decisions that have been implemented in Poland have provided strong disincentives to remain in the labour market, especially for females living in rural areas. The "Family 500+" programme gives each family 500 PLN per child[9]. Under this programme, it does not pay off for both parents to work if they have several children. This is especially likely to be the case in rural areas, where access to pre-school is low, and most jobs typically held by women are relatively low-paid. The introduction of such disincentives to work may lead to a long-lasting decrease in the country's labour supply.

Conclusions

In this paper, we examined the AWE and the DWE at the macro level. In contrast to previous research, we attempted to disentangle each effect by modelling them as resulting from separate shocks. In a labour market that is not fully competitive, the AWE can be examined as resulting from a negative shock to the wage rate, whereas the DWE can be analysed as resulting from a positive shock to job search duration. Hence, we were able to examine these effects simultaneously, as well as separately. This approach is especially useful given that these phenomena affect different parts of the population in the labour market differently. We performed our empirical analysis based on data for the Polish labour market in the 1996–2016 period, both overall and broken down by age and sex.

We found evidence of a transitory added worker effect and a persistent discouraged worker effect. During most of the study period, the DWE prevailed, except in 2009–2010. A more detailed analysis led us to conclude that there were large heterogeneities in certain age-sex groups. Based on our results, we can infer that workers who entered the labour market out of necessity were more likely to leave it when they were able to do so, and that Poles were very prone to leaving the labour market for market reasons.

[9] Prior to July 2019, the benefit for the first child was subject to income level conditions. Hence, we did not observe this effect directly due to the time span we analysed. Nevertheless, research has provided evidence of the non-negligible impact of this programme on labour force participation (compare Magda *et al*., 2020).

Given the country's high demand for labour and labour supply shortages, we argue that Poland needs a clear set of policy interventions aimed at encouraging workers to re-enter the labour market, and to remain in it permanently, or for longer periods of time. A number of changes in labour market institutions — including changes in the flexibility of the labour market, tax wages, employment intermediation, and eligibility for benefits — could affect the potential labour supply and the employability of workers by encouraging adjustments in worker qualifications, and by making job searches easier. In future research, we will test the non-linearity of the two effects separately. We also plan to apply our approach to other countries, testing whether the model holds and the results are similar to those in Poland, or whether they are country-specific.

References

Agell, J. (1999). On the benefits from rigid labour markets: norms, market failures, and social insurance. *Economic Journal, 109*(453), 143–164.

Altavilla, C., Garofalo, A., & Vinci, C.P. (2005). Is the discouraged worker effect time-varying? *CELPE Discussion Papers*, *97*.

Altuzarra, A., Gálvez Gálvez, C., & González Flores, A. (2019). Unemployment and labour force participation in Spain. *Applied Economics Letters*, *26*(5), 345–350. doi: 10.1080/13504851.2018.14703.

Baslevent, C., & Onaran, O. (2003). Are married women in Turkey more likely to become added or discouraged workers? *Labour*, *17*(3), 439–458.

Benati, L. (2001). Some empirical evidence on the 'discouraged worker' effect, *Economics Letters*, *70*(3), 387–395. doi: 10.1016/S0165-1765(00)00375-X.

Bredtmann, J., Otten, S., & Rulff, C. (2018). Husband's unemployment and wife's labor supply: the added worker effect across Europe. *ILR Review*, *71*(5), 1201–1231. doi: 10.1177/0019793917739617.

Battalio, R. C., Green, L., & Kagel, J. H. (1981). Income-leisure tradeoffs of animal workers. *American Economic Review, 71*(4), 621–632.

Coglianese, J. (2018). The rise of in-and-outs: declining labor force participation of prime age men. Harvard University. Retrieved from https://scholar.harvard.edu/files/coglianese/files/coglianese_2017_in-and-outs. pdf.

Congregado, E., Golpe, A., & van Stel, A. (2011). Exploring the big jump in the Spanish unemployment rate: evidence on an 'added worker effect'. *Economic Modelling*, *28*(3), 1099–1105. doi: 10.1016/j.econmod.2010.11.018.

Congregado, E., Golpe, A. A., & Carmona, M. (2012). Unemployment invariance hypothesis and structural breaks. *Empirical Economics Letters, 11*(5).

Congregado, E., Carmona, M., Golpe, A., & van Stel, A. (2014). Unemployment, gender and labor force participation in Spain: future trends in labor market. *Romanian Journal of Economic Forecasting*, *17*(1), 53–66.

Congregado, E., Gałecka-Burdziak, E., Golpe, A., & Pater, R. (2020). Asymmetry and non-linearity in discouraged and added worker effects. *Eastern European Economics*, *58*(3), 221–241. doi: 10.1080/00128775.2019.1710215.

Congregado, E., Gałecka-Burdziak, E., Golpe, A. A., & Pater, R. (2021). Unemployment invariance hypothesis and structural breaks in Poland. *Journal of Economic Asymmetries*, *24,* e00198. doi: 10.1016/j.jeca.2021.e00198.

Dagsvik, J., Kornstad, T., & Skjerpen T. (2006). Analysis of the discouraged worker phenomenon. Evidence from micro data. *Discussion Papers. Statistics Norway, Research Department*, 453,.

Dagsvik, J., Kornstad, T., & Skjerpen, T. (2013). Labor force participation and the discouraged worker effect. *Empirical Economics, 45*, 401–433. doi: 10.1007/s 00181-012-0598-9.

Danne, C. (2015). VARsignR: Estimating VARs using sign restrictions in R. *MPRA*, *68429*.

Darby, J., Hart, R., & Vecchi, M. (1998). Labour force participation and the business cycle: a comparative analysis of Europe, Japan and the United States. *Working Papers, Business School – Economics, University of Glasgow*, *9802*.

Ehrenberg, R. G., & Smith, R. S. (2006). *Modern labor economics: theory and public policy*. Utgave.

Emerson, J. (2011). Unemployment and labor force participation in the United States. *Economics Letters*, *111*(3), 203–206. doi: 10.1016/j.econlet.2011.02. 022.

Euwals, R., Knoef, M., & van Vuuren, D. (2011). The trend in female labour force participation: what can be expected for the future? *Empirical Economics*, *40*(3), 729–753. doi: 10.1007/s00181-010-0364-9.

Evans, A. (2018). Evidence of the added-worker and discouraged-worker effects in Australia. *International Review of Applied Economics*, *32*(4), 472–488. doi: 10.1080/02692171.2017.1351530.

Filatriau, O., & Reynes, F. A. (2012). New estimate of discouraged and additional worker effects on labor participation by sex and age in OECD countries. *OFCE Document de travail*, *2012-09*.

Finegan, T. (1981). Discouraged workers and economic fluctuations. *Industrial and Labor Relations Review*, *35*(1), 88–102. doi: 10.2307/2523144.

Fry, R., & Pagan, A. (2011). Sign restrictions in structural vector autoregressions: a critical review. *Journal of Economic Literature*, *49*(4), 938–960. doi: 10.1257 /jel.49.4.938.

Fuchs, J., & Weber, E. (2013). A new look at the discouragement and the added worker effect hypotheses: applying a trend-cycle decomposition to unemployment. *Applied Economic Letters*, *20*(15), 1374–1378. doi: 10.1080/13504851.2 013.812777.

Gałecka-Burdziak, E., & Pater, R. (2016). Discouraged or added worker effect? Which one prevails in the Polish labour market? *Acta Oeconomica*, *66*(3), 491–507. doi: 10.1556/032.2016.66.3.6.

Guner, N., Kulikova, Y., & Valladares-Esteban, A. (2020). Does the added worker effect matter? *IZA Discussion Paper*, *12923*.

Harvey, A. C. (1989). *Forecasting structural time series models and the Kalman filter*. Cambridge: Cambridge University Press.

Kakinaka, M., & Miyamoto, H. (2012). Unemployment and labor force participation in Japan. *Applied Economic Letters*, *19*(11), 1039–1043.

Kaldor, N. (1957). A model of economic growth. *Economic Journal, 67*(268), 591–624.

Karaoglan, D., & Okten, C. (2015). Labor-force participation of married women in Turkey: a study of the added-worker effect and the discouraged-worker effect. *Emerging Markets Finance and Trade*, *51*(1), 274–290, doi: 10.1080/1540496X.2015.1011535.

Koopman, S. J., Harvey, A. C., Doornik, J. A., & Shephard, N. (2009). *Structural time series analyser, modeller and predictor STAMP™ 8.2*. London: Timberlake Consultants.

Lee, G., & Parasnis, J. (2014). Discouraged workers in developed countries and added workers in developing countries? Unemployment rate and labour force participation. *Economic Modelling*, *41*, 90–98. doi: 10.1016/j.econmod.2014.04.005.

Lundberg, S. (1985). The added worker effect. *Journal of Labor Economics, 3*(1), 11–37.

Magda, I., Kiełczewska, A., & Brandtc, N. (2020). The effect of child benefit on female labor supply. *IZA Journal of Labor Policy*, *10*(1), doi: 10.2478/izajolp-2020-0017.

Mankart, J., & Oikonomou, R. (2016). The rise of the added worker effect. *Economics Letters*, *143*, 48–51. doi: 10.1016/j.econlet.2016.03.019.

Martín-Román, Á. L. (2020). Beyond the added-worker and the discouraged worker effects: the entitled-worker effect. *GLO Discussion Paper*, *707*.

McConnell, C. R., Brue, S. L., & MacPherson, D. A. (2006). *Contemporary labor economics. International edition.* McGraw Hill Irwin.

Narayanan, S., Das, U., Liu, Y., & Barrett, C. B. (2017). The "discouraged worker effect" in public works programs: evidence from the MGNREGA in India. *World Development, 100*, 31–44. doi: 10.1016/j.worlddev.2017.07.024.

O'Brien, M. (2011). Discouraged older male workers and the discouraged worker effect. *Australian Journal of Labour Economics*, *14*(3), 217–235.

Österholm, P. (2010). Unemployment and labour-force participation in Sweden. *Economics Letters*, *106*(3), 205–208. doi: 10.1016/j.econlet.2009.12.002.

Pater, R. (2014). Are there two types of business cycles? A note on crisis detection. *e-finanse*, *10*(3), 1–28. doi: 10.14636/1734-039X_10_3_004.

Rubio-Ramirez, J. F., Waggoner, D., & Zha, T. (2010). Structural vector autoregressions: theory of identification and algorithms for inference. *Review of Economic Studies*, *77*(2), 665–696. doi: 10.1111/j.1467-937X.2009.00578.x.

Schweitzer, S. O., & Smith, R. E. (1974). The persistence of the discouraged worker effect. *ILR Review, 27*(2), 249–260.

Stephens, M. (2001). Worker displacement and the added worker effect. *NBER Working Paper,* 8260.

Tansel, A., & Ozdemir, Z. A. (2018). Unemployment invariance hypothesis, added and discouraged worker effects in Canada. *International Journal of Manpower*, *39*(7), 929–936. doi: 10.1108/IJM-04-2017-0059.

Van Ham, M., Mulder, C. H., & Hooimeijer, P. (2001). Local underemployment and the discouraged worker effect *Urban Studies*, *38*(10), 1733–1751.

Acknowledgements

This article was prepared within a project: "The cyclicality of the labour force participation. The added/discouraged worker effect analysis" financed by the National Science Centre Poland, project no. UMO-2016/21/D/HS4/02808.

Annex

Table 1. ADF unit root test results

Variables	t-Statistic	Prob.
Labour force participation rate	-1.86	0.35
Rate of unemployment	-3.36	0.06
Real Gross Domestic Product	0.46	0.98
Average duration of job search	-1.25	0.65
Real average monthly wages	-1.23	0.66

Table 2. Properties of cycles estimated with the UCM

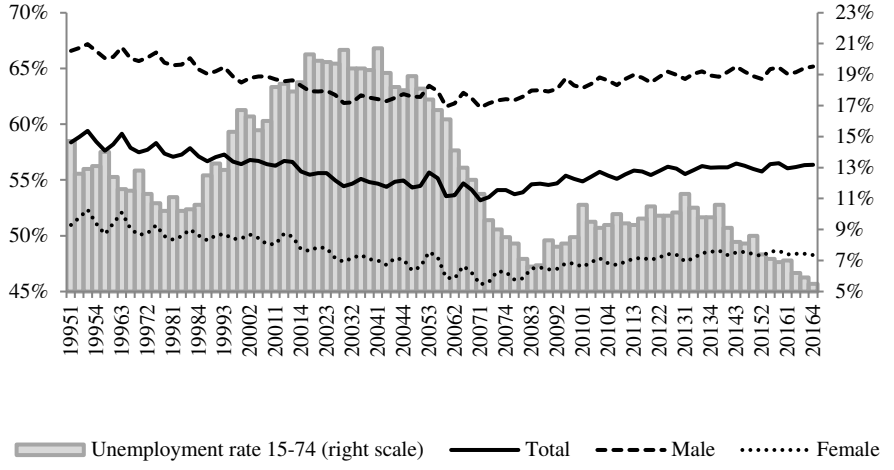
Variable	Period in years	Frequency in radians	Coefficient of cyclical variation*
Labour force participation rate	4.86	0.32	0.13%
Rate of unemployment	10.40	0.15	18.85%
Real Gross Domestic Product	3.82	0.41	0.06%
Average duration of job search	10.29	0.15	4.19%
Real average monthly wages	9.67	0.16	0.51%

* Coefficient of cyclical variation was calculated as a ratio of s.d. of the cyclical component to the mean of the raw time series.

Table 3. Cyclical relationships according to the estimates of the MUCM

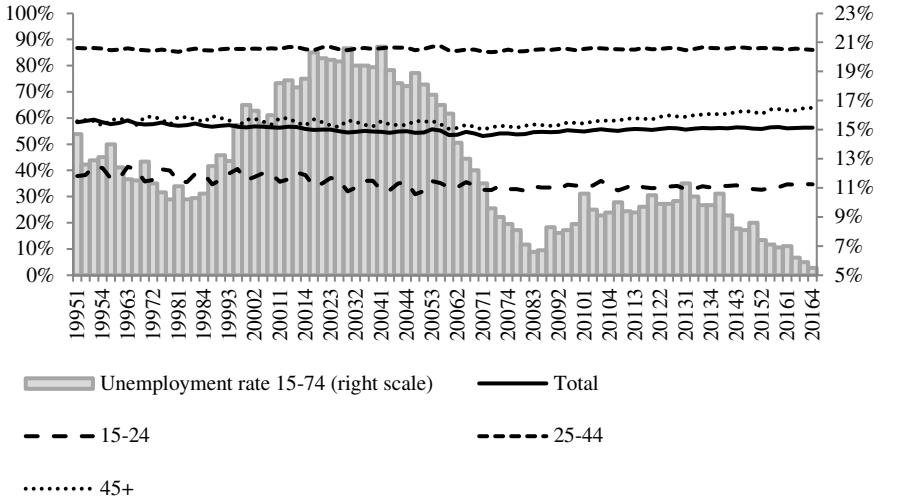
Endogenous variables	Cycle disturbance correlation	Eigenvalue in %	Cycle period in years
Labour force participation rate cycles with:			
Real Gross Domestic Product	-8.3e-7	0.33	3.74
Rate of unemployment	-1.00	-1.3e-15	3.42
Unemployment rate & GDP	-0.41 -0.38	6.58 1.2e-16	3.58
Job search duration	-1.00	1.1e-16	9.98
Real monthly wages	-1.00	7.9e-4	9.79
Job search duration & Real monthly wages	0.95 -0.94	1.45 -4.0e-16	10.49

Figure 1. Labour force participation rate, broken down by gender and the rate of unemployment for Poland



Source: own elaboration based on data from Central Statistical Office in Poland.

Figure 2. Labour force participation rate, broken down by age and the rate of unemployment for Poland



Source: own elaboration based on data from Central Statistical Office in Poland.

Figure 3. Estimated common cycle between LFPR, GDP, and UR

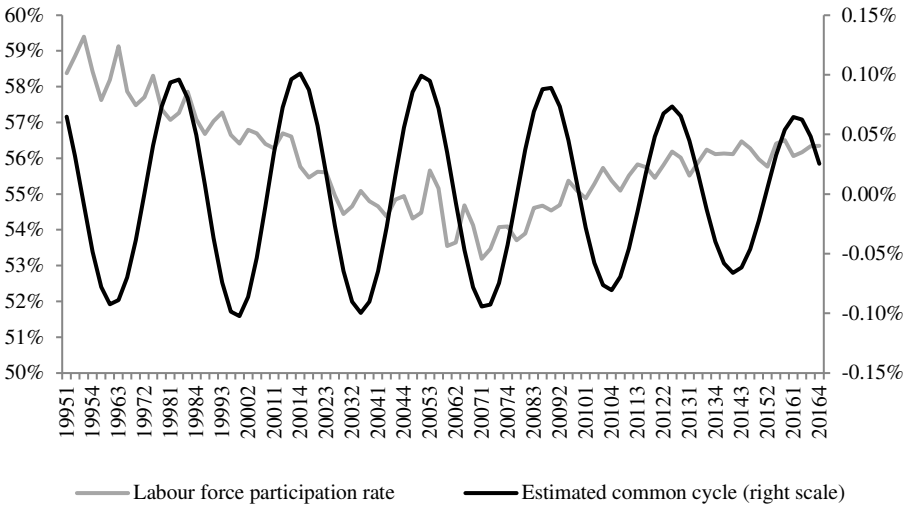


Figure 4. Response of LFPR to 1 s.d. shocks on the basis of a VAR(3) model in differences with 95% confidence intervals. From the left: (positive) income shock, demographic shock, and job search time shock

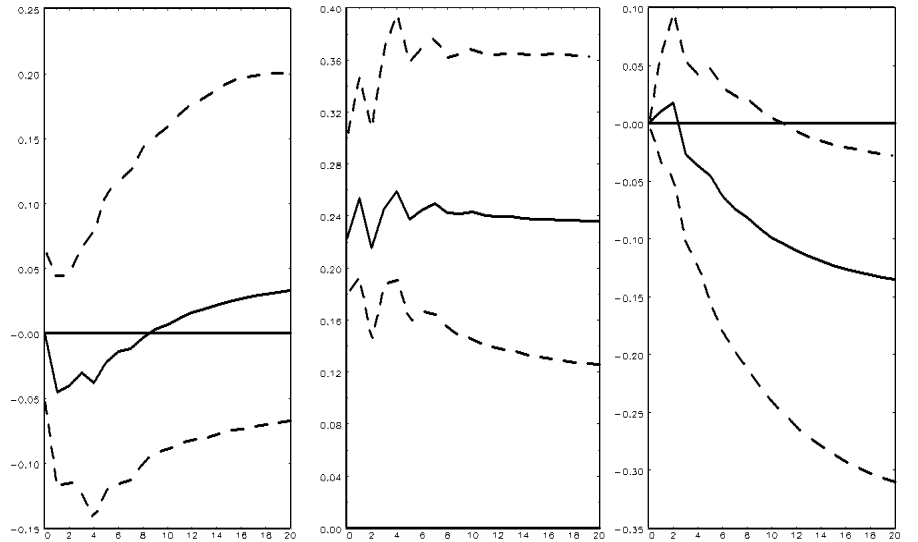


Figure 5. Response of endogenous variables to 1 s.d. negative income shock with 68% error bands

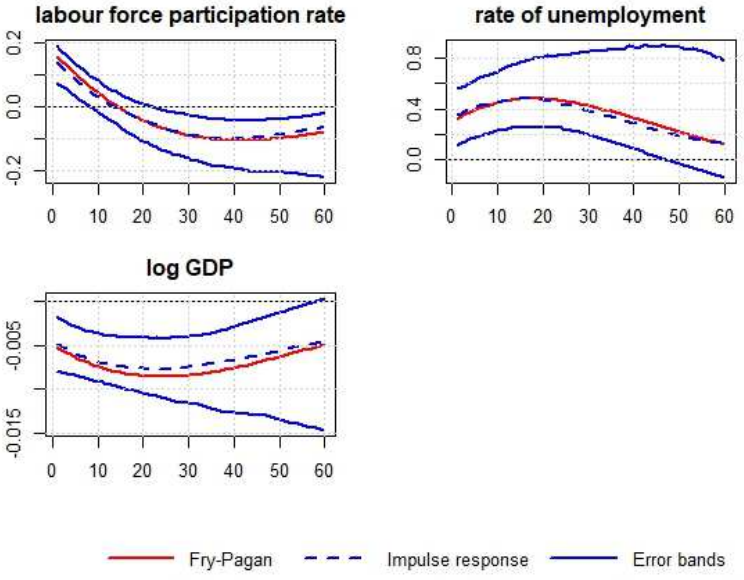


Figure 6. Response of endogenous variables to 1 s.d. positive job search time shock with 68% error bands

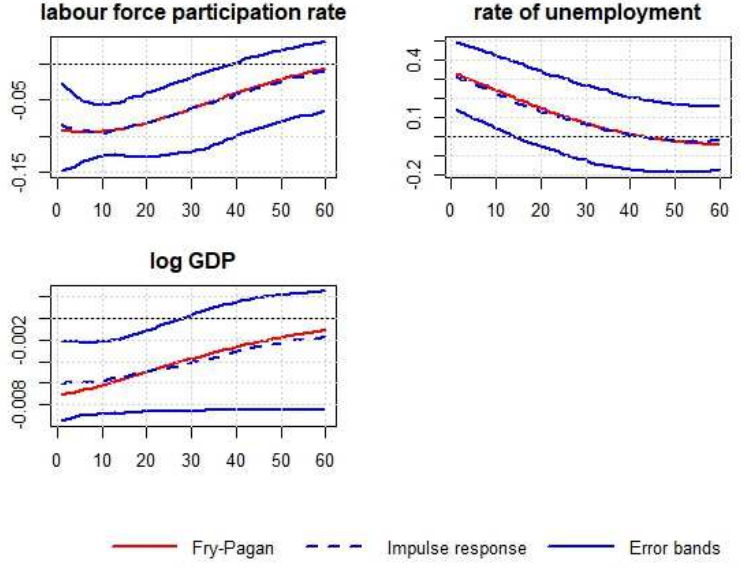


Figure 7. Estimated added and discouraged effect from a historical perspective

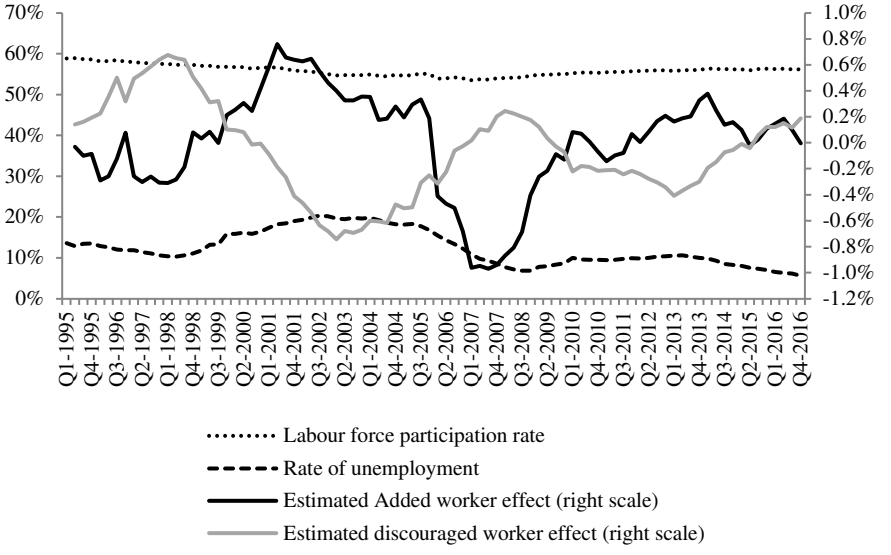


Figure 8. Response of endogenous variables to 1 s.d. negative income shock with 68% error bands — different measures for endogenous variables

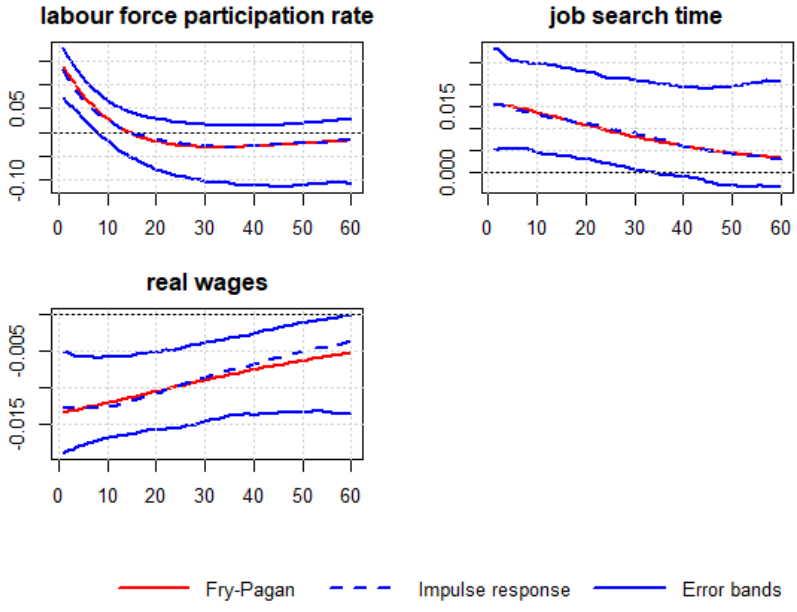


Figure 9. Response of endogenous variables to 1 s.d. positive job search time shock with 68% error bands – different measures for endogenous variables

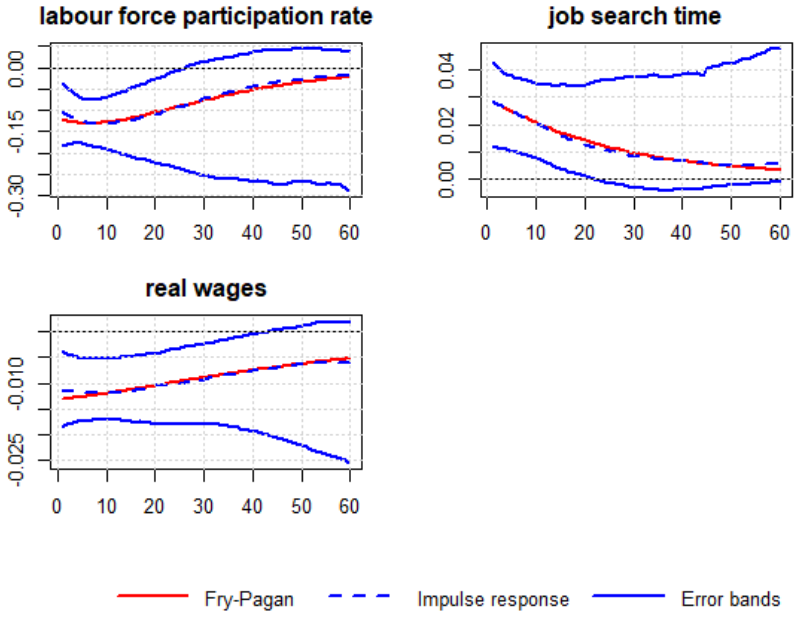


Figure 10. Response of LFPR to negative income shock across gender and age groups

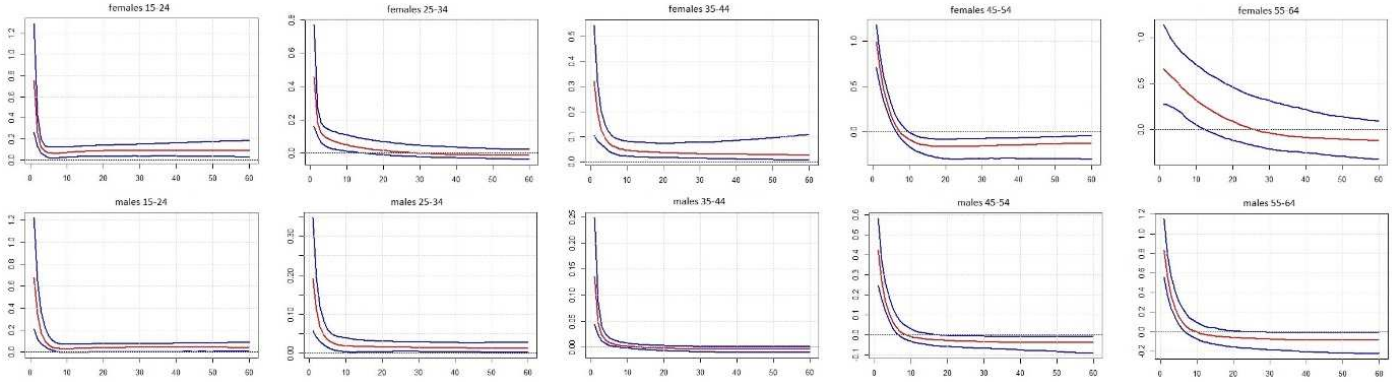


Figure 11. Response of LFPR to positive job search time shock across gender and age groups