BANCA D'ITALIA
EUROSISTEMA

Temi di Discussione

(Working Papers)

Labor force participation, wage rigidities, and inflation

by Francesco Nucci and Marianna Riggi

February 2016

Number 1054

BANCA D'ITALIA
EUROSISTEMA

Temi di discussione

(Working papers)

Labor force participation, wage rigidities, and inflation

by Francesco Nucci and Marianna Riggi

Number 1054 - February 2016

ISSN 1594-7939 (print)
ISSN 2281-3950 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

LABOR FORCE PARTICIPATION, WAGE RIGIDITIES, AND INFLATION

by Francesco Nucci[+] and Marianna Riggi*

Abstract

The fall in US labor force participation during the Great Recession stands in sharp contrast with its parallel increase in the euro area. In addition to structural forces, cyclical factors are shown to account for this phenomenon, with the participation rate being procyclical in the US from the inception of the crisis and countercyclical in the euro area. We rationalize these diverging dynamics by using a general equilibrium business cycle model, which nests the endogenous participation decisions into a search and matching model. We show that the "added worker" effect might outweigh the "discouragement effect" if real wage rigidities are allowed for and/or habit in consumer preferences is sufficiently strong. We then draw the implications of variable labor force participation rates for inflation and establish the following result: if endogenous movements in labor market participation are envisaged, then the degree of real wage rigidities becomes almost irrelevant for price dynamics. Indeed, during recessions, the upward pressures on inflation stemming from the lack of a downward adjustment in real wages are offset by an opposite influence from the additional looseness in the labor market, due to the higher participation rate associated with wage rigidities.

JEL Classification: E31, E32, E24.
Keywords: labor force participation, real wage rigidities, habit, inflation, discouragement effect, added worker effect.

Contents

[+] Sapienza, University of Rome.

* Bank of Italy, Directorate General for Economics, Statistics and Research.

1 Introduction[1]

The understanding of cyclical and structural developments in the labor market is a key challenge for monetary policy both in the US, where maximum employment is a statutory objective, and in the euro area, as labor market slack has implications for inflation (Draghi, 2014). Since the onset of the Great Recession, the disentanglement between cyclical and structural forces underlying labor market dynamics has become even more complex as the pattern of many variables has markedly changed relative to the postwar period (Farber, 2011).

In dealing with these issues at the Jackson Hole Symposium, Fed Chair Janet Yellen (2014) has placed strong emphasis on the behavior of labor market participation. In the US economy the labor force participation rate has fallen by about three percentage points in the wake of the Great Recession and a relevant share of this decline reflects the severity of the downturn and the weakness of the US labor market in that period. In a recent study, Erceg and Levin (2014) show that cyclical forces account for the bulk of the recent fall in the US participation rate, which has exhibited a procyclical pattern since 2007 while it was essentially acyclical during the previous post-war period (see also, among others, Van Zandweghe, 2012; Aaronson, Davis and Hu, 2012; and Fujita, 2014).

Against this background, a strikingly different behavior of labor market participation has been recorded in the euro area, with an increase throughout the Great Recession period. We provide evidence that this post-2007 rising pattern in the euro area labor force participation rate is to some extent attributable to cyclical factors and, in contrast to the US economy, participation in the euro area has displayed a countercyclical profile since 2008, while it was substantially acyclical beforehand.

By using a theoretical model of fluctuations with endogenous labor force participation, we propose a structural interpretation of these diverging developments in the two areas and shed light on the implications that the cyclical pattern of the participation rate might have for inflation.

The theoretical model integrates nominal price rigidities à la Calvo (1983) and search and matching frictions in the labor market. Our framework is in line with the modern theory of unemployment fluctuations à la Diamond-Mortensen-Pissarides, that reads unemployment as an equilibrium phenomenon in which the volumes of job-seeking by workers

[1] We thank Regis Barnichon, Raf Wouters and participants to the ECB conference "Challenges for Macroeconomic Policy in a Low Inflation Environment" (2015) and to the Bank of Italy's Workshop on "Low Inflation and its Implications for Monetary Policy" (2015) for helpful comments. The views expressed herein are those of the authors and do not necessarily reflect those of the Bank of Italy.

and worker-seeking by employers reach a balance determined by the relative prices of the two activities. Differently from standard models of the business cycle, the household's labor supply decision also includes the proportion of the family members that should participate in market work activities rather than contribute to housework.

We show that during recessions the fall in the chances of finding a job and the decline in real wages drive potential workers out of the labor force. This is the so called *discouragement effect*, which leads to a procyclical response of labor force participation to shocks, as in the US economy. However, a different scenario emerges when real wage rigidities are allowed for. The latter prevent the workers' pays from falling as much as the reservation wages, thus inducing a countercyclical profile of the wage markup. We show that this feature, combined with habits in consumers' preferences, which result in the household aiming at maintaining pre-crisis consumption level, yields a different prediction for the response of labor supply to contractionary shock. Indeed, non-participating family members might be prompted to seek jobs during a severe downturn. This effect, which came to be known in the literature as the *added worker effect,* implies a countercyclical profile of labor force participation, as the one documented in the euro area during the Great Recession.

After rationalizing the cyclical movements in labor force participation, we draw their implications for price dynamics. In general, the cyclical pattern of labor market participation weighs on inflation by affecting labor market tightness, i.e. the balance between the demand for, and the supply of, labor. An increase in the number of participants makes the labor market looser. A looser labor market exerts a downward pressure on inflation by reducing hiring costs and by inducing a downward pressure on wages, because both the worker's outside option during the bargaining process and the firm's surplus from an established employment relationship do decrease. Based on these channels, we establish a new, and perhaps surprising, result. When endogenous participation decisions are allowed for, the degree of real wage rigidities becomes almost irrelevant for inflation dynamics.

According to a workhorse new Keynesian model, that abstracts from endogenous movements in labor force participation, real wage rigidities shrink the response of inflation to demand shocks and amplify the response of inflation to supply shocks, by limiting the downward (upward) adjustment of real wages during recessions (booms). We show that, when endogenous developments in labor force participation are allowed for, a high degree of wage rigidities induces countercyclical movements in labor supply, whose effects on inflation countervail those of opposite sign induced by the wage rigidities themselves. Overall, inflation dynamics turn out to be not affected by the degree of real wage rigidities.

This outcome recalls the result of Krause and Lubik (2007), who show that, in a new Keynesian model with search and matching frictions, the allocative role of real wages is reduced, as hiring frictions drive a wedge between the effective real marginal cost and unit labor cost. The former can change even if the real wage does not, as the effective real marginal cost is given by unit labor cost plus an additional dynamic term that depends on the difference between the current value of the average worker and the expected cost of hiring. Importantly, however, a novel dimension of our own finding is that, because of the endogenous movements in labor force participation, the real wage bill and this additional dynamic term are affected in opposite direction by real wage rigidities. Hence, we show that the effects of wage rigidities on inflation dynamics, rather than being reduced relative to a frictionless labor market, become almost nil if the endogeneity of participation is allowed for.

The general message is that the assessment of the impact of wage rigidities on inflation cannot ignore the effects that wage rigidities generate on labor supply, an additional important channel that has been neglected so far in the literature.

The paper is organized as follows. Section 2 presents some evidence on the patterns of labor force participation in the US and in the euro area with a focus on the cyclical developments. Section 3 sets up the theoretical model. Section 4 points out the features which determine a countercyclical versus a procyclical response of labor market participants. Section 5 discusses the implications for inflation. Section 6 concludes.

2 Labor force participation in the US and the euro area

A notable feature of the Great Recession in the aftermath of the global financial crisis is the sharp increase in the unemployment rate in both the US and the euro area. Indeed, the pattern of the unemployment rate has been similar across the two regions from 2008 through early 2011, with a steep rise and a subsequent reduction, although in 2011 the sovereign debt shock, specific to the euro area, has induced a second increase in its unemployment rate in contrast with its continuing fall in the US.

Against this backdrop, the behavior of labor force participation is markedly diverging in the two areas throughout the whole period associated with the Great Recession. The declining pattern of the labor force participation rate (LFPR) in the US economy stands in sharp contrast with the parallel increase in the euro area. These opposite patterns are a peculiar feature of the Great Recession; however they are not exclusive to that period, as labor market participation started to decline in the US economy at around the turn of the 21st century (albeit at a lower rate) while a rise of the participation rate in the euro area was recorded throughout the whole past decade. Figure 2 compares the diverging development in participation in the two regions by focusing on the labor force aged 15-64 (i.e. persons in that age group that are employed or actively seek work) as a percentage of the total population in the same age class. In this section, we document the recent behavior of labor force participation in the US and the euro area with a particular focus on the role of cyclical developments.

2.1 Developments in labor market participation in the US

In the United States the labor force participation rate of the civilian noninstitutional population aged 16 and older has attained a peak of 67.3 per cent in early 2000 and has declined thereafter, being about 66 per cent at the end of 2007 and reaching a level below 63 per cent at the end of 2014 (62.8 per cent in the fourth quarter). To understand these developments and assess the role of cyclical factors during the Great Recession, it is important to broaden the perspective and recall first that, between mid-1960s and 2000, the labor force participation has steadily risen in the US. There are long-run demographic, cultural and institutional factors that account for this pattern, which reflects heterogeneous developments across age and gender groups. In the 1970s and 1980s, when the baby-boom generation (i.e. the individuals born between mid-1940s and mid-1960s) grew up and entered the prime-age group (25 to 54 years), which is typically characterized by a higher degree of participation to the labor market, a steep rise of the aggregate participation rate has occurred due to the shift in the composition of the population. Moreover, a steady upward trend has been documented in female labor participation since 1948, which reached a level of about 60 per cent in mid-1990s. In addition to that, the developments in health and the increase of longevity have induced individuals to postpone retirement so as to accumulate more wealth in order to face lengthier retirement periods. Finally, technological progress and the increases in the endowment of skills and human capital have prompted a structural change in the distribution of jobs with a higher proportion of occupations with longer careers length (see Aaronson, Davis and Hu, 2012 and Van Zandweghe, 2012; Burlon and Vilalta-Bufí 2014, and the references therein).

Against this background, the most important structural factor behind the decline of the US labor force participation rate since 2000 is the increasing share of older-age individuals (55 and over) in the working age population as the baby-boom generation becomes old and progressively shifts towards age groups with lower participation rates compared to those of prime-age individuals. Another development explaining the drop in the US participation rate since its peak in the early 2000's is the decline in the labor market participation among the younger-age group which largely mirrors a higher incidence of schooling and has been even more evident since the start of the Great Recession (see Aaronson, Park and Sullivan, 2006 and Aaronson, Davis and Hu, 2012). Moreover, a significant portion of the decline in the US participation rate since 2000 is due to the increase of disability rates and, since 2010 only, in retirement rates also (Fujita, 2014). Barnichon and Figura (2015) document a decline over the past 30 years in the share of nonparticipants who report wanting to work and argue that this decline has contributed to a large extent to the downward trend in US participation over the past two decades. They also show that reforms in the area of welfare and social insurance can account for about 50 per cent of the decrease in the desire to work among nonparticipants.

Whilst the drop of labor force participation begins before the Great Recession, it has been more pronounced since then. Several contributions have convincingly shown that cyclical factors play a relevant role in accounting for these developments and, in particular, movements in the labor force participation rate since 2007 largely reflect a pro-cyclical component. Indeed, some studies document a stronger relationship between labor force participation and the business cycle in coincidence with the Great Recession, showing that the cyclical component of the participation rate significantly moves in the same direction as that of the state of the economy, contrary to the previous post-war period when participation was acyclical. For example, Van Zandweghe (2012) examines the correlation between the unemployment rate and changes in LFPR and finds that, since 2007, it is equal to -0.13, while the two series were previously uncorrelated. Moreover, he documents that between 2007 and 2011 the average correlation of the LFPR and the unemployment rate across US states has changed to -0.52, from the lower levels (in absolute value) recorded over the previous periods. Interestingly, Van Zandweghe (2012) also performs a multivariate Beveridge-Nelson decomposition and finds that cyclical factors accounts for 58 per cent of the decline in LFPR over the 2007-2011 period.

Similarly, Erceg and Levin (2014) provide convincing evidence that the bulk of the post-2007 drop in the US labor force participation is due to cyclical developments. In particular, they estimate a linear regression on cross-section data on the US states, where the change in the LFPR for prime-age adults over the period 2007 to 2012 is regressed on a constant and the corresponding change of the unemployment rate. They find that the coefficient on the change in unemployment is negative and highly significant while the regression intercept is not statistically different from zero. Erceg and Levin (2014) also use labor force projections released by the BLS in 2007 and document that the influence of demographic factors on the pronounced post-2007 decline of the US participation rate is rather limited (see Canon, Debbaut and Kudlyak, 2013 for a note of caution on this). Also Fujita (2014) argues that the drop in the participation rate has been driven by both structural, long-run factors and business cycle conditions. In particular, he delves into the Current Population Survey (CPS) micro data and shows that the increased incidence of "discouraged workers" since the Great Recession explains about 30 per cent of the total decline in the participation rate between 2007 and 2011.

There is therefore agreement on the view that cyclical factors do play a role in accounting for recent dynamics in the US labor market participation.[2] On the other hand, as emphasized by Fed Chair Janet Yellen (2014), this does not imply that a line of distinction can be easily drawn between structural and cyclical factors, as several developments during the Great Recession - such as the change in disability rates, retirement choices and educational enrollments - are likely to reflect forces of both types. This, of course, applies also to the euro area, to which we now turn, where the participation to the labor market, however, has exhibited a markedly different pattern.

2.2 Developments in labor market participation in the euro area

In the euro area the labor force participation rate of the working age population (15-64) has steadily risen from 67.5 per cent in 2000 to 71 per cent at the end of 2007 and has reached 72.4 per cent in the third quarter of 2014. This post-2007 increase in labor market participation is common to the vast majority of euro area countries with Ireland and Portugal as sole exceptions. This increasing path is shown in Figure 2 for both the euro area and its largest four countries (see European Central Bank, various years).

As is well known, the aggregate participation rate hides large heterogeneity across population groups and across countries. In a long run perspective, the participation rate has grown in the euro area since the early 80s and this pattern originates from a steady increase in the female participation rate and a parallel gradual decline of the male participation rate until mid-90s, followed by a weak increase thereafter. Moreover,

[2] Hotchkiss and Rios-Avila (2013) find that the dramatic decline in the LFPR during the Great Recession is explained almost entirely by cyclical factors. See also Bengali, Daly and Valletta (2013). An exception is Bullard (2014), who argues that the actual level of labor force participation rate in the US is not far from its trend and therefore its cyclical component is relatively small.

the participation to the labor market among young individuals (aged 15-24) has declined markedly since mid-80s for both women and men while, on the contrary, a steady increase in participation has been recorded for the group of older individuals since about mid-90s (see Balleer, Gómez-Salvador and Turunen, 2009). Data from 2000 onwards confirm this evidence for women and men of the age groups 55-64 and 65-74.

Changes in preferences, social norms and cultural attitude towards work explain the women's increasing participation to the labor market. On the other hand, shifts in the institutional settings of the labor market and pension reforms have induced a postponement of the retirement age across several countries of the region, positively affecting the participation rate. Immigration from non-euro area countries has also contributed positively to labor supply. Moreover, demographic factors have played a role in the overall rise of participation until 2007 due to the increased share of the population in prime working age (see European Central Bank, 2008).[3]

As for the United States, the pattern of labor force participation in the euro area in the post-2007 period reflects pre-existing structural, long run developments. However, part of the increase in participation during the Great Recession is likely to reflect cyclical factors. In particular, in the wake of a severe downturn, alongside a possible discouragement effect, the added worker effect may also materialize. That is, the households' labor supply might increase after idiosyncratic and/or economy-wide income shocks associated with employment losses or severe wage cuts. Indeed, the decision to switch status and participate to the labor market during a deep downturn aims at compensating for the possibly large and protracted income contraction within the household (see European Central Bank, various issues). The worker added effect would therefore contribute to a counter-cyclical response to shocks of labor force participation, especially that of women.

In this section we investigate whether the cyclical component of labor force participation rate in the euro area during the Great Recession exhibits significant co-movements with the state of the economy and we establish the sign of this co-movement. We provide some evidence that in the post-2007 period the cyclical component of labor force partici-

[3]During the Great Recession, on the contrary, the change of the population structure has acted in the direction of decreasing, rather than increasing, the aggregate participation rate. To show this, we calculated the hypothetical labor force participation rates throughout the 2007-2013 period by holding the population shares across age groups fixed at 2007 levels. By comparing these rates with the corresponding actual ones no notable differences emerge. However, we also constructed a hypothetical participation rate by keeping fixed the participation rates of each age group at their 2007 figures while allowing the population shares to vary. These counterfactual rates are systematically lower than the corresponding actual rates, suggesting that the observed shifts in the population distribution have contributed to drive down the participation rate.

pation in the euro area has evolved in the opposite direction to that of the business cycle, displaying a countercyclical profile. On the other hand, by considering a longer sample the evidence points to a rather acyclical pattern of the participation rate.

In Table 1 we report regression results on quarterly data for the euro area where the de-trended quarterly LFPR, derived with the Hodrick-Prescott (HP) filter, is regressed on the rate of change in real GDP. The estimated coefficient associated to the latter variable is negative and statistically significant (-0.088 with a standard error of 0.043) when we focus on the post-2007 period and consider both women and men in their working age (see column 1). We also report regression results over a longer sample where the coefficient associated to GDP growth is allowed to vary depending on the sub-sample (see column 2). It turns out that the estimated coefficient is negative and statistically significant only in the post-2007 period. This result is driven by female participation: when we focus on the participation rate of women only, the estimated effect of the GDP growth rate is negative and statistically significant only in the post-2007 period, while it is positive and not significant in the previous period (see columns 3 and 4). When male labor force participation is considered, the estimated coefficient associated to GDP growth is negative in the post-2007 period but is not statistically significant at conventional levels. This evidence corroborates the relevance of the added worker effect, as the latter is known to be a significant determinant of female labour supply.

We have also investigated this issue by looking at data at the country level within the euro area over the period from 2008:Q1 to 2013:Q4. In particular, we have estimated a panel regression in which we control for cross-country heterogeneity by allowing for time-invariant, country-specific fixed effects in the estimation. The findings are reported in Table 2 and confirm the previous results. Indeed, using the de-trended LFPR as dependent variable, the estimated coefficient associated to the GDP growth rate is negative and statistically significant (-0.048 with a standard error of 0.020) lending support to the hypothesis of countercyclical elements in the post-2007 profile of LFPR in the euro area.[4]

To provide further evidence that the pattern of labor force participation in the euro area has exhibited countercyclical features in the wake of the Great Recession, while being essentially acyclical beforehand, we have computed time-varying correlations between the de-trended $LFPR$ and the rate of change of GDP, reported in Figure 3. The evidence suggests that these correlations have become negative and larger (in absolute value) in

[4] We have also experimented with another panel specification in which the change in $LFPR$ is used as dependent variable and the change in the unemployment rate is used as regressor. The estimated coefficient associated with the unemployment term is positive and statistically significant (0.083 with a standard error of 0.040).

the post-2007 period while they were in general positive, albeit close to zero, before 2008.

In Figure 4 we use information for each euro area country related to the overall change in its $LFPR$ in the post-2007 period as well as on the intensity and severity of the recession. The latter indicator is measured for each country as the difference between the lowest and the highest values of real GDP attained over the whole post-2007 period. The scatter plot suggests that the more severe the downturn has been in a country in terms of GDP loss, the higher the change in the labor force participation rate has been.

All in all, this evidence suggests that cyclical developments played a role in shaping the behavior of labor market participation in the post-2007 period and that participation in the euro area exhibited contercyclical features. In the following sections we develop a theoretical model in which cyclical patterns in the participation are explicitly allowed for and where a structural interpretation is provided for their diverging profile in the two areas during the Great Recession.

3 The model

The theoretical model presented here builds on the New Keynesian framework with unemployment developed by Blanchard and Galí (2010a) and extended by Galí (2011). The Blanchard and Galí's model combines a concave utility function over consumption and leisure with labor market frictions à la Diamond, Mortensen and Pissarides, real wage rigidities and staggered price setting. In order to allow for endogenous labor force in the model, we draw on the home production literature. Family members can be either employed, unemployed and searching for a job, or out of the labor force; those individuals who are not participating in the labor market engage in housework activities, which increase the utility of the whole family. The household allocates family members between the market and the home sectors on the basis of the relative return from being in each of them, and assigns an equal consumption level to all members in order to share consumption risk within the family.

While our model is related to an extensive body of literature, the two models which are closest to our own are those by Erceg and Levin (2014) and Campolmi and Gnocchi (2014). Erceg and Levin augment a standard New Keynesian model (without labor market frictions) with endogenous labor force participation and adjustment costs of moving members between the market and the home sectors, to account for the gradual adjustment of the labor force. In their set-up labor market participation is always procyclical and the main focus of the study is on the effects of different monetary rules. Campolmi and Gnocchi (2014) nest the endogenous participation margin and the provision of unemployment benefits into a search model in the Diamond-Mortensen-Pissarides tradition. In their dynamic general equilibrium framework they abstract from the conventional margin between consumption and leisure and show that, although labor force participation is the least volatile among labor market variables, neglecting it is problematic as the participation margin helps to mitigate the Shimer critique, i.e. the inability of the basic search and matching model to reconcile the strong procyclicality of the job finding rate with the weak procyclicality of labour productivity.

3.1 Labor market flows

We follow Campolmi and Gnocchi (2014) in modeling labor market flows. The relevant decision unit is the representative household with a continuum of members represented by the unit interval. Let E_t be the mass of employed, U_t the pool of unemployed and L_t the mass of non-participant members so that $E_t + U_t + L_t = 1$. We assume an exogenous separation rate, $\rho \in (0,1)$.[5] Therefore, at the end of the period $t-1$ the non- employment pool is made up by the unemployed, U_{t-1} (i.e. those who were not hired at the beginning of the period), those who separated from their jobs, ρE_{t-1}, and the non participants:

$$\underbrace{U_{t-1} + \rho E_{t-1} + L_{t-1}}_{\text{non-employment pool}} = 1 - (1-\rho)\, E_{t-1}$$

The size of the pool of jobless individuals who are available for hire at the beginning of period t is denoted with S_t. Thus, the following relationship holds, $S_t + L_t = U_{t-1} + \rho E_{t-1} + L_{t-1}$, indicating that, out of the non-employment pool, some household members will be searchers in the following period, t, and the remaining ones will be non-participants. Denoting with $N_t = 1 - L_t$ the members who are in the labor force, we have:

$$S_t = N_t - (1-\rho)\, E_{t-1}, \tag{1}$$

[5]The assumption of an acyclical separation rate is consistent with the recent literature showing that movements in the job finding rate has a predominant role in explaining workers' flows, relative to those of the firing rate. Indeed, the last three US downturns have not been characterized by a wave of job losses. On the contrary, rising unemployment has been caused by the fact that - once unemployed - the probability of finding jobs has fallen sharply. This contrasts with the common wisdom that recessions are periods characterized primarily by high job loss rates (see Blanchard and Diamond, 1990). On the basis of this evidence, Hall (2005) argues convincingly that in the US economy unemployment rises because it is hard to find a job and not because an unusually large number of individuals are fired (see also Elsby, Hobijn, and Sahin, 2010). Along this line, Shimer (2005, 2007) documents that, whereas the job finding probability has been strongly procyclical over the last two decades, the separation rate is acyclical. See Barnichon (2011) for a note of caution about the assumption of an acyclical separation rate.

where $S_t \geq 0$ and $N_t \geq (1-\rho) E_{t-1}$, implying that the pool of participants in period t should be at least as large as the pool of those who did not separate from their jobs in period $t-1$. As highlighted by Campolmi and Gnocchi (2014), this amounts to ruling out direct flows from the employment pool towards non participation. In other words, if household wished to reduce labor market participation, she would withdraw from the pool of unemployed members. We check that the steady state unemployment is large enough relative to shocks. We denote by M_t the measure of workers hired in period t; accordingly the job finding rate is defined as $f_t \equiv \frac{M_t}{S_t}$. Hence, we establish that $U_t = (1-f_t)S_t$. Workers are immediately productive in the period when they are hired.[6] Based on the previous definitions and assumptions, the time path of employment obeys the following:

$$E_t = (1-\rho) E_{t-1} + f_t S_t = (1-\rho)(1-f_t) E_{t-1} + f_t N_t = (1-\rho) E_{t-1} + \frac{f_t}{1-f_t} U_t \quad (2)$$

3.2 The household

The relevant decision unit is the infinitely-lived representative household, which has a utility functional of the form:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \xi_t \beta^t [\log (C_t - hC_{t-1}) - \psi \frac{E_t^{1+\varsigma}}{1+\varsigma} + \chi_t \frac{(1-N_t)^{1-\phi}}{1-\phi}] \quad (3)$$

where both ξ_t and χ_t are two preference disturbance term with mean unity, which follow a stationary first order autoregressive process, $C_t \equiv [\int_0^1 C_t(i)^{\frac{\epsilon-1}{\epsilon}}]^{\frac{\epsilon}{\epsilon-1}}$ is consumption (a CES function over a continuum of goods with elasticity of substitution ϵ, with $C_t(i)$ representing the quantity of good i consumed by the household in period t; we assume the existence of a continuum of goods represented by the interval $[0;1]$) and h represents the degree of internal habit persistence. Home production yields a period utility benefit, $\chi_t \frac{L_t^{1-\phi}}{1-\phi}$, that rises in the number of members allocated to the home-sector L_t; ς and ϕ are both positive constants. State-contingent securities offer workers full insurance against differences in their specific income. The household assigns equal consumption to

[6] This timing convention is analogous to that of many contributions (among them, see Blanchard and Galí, 2010a; Gertler, Sala and Trigari, 2008; and Faia, 2009). It has the advantage of being consistent with the bulk of the business cycle literature, where employment is assumed to be a non-predetermined variable. By contrast, however, other search and matching models assume that it takes one period for a new hire to become productive. This implies that employment is predetermined by one period even with an infinitely efficient matching technology which prevents employment from responding contemporaneously to shocks.

all members in order to share consumption risk within the family.[7] The period budget constraint takes the form:

$$\int_0^1 P_t(i)\, C_t(i)\, di + Q_t B_t \leq B_{t-1} + W_t E_t + T_t \tag{4}$$

where $P_t(i)$ is the price of good i, W_t is the nominal wage, B_t represents purchases of one-period bonds (at a price Q_t), and T_t is a lump sum component of income (which may include, among other items, dividends from ownership of firms). In order to allocate its consumption expenditures among the different goods, the consumption index, C_t, needs to be maximized for any given level of expenditures $\int_0^1 P_t(i)\, C_t(i)\, di$. The solution to that problem yields the set of demand equations, $C_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\epsilon} C_t$, for all $i \in [0,1]$, where P_t is an aggregate price index. Conditional on this optimal behavior, we have $\int_0^1 P_t(i)\, C_t(i)\, di = P_t C_t$. The household maximizes (3), subject to (4), as well as to $E_t = (1-\rho)(1-f_t)(N_{t-1} - U_{t-1}) + f_t N_t$. Solving the household's optimization problem we obtain a conventional Euler equation:

$$Q_t = \beta \mathbb{E}_t \frac{\Lambda_{t+1}}{\Lambda_t} \frac{\xi_{t+1}}{\xi_t} \frac{P_t}{P_{t+1}} \tag{5}$$

where

$$\Lambda_t = \frac{1}{C_t - hC_{t-1}} - h\beta \mathbb{E}_t \frac{\xi_{t+1}}{\xi_t} \frac{1}{C_{t+1} - hC_t}, \tag{6}$$

and the participation condition:

$$\underbrace{\frac{\chi_t (1-N_t)^{-\phi}}{\Lambda_t}}_{MRS_{L,C} \equiv U_L/U_C} = f_t \left(\frac{W_t}{P_t} - \underbrace{\frac{\psi E_t^{\varsigma}}{\Lambda_t}}_{MRS_{E,C} \equiv U_E/U_C} \right) + f_t \mathbb{E}_t \frac{\chi_{t+1}(1-N_{t+1})^{-\phi}}{\Lambda_{t+1}} \beta (1-\rho) \frac{\Lambda_{t+1}}{\Lambda_t} \frac{\xi_{t+1}}{\xi_t} \frac{(1-f_{t+1})}{f_{t+1}} \tag{7}$$

[7] Indeed, in the presence of unemployment risk, differences in consumption levels between employed and unemployed workers might emerge. The full income insurance scheme avoids this possibility and implies that the income of an unemployed person is the same as the income of an employed member.

according to which the representative household chooses to allocate members to market production up to the point at which the marginal cost in terms of foregone home production equals the marginal return to market work. The latter is given by the wage markup over the marginal rate of substitution and the option value of getting an additional member into employment, both weighted by the probability of finding a job in time t, f_t. The intuition for the term, $(1-\rho)\frac{(1-f_{t+1})}{f_{t+1}}$, is that a positive option value arises as long as a match realized in period t allows the household to stay in the working relationship in period $t+1$ and as long as the probability of finding a job in period $t+1$ is less than 1.[8] By solving equation (7) forward, we establish that labor force participation depends on the expected discounted stream of premiums generated by an additional hire.

3.3 Firms

As for the firms, we distinguish between two sectors: retail and intermediate firms. Household's members are employed by intermediate firms which face a hiring cost and operate in a competitive market in relation to the goods they produce. Intermediate firms sell their output to retailers, which are monopolistically competitive and set prices in a staggered fashion.[9]

We assume a continuum of retailers indexed by $i \in [0,1]$, each producing a differentiated final good. The retail firm purchases the intermediate output on a perfectly competitive market and converts it into a differentiated final good. All retail firms have access to an identical technology:

$$Y_t(i) = X_t(i), \tag{8}$$

where $X_t(i)$ is the quantity of the single intermediate good. The latter is produced by a large number of identical, perfectly competitive intermediate firms, indexed by $j \in [0,1]$, and with a technology:

$$X_t(j) = A_t E_t(j) \tag{9}$$

where A_t represents the state of technology, that is common across firms and varies exogenously over time according to a stationary first order autoregressive process. Firms

[8] Indeed, the term $(1-f_{t+1})/f_{t+1}$ is the wedge between the matches and the pool of unemployed: $M_t = \frac{1-f_{t+1}}{f_{t+1}} U_t$

[9] The motivation for the separation between final goods producers with monopoly power and intermediate good producers operating in a perfectly competitive environment is to avoid interactions between price setting and wage bargaining at the firm level.

incur a cost to hire new workers and vacancies are filled immediately by paying the hiring costs. As in Blanchard and Galí (2010a), the cost per hire (G_t) is taken as given by each firm and is increasing with labour market tightness f_t:[10]

$$G_t = A_t B f_t^{\eta} \tag{10}$$

where B is a positive constant and $\eta \geq 0$ measures the elasticity of hiring costs to labor market conditions.[11]

The wholesale firm maximizes profits

$$\mathbb{E}_t \sum_{k=0}^{\infty} \beta^k \frac{\Lambda_{t+k}}{\Lambda_t} \frac{\xi_{t+k}}{\xi_t} \left(\frac{1}{\mu_{t+k}} A_{t+k} E_{t+k}(j) - \frac{W_{t+k}}{P_{t+k}} E_{t+k}(j) - A_{t+k} B f_{t+k}^{\eta} M_{t+k}(j) \right) \tag{11}$$

subject to Eq. (2), where $\mu_t = \frac{P_t}{P_t^I}$ is the markup of retail over intermediate prices. The first order conditions for this problem imply:

$$\frac{1}{\mu_t} = \frac{W_t}{P_t A_t} + B f_t^{\eta} - \beta \mathbb{E}_t \frac{\Lambda_{t+1}}{\Lambda_t} \frac{\xi_{t+1}}{\xi_t} (1-\rho) \frac{A_{t+1}}{A_t} B f_{t+1}^{\eta} + \mu_t^p \tag{12}$$

where μ_t^p is a cost push term with mean unity which follows a stationary first order autoregressive process. Following Calvo (1983), retailers can reset their price at random dates: in each period only a randomly chosen fraction $(1-\theta)$ of retailers adjusts their prices. The remaining retailers keep their prices unchanged. The pricing decision of a retail firm obeys the following equilibrium condition:

$$\mathbb{E}_t \sum_{k=0}^{\infty} \theta^k \beta^k \frac{\Lambda_{t+k}}{\Lambda_t} \frac{\xi_{t+k}}{\xi_t} \frac{P_t}{P_{t+k}} Y_{t+k/t} \left(\frac{P_t^*}{P_{t-1}} - \frac{\epsilon}{\epsilon - 1} MC_{t+k/t} \frac{P_{t+k}}{P_{t-1}} \right) = 0 \tag{13}$$

where $Y_{t+k/t}$ and $MC_{t+k/t}$ denote, respectively, output and the real marginal cost in $t+k$ for a firm that last reset its prices in t.

[10] As in Blanchard and Galí (2010a), f_t is both an index of labour market tightness and, from the viewpoint of the unemployed, the probability of being hired in period t.

[11] As in Blanchard and Galí (2010a), the hiring cost is assumed to grow with productivity in order to rule out that productivity improvements can affect the cost of hiring relative to the cost of producing. Also, note that in the Diamond-Mortensen-Pissarides framework the expected cost of hiring an additional worker in the steady state is proportional to the average duration of vacancy, which, in turn, is proportional to the ratio of vacancies to hires. As a consequence, assuming a matching function of the form $M = ZS^{\alpha}V^{1-\alpha}$, we have $\frac{V}{M} = Z^{\frac{1}{\alpha-1}} \left(\frac{M}{S}\right)^{\frac{\alpha}{1-\alpha}}$. Thus, as stressed by Blanchard and Galí (2010a), the parameter η corresponds to $\frac{\alpha}{1-\alpha}$ in the standard Diamond, Mortensen, Pissarides model.

3.4 Wages

The presence of a surplus associated with existing relations implies that many wages may be consistent with equilibrium. We follow Hall (2005) and assume equilibrium wage stickiness. In particular, we assume a backward looking social norm, where the wage norm is a rule to select an equilibrium within the bargaining set. The actual wage level is given by a weighted average of past wage level and the equilibrium real wage, $(W_t^r)^*$:

$$\frac{W_t}{P_t} = \left(\frac{W_{t-1}}{P_{t-1}}\right)^{\gamma} (W_t^r)^{*(1-\gamma)}$$

where the equilibrium wage is defined as the Nash wage schedule (Hall, 2005). Nash bargaining satisfies:

$$\mathcal{S}_t^H = \vartheta \mathcal{S}_t^F \tag{14}$$

where $\mathcal{S}_t^H$ and $\mathcal{S}_t^F$ denotes the household's and firm's surplus from an established employment relationship, respectively, and ϑ represents the relative bargaining power of workers. As in Campolmi and Gnocchi (2014), if the household and the firm do not reach an agreement and deviate from equilibrium, the member enters the unemployment rather than the employment pool after the participation rate has been chosen. Therefore, the surplus of employing one additional member is evaluated by keeping constant the participation rate at t. We have:

$$\mathcal{S}_t^H = \frac{W_t}{P_t} - \frac{\psi E_t^{\varsigma}}{\Lambda_t} + \beta \mathbb{E}_t \frac{\Lambda_{t+1}}{\Lambda_t} \frac{\xi_{t+1}}{\xi_t} (1-\rho)(1-f_{t+1}) \mathcal{S}_{t+1}^H \tag{15}$$

On the other hand, the firm's surplus from an established employment relationship is:

$$\mathcal{S}_t^F = A_t B f_t^{\eta}, \tag{16}$$

because any current worker can be immediately replaced with someone who is unemployed by paying the hiring cost. Combining Eqs. (15), (16) and (14), we have the Nash wage schedule:

$$(W_t^r)^* = \frac{\psi E_t^{\varsigma}}{\Lambda_t} + \vartheta A_t B f_t^{\eta} - \beta \vartheta \mathbb{E}_t \frac{\Lambda_{t+1}}{\Lambda_t} \frac{\xi_{t+1}}{\xi_t} (1-\rho)(1-f_{t+1}) A_{t+1} B f_{t+1}^{\eta} \tag{17}$$

3.5 Aggregate resource constraint and monetary policy

The aggregate resource constraint is:

$$C_t = A_t(E_t - Bf_t^{\eta} M_t)$$

As in Blanchard and Galí (2010b), we assume that interest rate decisions are taken on the basis of inflation:

$$\frac{1+i_t}{\overline{R}} = \left(\frac{P_t}{P_{t-1}}\right)^{\phi_\pi},$$

where $\overline{R}$ is the steady-state nominal gross rate.

3.6 Calibration

We take each period to correspond to a quarter. For the discount factor, β, we assume the value commonly found in the literature (0.99). The two elasticity parameters for preferences, ς and ϕ, are set equal to 1. ψ is calibrated to a value of 1, as in Blanchard and Galí (2010a). In most of the exercises that follow, we vary the degree of internal habit persistence, h, within the range $[0, 1)$ over which it is theoretically defined. When we single out a specific value, we set it at 0.7, a rather standard calibration for macroeconomic models (see e.g. Boldrin, Christiano and Fisher, 2001 and Christiano, Eichenbaum and Evans, 2005).

As for the labor market parameters, we follow Blanchard and Galí (2010a) and set the steady state job finding rate, f, equal to 0.7 (corresponding approximately, to a monthly job finding rate of 0.3) and the separation rate, ρ, equal to 0.12. These values yield a steady state unemployment rate, $(1-f)\left[\frac{1-(1-\rho)}{1-(1-\rho)(1-f)}\right]$, of 5 percent, arguably a reasonable value (see Appensix). We calibrate the elasticity of hiring costs to labor market tightness, η, to a value of 1. As elucidated by Blanchard and Galí (2010a), this calibration derives from the mapping between this model and the standard Diamond, Mortensen and Pissarides' type of framework. Indeed, with a matching function of the form, $M = ZS^{\alpha}V^{1-\alpha}$, one obtains $\frac{V}{M} = Z^{\frac{1}{\alpha-1}}\left(\frac{M}{S}\right)^{\frac{\alpha}{1-\alpha}}$. Given the link between the cost of hiring and the incidence of vacancies, the parameter η corresponds to $\frac{\alpha}{1-\alpha}$ in the Diamond, Mortensen and Pissarides model and $\eta = 1$ is consistent with estimates of α which are typically close to 0.5. Also, as in Blanchard and Galí (2010a), we calibrate the parameter B, pertaining to the level of hiring costs, so that in steady state hiring costs are a one percent fraction of GDP, a plausible figure. As the steady-state ratio between hiring costs and GDP is equal to $Bf^{\eta}\rho$, this implies a value of B equal to 0.1.

The relative bargaining power of workers, ϑ, is set to a value of 1, in order to make the model consistent with the Hosios condition, that in our framework reads $\vartheta = \eta$. The steady-state labor force participation rate, N, is set at 65 percent, a plausible value. As in Blanchard and Galí (2010b) and in a number of other contributions, we set the Calvo parameter, θ, to 0.8. Finally, the Taylor coefficient in the monetary policy rule, ϕ_π, is set to 1.1, a reasonable value, consistent with a unique equilibrium.

4 The cyclical patterns of labor force participation

Our model is consistent with both a procyclical and a countercyclical response of labor force participation to shocks. The cyclical profile of labor force participation hinges, in particular, on two key parameters: the degree of real wage rigidities and the extent to which households care about the distance between their current consumption and its past level. To see the economic intuition, consider again the optimal condition for participation:

$$\chi_t(1-N_t)^{-\phi} = f_t\Lambda_t\left(\frac{W_t}{P_t} - \frac{\psi E_t^{\varsigma}}{\Lambda_t}\right) + f_t\mathbb{E}_t\chi_{t+1}\frac{\xi_{t+1}}{\xi_t}(1-N_{t+1})^{-\phi}\beta\left(1-\rho\right)\frac{(1-f_{t+1})}{f_{t+1}} \quad (18)$$

- During downturns, the fall in the workers' probability of finding jobs, f_t, and the worsening of the real wage drive family members out of the labor force. This is the well known *discouragement effect,* that leads to a procyclical labor force participation.

- The cyclical profile of labor market participation depends on the cyclical behavior of the wage markup, $\left(\frac{W_t}{P_t} - \frac{\psi E_t^{\varsigma}}{\Lambda_t}\right)$. A wage premium that rises after a recessionary shock encourages family members to enter the labor market, favoring a countercyclical behavior of labor force; conversely, if the wage premium falls during downturns, then labor market participation is likely to decrease, displaying a procyclical development. Hence, the degree of real wage rigidities, γ, influences the cyclical profile of labor force participation, because it steers the cyclical behavior of the wage markup. In the wake of a contractionary shock, if γ is large the real wage would fall by less than the reservation wage, and the wage markup increases.

- Moreover, the sign of the response of labor market participation to shocks depends on habit formation. Indeed, a recessionary shock implies a decrease in consumption and therefore yields a negative wealth effect (an increase in Λ_t), leading to an increase in labor force participation. The higher the degree of internal habit formation, h, the stronger the wealth effect and the more likely labor supply does increase in the short run.

In sum, our theoretical model suggests two distinct channels through which the diverging cyclical developments of labor force participation in the US and the euro area since 2007 can be rationalized. Indeed, in the aftermath of the severe downturn that followed the global financial crisis, the different relevance of real wage rigidities in the US and the euro area, coupled with the different degree of habit in consumption, can generate an opposite cyclical pattern in labor force participation. Using household data, Dynan (2000) lends no support for the presence of habit formation in the US economy. On the other hand, Bayesian estimates by Smets and Wouters (2005) of DSGE models for both the US and euro area economy over the 1983:1-2002:2 point to a lower value of the habit persistence parameter in the US (0.44) compared to that in the euro area (0.61).

As for the wage markup, Galí, Gertler and López-Salido (2003) provide convincing evidence on its markedly countercyclical profile in the euro area and point to the importance of real wage rigidities to back this finding. In principle, rather than being a consequence of real wage rigidities, a countercyclical wage markup could alternatively reflect desired countercyclical changes in the markups by workers, in a flexible wages environment. However, in a recent study by the ECB (European Central Bank, 2012) estimates have been obtained on the wage responsiveness to unemployment developments using panel estimates which pool the data across the euro area countries. Importantly for our argument, the results do point to a significant degree of downward real wage rigidities.

Figure 5 reports the response at impact of labor force participation to a contractionary demand and supply shock, under different values for γ and h. The former shock is modeled as a negative shock to the discount factor (a negative shock to the consumer's impatience, ξ_t); it is an intertemporal disturbance, which induces households to postpone consumption and leading to a decrease in both GDP and inflation. The latter is modeled as a cost push cost, leading to a decrease in GDP and an increase in inflation. Figure 6 reports the response at impact of the wage markup.

5 Labor force participation, wage rigidities and inflation

The implications of real wage rigidities for the equilibrium level of inflation have been extensively studied in the literature. Conditional to an adverse supply shock, for a given money rule inflation will rise more, the slower real wages adjust (see Blanchard and Galí

2007, 2010a and 2010b). Indeed, when wages are rigid, it takes time for the real wage to downwardly adjust to labor market slack and the increase in inflation will turn out to be wider than under flexible wages (see Figure 7, panel A).

Now consider a recessionary demand shock, driving down both GDP and inflation. Real wage rigidities prevent the real wage from fully adjusting downward after the demand shortfall. The fall in inflation is thus limited relative to the case in which wages are fully flexible (see Figure 8, panel A).

In what follows we show that, when endogeneity in the participation margin is considered, the degree of real wage rigidities becomes irrelevant for inflation dynamics. Indeed, to the extent that real wage rigidities prompt a countercyclical response of labor force, falling in booms and rising in slumps, they leave price dynamics virtually unchanged.

In order to clarify the intuition, let us illustrate how movements in the labor force influence price dynamics.

Changes in labor force participation impinge on inflation by affecting the balance between the demand for, and the supply of, labor, i.e. labor market *tightness*. The latter, which is measured in the model by $f_t \equiv \frac{M_t}{S_t}$, affects the marginal cost of production by influencing wages and hiring costs.[12]

Consider, for instance, an increase in the number of participants. This makes the labor market looser. According to the theoretical model, a looser labor market exerts a downward pressure on inflation, by reducing hiring costs and exerting a downward pressure on wages, because both the worker's outside option during the bargaining process and the firm's surplus from an established employment relationship decrease.

The dependence of hiring costs upon labor market tightness is a standard property in the class of unemployment models in the Diamond-Mortensen-Pissarides tradition, where the expected value of hiring costs corresponds to the cost of posting a vacancy times the expect time to fill it. This expected time is an increasing function of the ratio of vacancies to unemployment, which in turn can be expressed as a function of labor market tightness. Here we have followed the formalization of Blanchard and Galí (2010a), where vacancies are filled immediately by paying the hiring cost. The two approaches are nonetheless equivalent, as they both share the property that hiring costs are increasing with labor market tightness (see Eq. 10).

As for real wages, in order to gauge their dependence on labor market tightness,

[12] The real marginal cost (see equation 12) is given by the ratio of real wage to productivity $\frac{W_t}{P_t}\frac{1}{A_t}$ plus the hiring cost Bf_t^{η}, net of savings in future hirings resulting from the reduced hiring needs in period t+1.

consider again the Nash real wage (Eq. 17). Let $b \in (0,1)$ denote the worker's bargaining power ($\vartheta \equiv \frac{b}{1-b}$), so that the equilibrium wage can be written as:

$$(W_t^r)^* = b\overline{W}_t^r + (1-b)\underline{W}_t^r \tag{19}$$

where $\underline{W}_t^r$ and $\overline{W}_t^r$ are defined as follows:

$$\underline{W}_t^r \equiv \frac{\psi E_t^{\varsigma}}{\Lambda_t} - \beta \mathbb{E}_t \frac{\Lambda_{t+1}}{\Lambda_t} \frac{\xi_{t+1}}{\xi_t} (1-\rho) \mathcal{S}_{t+1}^H + \beta \mathbb{E}_t \frac{\Lambda_{t+1}}{\Lambda_t} \frac{\xi_{t+1}}{\xi_t} (1-\rho) f_{t+1} \mathcal{S}_{t+1}^H \tag{20}$$

$$\overline{W}_t^r \equiv \frac{A_t}{\mu_t} + \beta \mathbb{E}_t \frac{\Lambda_{t+1}}{\Lambda_t} \frac{\xi_{t+1}}{\xi_t} (1-\rho) A_{t+1} B f_{t+1}^{\eta} \tag{21}$$

$\underline{W}_t^r$ denotes the worker's opportunity cost of holding the job, i.e. the sum of labor disutility - net of the discounted future surplus resulting from the employment relationship - and the value of searching for other jobs. The latter increases with labor market tightness, f_{t+1}: a higher probability of finding a job in period $t+1$ increases the worker's outside option during the bargaining process, raising the required minimum wage.

$\overline{W}_t^r$ is the firm's reservation wage: it equals the sum of the marginal revenue product and the marginal saving on hiring costs resulting from the reduced hiring needs in $t+1$. The latter increases with labor market tightness, which raises the firm's surplus associated with an existing relationship.

All in all, the equilibrium wage rises with labor market tightness because the latter drives up the firm's surplus associated with an employment relationship - thus increasing the maximum wage that firms are willing to pay - and lowers the continuation value to an employed worker, because workers' outside option increases, thus raising the minimum wage that workers are willing to accept.

Consider again a recessionary supply or demand shock. As we emphasized before, real wage rigidities entail upward pressures on marginal costs, by limiting the downward adjustment of the real wage. This tends to amplify the increase in inflation conditional on adverse supply shocks, while tempering the drop in price dynamics associated with demand-driven downturns. However, for the reasons pointed out in Section 4, real wage rigidities entail a countercyclical response of labor force, driving potential workers into the labor market during a recession. The decline in the index of labor market tightness, f_t, is amplified compared to that when participation is constant (see Figures 9 and 10). This additional looseness in the labor market, induced by the increase in labor supply, exerts a downward pressure on marginal cost, via the downward pressure on hiring costs and wages, and thus counteracts the upward pressure due to wage rigidities.

In sum, wage rigidities have a direct impact on the marginal cost by affecting real wage dynamics, but they also induce cyclical movements in labor force participation and, hence, on labor market tightness, that have effects of opposite sign on the real marginal cost with respect to that of wage rigidities. The overall impact on inflation is almost nil (see Figures 7 and 8, panel B).

6 Concluding remarks

In the aftermath of the Great Recession, the United States and the euro area have experienced a diverging path in their labor force participation. A large drop in US labor force participation stands in sharp contrast with its parallel increase in the euro area.

Several contributions have documented that cyclical factors account for the bulk of the post-2007 decline in the US participation to the labor market. We provide evidence that, in addition to structural long run developments, a part of the recent increase in the euro area labor force participation rate reflects cyclical developments. Whereas in the US labor force participation rate has behaved in a procyclical fashion since 2007, it has displayed a countercyclical profile in the euro area.

We use a theoretical model to rationalize these diverging developments. Our model integrates endogenous participation decisions in the new Keynesian model of unemployment developed by Blanchard and Galí (2010a): household labor supply choices interact with search and matching frictions in the labor market. This framework allows us to shed light on the relevant forces behind the cyclical movements in labor force participation. During downturns, the fall in workers' chances of finding jobs and the worsening of employment conditions drive potential workers out of the labor force. This effect, known in the literature as the "discouragement" channel, leads to a procyclical profile of labor force participation, as the one recently emerged in the US.

However, the "added worker effect" might become predominant if the degree of real wage rigidities is sufficiently high, entailing countercyclical wage markups, and /or preferences feature a high degree of habit formation, i.e. households aim at maintaining their pre-crisis consumption level, strengthening the wealth effects associated with shocks.

Through the lenses of our model we then study the implications for inflation, establishing a result on the interaction between real wage rigidities, labor force cyclicality and inflation. When endogenous movements in labor force participation are allowed for, wage rigidities are irrelevant for inflation dynamics. Indeed, during downturns, on the one hand real wage rigidities exert upward pressures on the marginal cost by limiting the downward adjustment of real wages, but on the other, real wage rigidities drive non-participating workers into the labor force, leading to a countercyclical behavior of labor supply. Relative to the constant participation scenario, this channel induces an additional looseness in the labor market that exerts downward pressures on the marginal costs. The overall impact on inflation is almost nil.

Our chief conclusion is that the assessment of the effects of real wage rigidities on inflation cannot disregard the impact that they exert on labor supply. Testing these predictions on data is the next natural step in our research agenda.

References

[1] Aaronson Daniel, Jonathan Davis and Luojia Hu, (2012), “Explaining the Decline in the US Labor Force Participation Rate”, The Federal Reserve Bank of Chicago, Chicago Fed Letters, number 296.

[2] Aaronson Daniel, Kyung-Hong Park, and Daniel Sullivan, (2006), “The decline in teen labor force participation”, Economic Perspectives, Federal Reserve Bank of Chicago, Vol. 30, First Quarter, pp. 2–18.

[3] Balleer Almut, Ramón Gómez-Salvador and Jarkko Turunen, (2009), “Labour force participation in the euro area: a cohort based analysis”, European Central Bank, ECB Working Paper Series, No. 1049.

[4] Barnichon, Regis (2011), “Vacancy posting, Job separation and Unemployment Fluctuations”, *Journal of Economic Dynamics and Control*, Forthcoming.

[5] Barnichon, Regis and Andrew Figura, (2015), “Declining Desire to Work and Downward Trends in Unemployment and Participation”, in *NBER Macroeconomics Annual 2015*, Volume 30.

[6] Bengali Leila, Daly Mary and Valletta Rob, (2013), “Will Labor Force Participation Bounce Back?”, Federal Reserve Bank of San Francisco Economic Letter, May, No. 14.

[7] Blanchard Olivier J. and Peter Diamond (1990), “The Cyclical Behavior of the Gross Flows of US Workers”, *Brookings Papers on Economic Activity*, 1, 1-60.

[8] Blanchard, Olivier J. and Jordi Galí, (2007), “Real Wage Rigidities and the New Keynesian Model,” *Journal of Money, Credit and Banking*, supplement to vol. 39, no. 1, 2007, 35-66.

[9] Blanchard, Olivier J. and Jordi Galí, (2010a), “Labor Markets and Monetary Policy: A New-Keynesian Model with Unemployment,” *American Economic Journal: Macroeconomics*, 2(2), 1-30.

[10] Blanchard, Olivier J. and Jordi Galí, (2010b), “The Macroeconomic Effects of Oil Price Shocks:Why are the 2000s so different from the 1970s?,” NBER Chapters, in: International Dimensions of Monetary Policy, National Bureau of Economic Research, Inc., 373-421.

[11] Boldrin, Michele and Christiano, L.J. and J. Fisher, (2001), "Habit persistence, asset returns and the business cycle", *American Economic Review*, 86, pp. 1154–1174.

[12] Bullard, James, (2014), "The Rise and Fall of Labor Force Participation in the United States", Federal Reserve Bank of St. Louis *Review*, First Quarter,96(1), pp. 1-12.

[13] Burlon, Lorenzo and Montserrat Vilalta-Bufí, (2014), "Technical progress, retraining cost and early retirement", Temi di Discussione 963, (Bank of Italy Working Paper).

[14] Calvo, Guillermo. A., (1983), "Staggered Prices in a Utility-Maximizing Framework", *Journal of Monetary Economics*, 2(3), 383-98.

[15] Campolmi, Alessia and Stefano Gnocchi, (2014), "Labor Market Participation, Unemployment and Monetary Policy", Bank of Canada Working paper 2014/9.

[16] Canon Maria, Debbaut Peter and Marianna Kudlyak, (2013), "A Closer Look at the Decline in the Labor Force Participation Rate", The Regional Economist, Federal Reserve Bank of St. Louis, 21(4), pp. 10-11.

[17] Christiano, L.J., M. Eichenbaum and C.L. Evans, (2005), "Nominal rigidities and the dynamic effects of a shock to monetary policy", Journal of Political Economy, 113, pp. 1–45.

[18] Draghi, Mario, (2014), "Unemployment in the euro area", Remarks at the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming, August 22.

[19] Dynan, Karen. E., (2000), "Habit Formation in Consumer Preferences: Evidence from Panel Data", *American Economic Review*, 90(3), 391-406.

[20] Elsby, Michael, Bart Hobijn, and Aysegul Sahin, (2010), "The labour Market in the Great Recession", *Brookings Papers on Economic Activity,* Spring, 1-56.

[21] Erceg Christopher J. and Levin Andrew T., (2014), "Labor Force Participation and Monetary Policy in the Wake of the Great Recession", *Journal of Money, Credit and Banking*, 46(2), 3-49.

[22] European Central Bank, (2008), "Labour Supply and Employment in the Euro Aea Countries. Developments and Challenges", Occasional Paper Series no. 87.

[23] European Central Bank, (2012), "Euro Area Labour Markets and the Crisis", Structural Issues Report, October.

[24] European Central Bank, (various years), "Economic Bulletin" (formerly "Monthly Bulletin"), various monthly issues.

[25] Faia Ester, (2009), "Ramsey monetary policy with labor market frictions", *Journal of Monetary Economics*, Vol. 56, 4, 570-581.

[26] Farber, Henry S., (2011), "Job Loss in the Great Recession: Historical Perspective from the Displaced Workers Survey, 1984-2010", NBER Working Paper Series 17040.

[27] Fujita Shigeru, (2014), "On the Causes of Declines in the Labor Force Participation Rate", Federal Reserve Bank of Philadelphia Research Rap Special Report.

[28] Galí, Jordi, (2011), "Monetary Policy and Unemployment", in B. Friedman and M. Woodford, eds., Handbook of Monetary Economics, vol. 3a, Elsevier B.V., 487-546.

[29] Galí, Jordi., Mark. Gertler and J. David. López-Salido, (2003), "The euro area inefficiency gap", Banco de Espana, Documento de Trabajo 0302.

[30] Gertler, Mark., Sala, Luca and Antonella Trigari, (2008), "An Estimated Monetary DSGE Model with Unemployment and Staggered Nominal Wage Bargaining" *Journal of Money, Credit and Banking*, vol. 40 (8): 1713-1764.

[31] Hall, Robert E., (2005), "Employment Efficiency and Sticky Wages: Evidence from Flows in the Labor Market", *The Review of Economics and Statistics*, 87(3), 397-407.

[32] Hotchkiss Julie L. and Rios-Avila Fernando, (2013), "Identifying Factors behind the Decline in the Labor Force Participation Rate", Business and Economic Research, Macrothink Institute, Vol. 3, No. 1.

[33] Krause, Michael U. and Lubik, Thomas A., (2007), "The (ir)relevance of real wage rigidity in the New Keynesian model with search frictions", *Journal of Monetary Economics*, Elsevier, vol. 54(3), 706-727.

[34] Shimer, Robert, (2005), "The Cyclical Behavior of Equilibrium Unemployment and Vacancies", *American Economic Review*, 95(1): 25-49.

[35] Shimer, Robert, (2007), "Reassessing the Ins and Outs of Unemployment," NBER WP 13421.

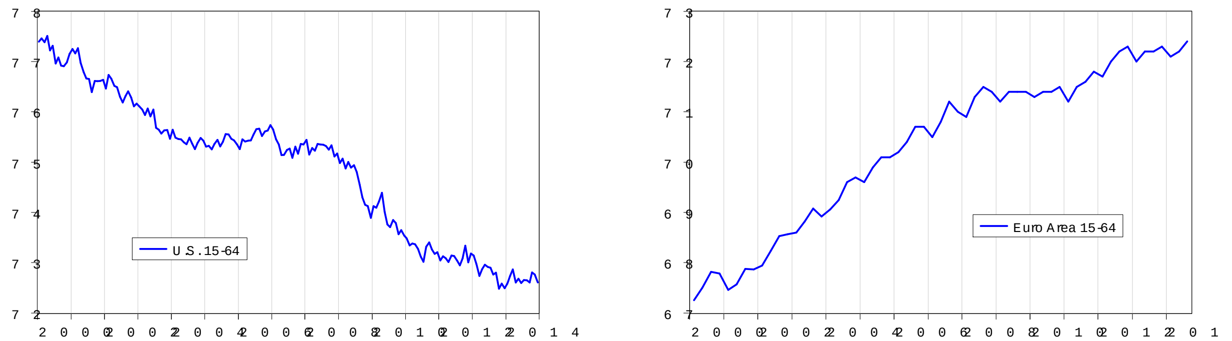
[36] Smets, Frank and Wouters, Raf, (2005), "Comparing Shocks and Frictions in US and Euro Area Business Cycles: a Bayesian DSGE Approach", *Journal of Applied Econometrics*, 20: 161–183.

[37] Van Zandweghe Willem, (2012), "Interpreting the Recent Decline in Labor Force Participation", Federal Reserve Bank of Kansas City Economic Review, First Quarter, pp. 5-34;

[38] Yellen, Janet. L., (2014), "Labor Market Dynamics and Monetary Policy", Remarks at the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming, August 22.

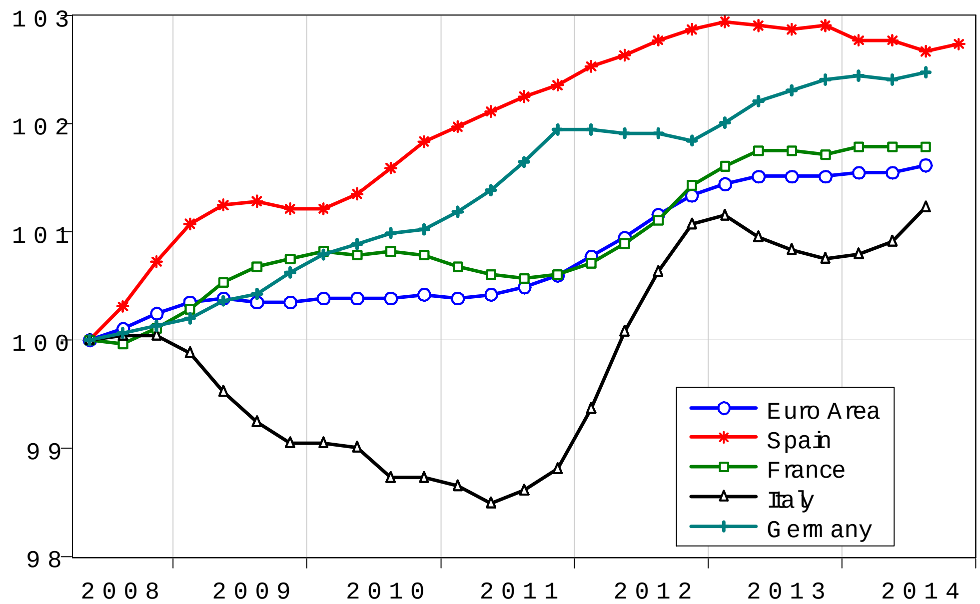
Tables and figures

Figure 1. Labor force participation rate in the US and euro area economy



Source: US: OECD; euro area: Labor Force Survey (Eurostat). Notes: Data are on the Activity Rate, Aged 15-64, All Persons. Euro area data refer to the EA-18 aggregate and figures between 2000 and 2004 have been reconstructed by aggregating national data using the working-age population shares as weights.

Fig. 2: The participation rate in the euro area and the largest four countries



Source: Labor Force Survey (Eurostat). Notes: for each country and the euro area (EA-18) we report the four-quarter moving average (index 2008:Q1=100). Population aged 15-64 is the one considered.

Tab. 1: Regression results on euro area data

	Dependent variable: $LFPR_t{-}LFPR\_trend_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
	$Total$		$Female$		$Male$	
$Constant$	-0.010	-0.027	-0.007	-0.028	-0.017	-0.024
	(0.036)	(0.029)	(0.030)	(0.030)	(0.045)	(0.036)
$\frac{GDP_t-GDP_{t-1}}{GDP_{t-1}}$	-0.088^{**}	$--$	-0.084^{**}	$--$	-0.079	$--$
	(0.043)	$--$	(0.037)	$--$	(0.055)	$--$
$\frac{GDP_t-GDP_{t-1}}{GDP_{t-1}} * D\_pre\_2008$	$--$	-0.090	$--$	0.103	$--$	0.071
	$--$	(0.062)	$--$	(0.065)	$--$	(0.077)
$\frac{GDP_t-GDP_{t-1}}{GDP_{t-1}} * D\_post\_2008$	$--$	-0.090^{**}	$--$	-0.087^{**}	$--$	-0.080
	$--$	(0.041)	$--$	(0.044)	$--$	(0.052)
Number of observations	24	56	24	56	24	56

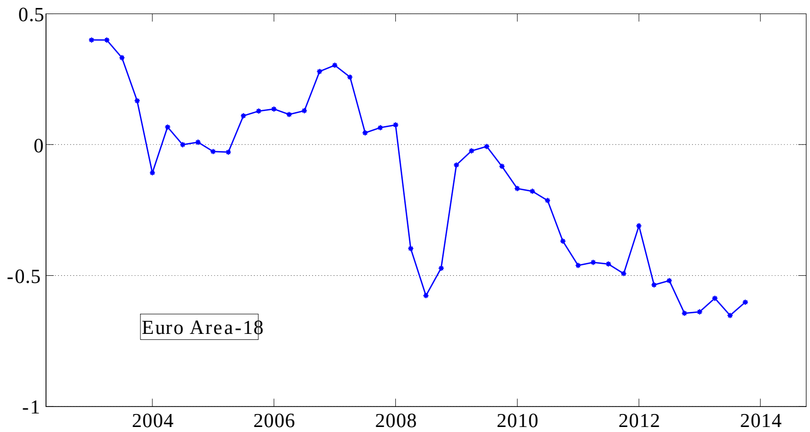
Notes: the sample is 2008:Q1 - 2013:Q4 in the estimation of equations whose results are reported in columns (1), (3) and (5). Conversely, the sample is 2000:Q1 - 2013:Q4 in the estimation of equations whose results are reported in columns (2), (4) and (6). Data refer to the euro area 18 aggregate. The dependent variable is $LFPR_t{-}LFPR\_trend_t$. The dummy variable D_pre_2008 is equal to one in the sub-sample ending on 2007:Q4 and zero otherwise. The dummy D_post_2008 is equal to one in the sub-sample starting on 2008:Q1 and zero otherwise.The trend of the labor force participation rate (LFPR) is measured through the HP procedure setting the smoothing parameter to 1600. The participation rate refers to the working age population (15-64). Standard errors are in parentheses. ** denotes significance at the 5 per cent level; * denotes significance at the 10 per cent level.

Tab. 2: Results from panel regressions on euro area countries with fixed effects

	$LFPR_{it} - LFPR\_trend_{it}$
Constant	-0.015
	(0.031)
$\frac{GDP_{it} - GDP_{it-1}}{GDP_{it-1}}$	-0.048^{**}
	(0.020)
Number of observations	456

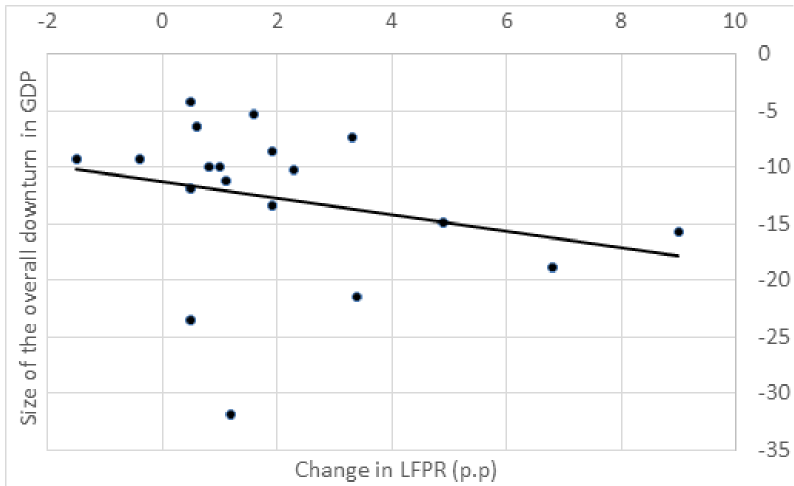
Sample: 2008:Q1 - 2013:Q4. In the panel estimation, we take account of the heterogeneity across countries by using country-specific time invariant effects. The index i refers to each euro area country (19 of them are considered including Lithuania). Notes: The dependent variable is $LFPR_{it} - LFPR\_trend_{it}$. The trend of the labor force participation rate (LFPR) is measured through the HP procedure setting the smoothing parameter to 1600. The participation rate refers to the working age population (15-64). Standard errors are in parentheses. ** denotes significance at the 5 per cent level; * denotes significance at the 10 per cent level.

Fig. 3: Time-varying correlations between de-trended $LFPR$ and the rate of change of GDP



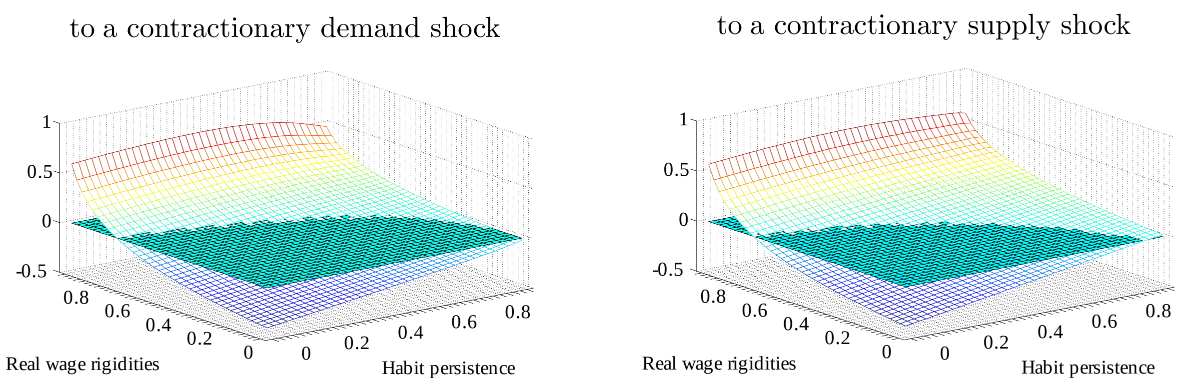
Notes: Rolling correlation coefficients between the labor force participation rate ($LFPR$) net of its trend and the rate of change of GDP have been calculated using 12-quarters windows over the period 2000:Q1 - 2013:Q4. The participation rate refers to the working age population (15-64).

Fig. 4: The participation rate and the intensity of the recession across euro area countries



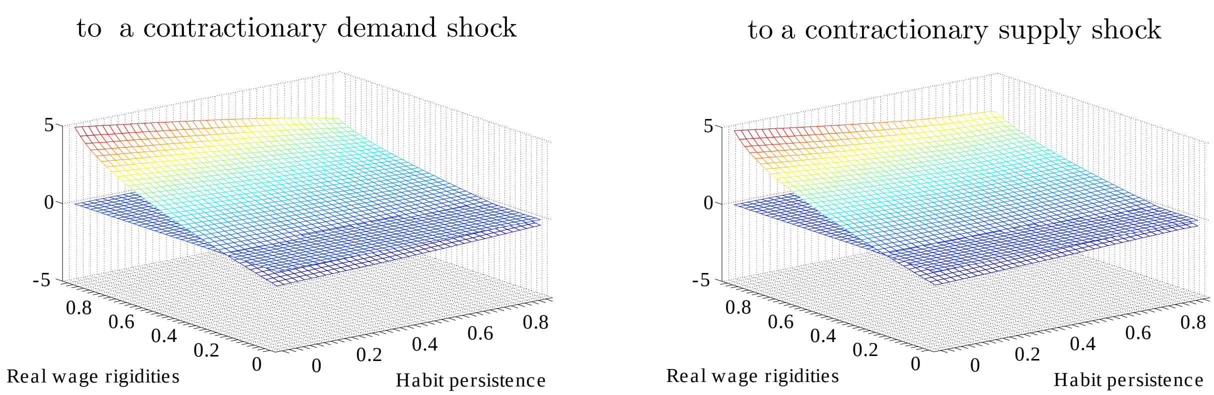
Notes: on the vertical axis, we consider the difference between the lowest and the highest vaue of real GDP attained by each country in the post-2007 period. In the horizontal axis the overal change over the post-2007 period is considered. The participation rate refers to the working age population (15-64). Euro area countries are 19 and include Lithuania.

Figure 5. Response at impact of labor market participation



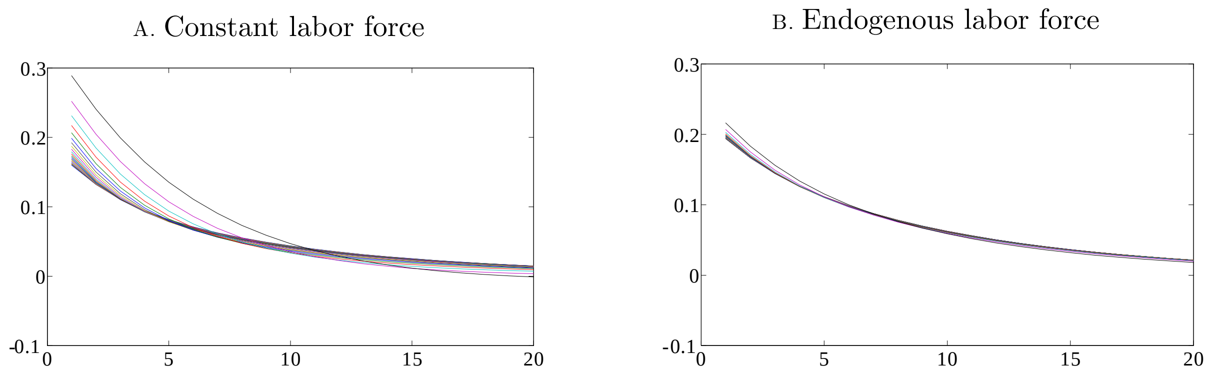
Note. The figure reports the response at impact of labor force participation to a 1% decrease in ξ_t (left panel) and to a 1% increase in μ_t (right panel), for different calibrated values of γ and h. The remaining parameters are calibrated as discussed in Section 3.6.

Figure 6. Response at impact of the wage markup



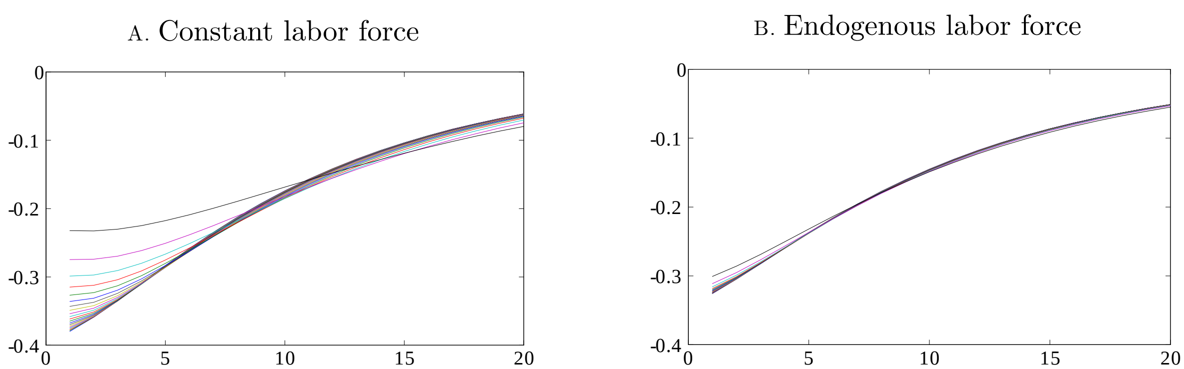
Note. The figure reports the response at impact of the wage markup to a 1% decrease in ξ_t (left panel) and to a 1% increase in μ_t (right panel), for different calibrated values of γ and h.The remaining parameters are calibrated as discussed in Section 3.6.

Figure 7. IRFs of inflation to a contractionary supply shock for different degree of real wage rigidities



Note. The figure reports the IRF of inflation to a 1% increase in μ_t, for different calibrated values of γ, between 0.0 and 0.95, when labor force participation is constant (panel A) and when it is endogenous (panel B). The remaining parameters are calibrated as discussed in Section 3.6.

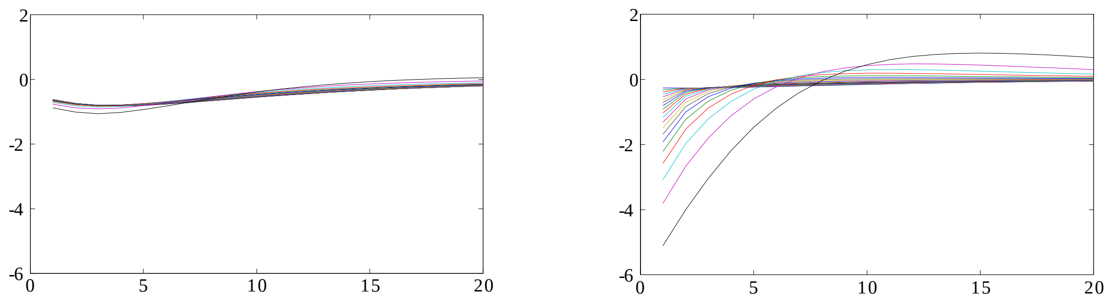
Figure 8. IRFs of inflation to a contractionary demand shock for different degree of wage rigidities



Note. The figure reports the IRF of inflation to a 1% decrease in ξ_t, for different calibrated values of γ, between 0.0 and 0.95, when labor force participation is constant (panel A) and when it is endogenous (panel B). The remaining parameters are calibrated as discussed in Section 3.6.

Figure 9. IRFs of labor market tightness to a contractionary supply shock for different degree of real wage rigidities

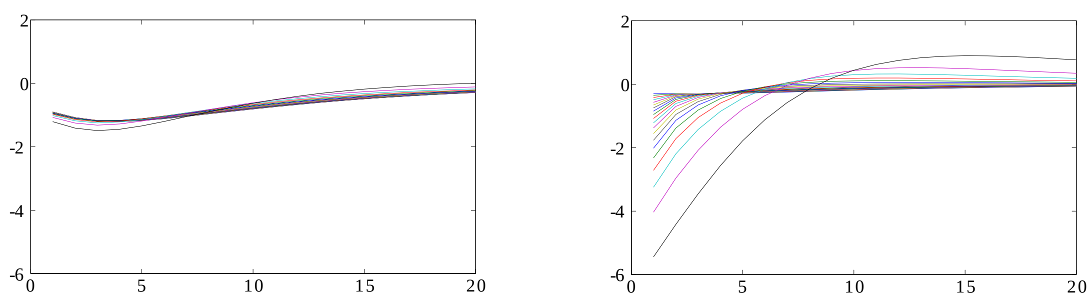
A. Constant labor force B. Endogenous labor force



Note. The figure reports the IRF of labor market tightness to a 1% increase in μ_t, for different calibrated values of γ, when labor force participation is constant (panel A) and when it is endogenous (panel B). The remaining parameters are calibrated as discussed in Section 3.6.

Figure 10. IRFs of labor market tightness to a contractionary demand shock for different degree of wage rigidities

A. Constant labor force B. Endogenous labor force



Note. The figure reports the IRF of labor market tightness to a 1% decrease in ξ_t, for different calibrated values of γ, between 0.0 and 0.95, when labor force participation is constant (panel A) and when it is endogenous (panel B). The remaining parameters are calibrated as discussed in Section 3.6.

Appendix

Steady state relations

Aggregate hirings in steady state are:

$$M = f\left[N - (1-\rho)E\right]$$

In steady state hiring costs represent the following fraction of GDP $\frac{\text{hiring costs}}{GDP} = \frac{Bf^{\eta}M}{Y} = \frac{Bf^{1+\eta}[N-(1-\rho)E]}{Y}$. Also note that the steady state relationship between E and N is:

$$E = \frac{f}{\left[1-(1-\rho)(1-f)\right]}N$$

After inserting the above equation in the previous expression for the steady state ratio between hiring costs and GDP, simple manipulations yield the following equation:

$$\frac{\text{hiring costs}}{GDP} = \frac{Bf^{\eta}M}{Y} = Bf^{\eta}\rho$$

Accordingly, we have $\frac{C}{Y} = \frac{C}{E} = 1 - \frac{Bf^{\eta}M}{Y} = 1 - Bf^{\eta}\rho$. Thus, steady state consumption is:

$$C = (1 - Bf^{\eta}\rho)E$$

From Eq. (17) we obtain:

$$(W^r)^* = \psi E_t^{1+\varsigma}(1 - Bf^{\eta}\rho)\frac{1-h}{1-h\beta} + \vartheta B f^{\eta}\left[1 - \beta(1-\rho)(1-f)\right]$$

The steady state unemployment rate is:

$$\frac{U}{N} = (1-f)\left[\frac{1-(1-\rho)}{\left[1-(1-\rho)(1-f)\right]}\right]$$

RECENTLY PUBLISHED "TEMI" (*)

N. 1028 – *The impact of CCPs' margin policies on repo markets*, by Arianna Miglietta, Cristina Picillo and Mario Pietrunti (September 2015).

N. 1029 – *European structural funds during the crisis: evidence from Southern Italy*, by Emanuele Ciani and Guido de Blasio (September 2015).

N. 1030 – *Female employment and pre-kindergarten: on the uninteded effects of an Italian reform*, by Francesca Carta and Lucia Rizzica (September 2015).

N. 1031 – *The predictive content of business survey indicators: evidence from SIGE*, by Tatiana Cesaroni and Stefano Iezzi (September 2015).

N. 1032 – *Sovereign debt exposure and the bank lending channel: impact on credit supply and the real economy*, by Margherita Bottero, Simone Lenzu and Filippo Mezzanotti (September 2015).

N. 1033 – *Does trend inflation make a difference?*, by Michele Loberto and Chiara Perricone (September 2015).

N. 1034 – *Procyclicality of credit rating systems: how to manage it*, by Tatiana Cesaroni (September 2015).

N. 1035 – *The time varying effect of oil price shocks on euro-area exports*, by Marianna Riggi and Fabrizio Venditti (September 2015).

N. 1036 – *Domestic and international macroeconomic effects of the Eurosystem expanded asset purchase programme*, by Pietro Cova, Patrizio Pagano and Massimiliano Pisani (September 2015).

N. 1037 – *Deconstructing the gains from trade: selection of industries vs. reallocation of workers*, by Stefano Bolatto and Massimo Sbracia (November 2015).

N. 1038 – *Young adults living with their parents and the influence of peers*, by Effrosyni Adamopoulou and Ezgi Kaya (November 2015).

N. 1039 – *Shoe-leather costs in the euro area and the foreign demand for euro banknotes*, by Alessandro Calza and Andrea Zaghini (November 2015).

N. 1040 – *The macroeconomic effects of low and falling inflation at the zero lower bound*, by Stefano Neri and Alessandro Notarpietro (November 2015).

N. 1041 – *The use of fixed-term contracts and the (adverse) selection of public sector workers*, by Lucia Rizzica (November 2015).

N. 1042 – *Multitask agents and incentives: the case of teaching and research for university professors*, by Marta De Philippis (November 2015).

N. 1043 – *Exposure to media and corruption perceptions*, by Lucia Rizzica and Marco Tonello (November 2015).

N. 1044 – *The supply side of household finance*, by Gabriele Foà, Leonardo Gambacorta, Luigi Guiso and Paolo Emilio Mistrulli (November 2015).

N. 1045 – *Optimal inflation weights in the euro area*, by by Daniela Bragoli, Massimiliano Rigon and Francesco Zanetti (January 2016).

N. 1046 – *Carry trades and exchange rate volatility: a TVAR approach*, by Alessio Anzuini and Francesca Brusa (January 2016).

N. 1047 – *A new method for the correction of test scores manipulation* by Santiago Pereda Fernández (January 2016).

N. 1048 – *Heterogeneous peer effects in education* by by Eleonora Patacchini, Edoardo Rainone and Yves Zenou (January 2016).

N. 1049 – *Debt maturity and the liquidity of secondary debt markets*, by Max Bruche and Anatoli Segura (January 2016).

N. 1050 – *Contagion and fire sales in banking networks*, by Sara Cecchetti, Marco Rocco and Laura Sigalotti (January 2016).

(*) Requests for copies should be sent to:
Banca d'Italia – Servizio Studi di struttura economica e finanziaria – Divisione Biblioteca e Archivio storico – Via Nazionale, 91 – 00184 Rome – (fax 0039 06 47922059). They are available on the Internet www.bancaditalia.it.

2013

A. MERCATANTI, *A likelihood-based analysis for relaxing the exclusion restriction in randomized experiments with imperfect compliance*, Australian and New Zealand Journal of Statistics, v. 55, 2, pp. 129-153, **TD No. 683 (August 2008).**

F. CINGANO and P. PINOTTI, *Politicians at work. The private returns and social costs of political connections*, Journal of the European Economic Association, v. 11, 2, pp. 433-465, **TD No. 709 (May 2009).**

F. BUSETTI and J. MARCUCCI, *Comparing forecast accuracy: a Monte Carlo investigation*, International Journal of Forecasting, v. 29, 1, pp. 13-27, **TD No. 723 (September 2009).**

D. DOTTORI, S. I-LING and F. ESTEVAN, *Reshaping the schooling system: The role of immigration*, Journal of Economic Theory, v. 148, 5, pp. 2124-2149, **TD No. 726 (October 2009).**

A. FINICELLI, P. PAGANO and M. SBRACIA, *Ricardian Selection*, Journal of International Economics, v. 89, 1, pp. 96-109, **TD No. 728 (October 2009).**

L. MONTEFORTE and G. MORETTI, *Real-time forecasts of inflation: the role of financial variables*, Journal of Forecasting, v. 32, 1, pp. 51-61, **TD No. 767 (July 2010).**

R. GIORDANO and P. TOMMASINO, *Public-sector efficiency and political culture*, FinanzArchiv, v. 69, 3, pp. 289-316, **TD No. 786 (January 2011).**

E. GAIOTTI, *Credit availablility and investment: lessons from the "Great Recession"*, European Economic Review, v. 59, pp. 212-227, **TD No. 793 (February 2011).**

F. NUCCI and M. RIGGI, *Performance pay and changes in U.S. labor market dynamics*, Journal of Economic Dynamics and Control, v. 37, 12, pp. 2796-2813, **TD No. 800 (March 2011).**

G. CAPPELLETTI, G. GUAZZAROTTI and P. TOMMASINO, *What determines annuity demand at retirement?,* The Geneva Papers on Risk and Insurance – Issues and Practice, pp. 1-26, **TD No. 805 (April 2011).**

A. ACCETTURO e L. INFANTE, *Skills or Culture? An analysis of the decision to work by immigrant women in Italy,* IZA Journal of Migration, v. 2, 2, pp. 1-21, **TD No. 815 (July 2011).**

A. DE SOCIO, *Squeezing liquidity in a "lemons market" or asking liquidity "on tap"*, Journal of Banking and Finance, v. 27, 5, pp. 1340-1358, **TD No. 819 (September 2011).**

S. GOMES, P. JACQUINOT, M. MOHR and M. PISANI, *Structural reforms and macroeconomic performance in the euro area countries: a model-based assessment,* International Finance, v. 16, 1, pp. 23-44, **TD No. 830 (October 2011).**

G. BARONE and G. DE BLASIO, *Electoral rules and voter turnout,* International Review of Law and Economics, v. 36, 1, pp. 25-35, **TD No. 833 (November 2011).**

O. BLANCHARD and M. RIGGI, *Why are the 2000s so different from the 1970s? A structural interpretation of changes in the macroeconomic effects of oil prices*, Journal of the European Economic Association, v. 11, 5, pp. 1032-1052, **TD No. 835 (November 2011).**

R. CRISTADORO and D. MARCONI, *Household savings in China,* in G. Gomel, D. Marconi, I. Musu, B. Quintieri (eds), The Chinese Economy: Recent Trends and Policy Issues, Springer-Verlag, Berlin, **TD No. 838 (November 2011).**

A. ANZUINI, M. J. LOMBARDI and P. PAGANO, *The impact of monetary policy shocks on commodity prices*, International Journal of Central Banking, v. 9, 3, pp. 119-144, **TD No. 851 (February 2012).**

R. GAMBACORTA and M. IANNARIO, *Measuring job satisfaction with CUB models,* Labour, v. 27, 2, pp. 198-224, **TD No. 852 (February 2012).**

G. ASCARI and T. ROPELE, *Disinflation effects in a medium-scale new keynesian model: money supply rule versus interest rate rule,* European Economic Review, v. 61, pp. 77-100, **TD No. 867 (April 2012)**

E. BERETTA and S. DEL PRETE, *Banking consolidation and bank-firm credit relationships: the role of geographical features and relationship characteristics,* Review of Economics and Institutions, v. 4, 3, pp. 1-46, **TD No. 901 (February 2013).**

M. ANDINI, G. DE BLASIO, G. DURANTON and W. STRANGE, *Marshallian labor market pooling: evidence from Italy,* Regional Science and Urban Economics, v. 43, 6, pp.1008-1022, **TD No. 922 (July 2013).**

G. SBRANA and A. SILVESTRINI, *Forecasting aggregate demand: analytical comparison of top-down and bottom-up approaches in a multivariate exponential smoothing framework,* International Journal of Production Economics, v. 146, 1, pp. 185-98, **TD No. 929 (September 2013).**

A. FILIPPIN, C. V, FIORIO and E. VIVIANO, *The effect of tax enforcement on tax morale,* European Journal of Political Economy, v. 32, pp. 320-331, **TD No. 937 (October 2013).**

2014

G. M. Tomat, *Revisiting poverty and welfare dominance*, Economia pubblica, v. 44, 2, 125-149, **TD No. 651 (December 2007).**

M. Taboga, *The riskiness of corporate bonds*, Journal of Money, Credit and Banking, v.46, 4, pp. 693-713, **TD No. 730 (October 2009).**

G. Micucci and P. Rossi, *Il ruolo delle tecnologie di prestito nella ristrutturazione dei debiti delle imprese in crisi*, in A. Zazzaro (a cura di), Le banche e il credito alle imprese durante la crisi, Bologna, Il Mulino, **TD No. 763 (June 2010).**

F. D'Amuri, *Gli effetti della legge 133/2008 sulle assenze per malattia nel settore pubblico,* Rivista di politica economica, v. 105, 1, pp. 301-321, **TD No. 787 (January 2011).**

R. Bronzini and E. Iachini, *Are incentives for R&D effective? Evidence from a regression discontinuity approach,* American Economic Journal : Economic Policy, v. 6, 4, pp. 100-134, **TD No. 791 (February 2011).**

P. Angelini, S. Neri and F. Panetta, *The interaction between capital requirements and monetary policy*, Journal of Money, Credit and Banking, v. 46, 6, pp. 1073-1112, **TD No. 801 (March 2011).**

M. Braga, M. Paccagnella and M. Pellizzari, *Evaluating students' evaluations of professors,* Economics of Education Review, v. 41, pp. 71-88, **TD No. 825 (October 2011).**

M. Francese and R. Marzia, *Is there Room for containing healthcare costs? An analysis of regional spending differentials in Italy,* The European Journal of Health Economics, v. 15, 2, pp. 117-132, **TD No. 828 (October 2011).**

L. Gambacorta and P. E. Mistrulli, *Bank heterogeneity and interest rate setting: what lessons have we learned since Lehman Brothers?,* Journal of Money, Credit and Banking, v. 46, 4, pp. 753-778, **TD No. 829 (October 2011).**

M. Pericoli, *Real term structure and inflation compensation in the euro area*, International Journal of Central Banking, v. 10, 1, pp. 1-42, **TD No. 841 (January 2012).**

E. Gennari and G. Messina, *How sticky are local expenditures in Italy? Assessing the relevance of the flypaper effect through municipal data,* International Tax and Public Finance, v. 21, 2, pp. 324-344, **TD No. 844 (January 2012).**

V. Di Gacinto, M. Gomellini, G. Micucci and M. Pagnini, *Mapping local productivity advantages in Italy: industrial districts, cities or both?*, Journal of Economic Geography, v. 14, pp. 365–394, **TD No. 850 (January 2012).**

A. Accetturo, F. Manaresi, S. Mocetti and E. Olivieri, *Don't Stand so close to me: the urban impact of immigration,* Regional Science and Urban Economics, v. 45, pp. 45-56, **TD No. 866 (April 2012).**

M. Porqueddu and F. Venditti, *Do food commodity prices have asymmetric effects on euro area inflation,* Studies in Nonlinear Dynamics and Econometrics, v. 18, 4, pp. 419-443, **TD No. 878 (September 2012).**

S. Federico, *Industry dynamics and competition from low-wage countries: evidence on Italy*, Oxford Bulletin of Economics and Statistics, v. 76, 3, pp. 389-410, **TD No. 879 (September 2012).**

F. D'Amuri and G. Peri, *Immigration, jobs and employment protection: evidence from Europe before and during the Great Recession,* Journal of the European Economic Association, v. 12, 2, pp. 432-464, **TD No. 886 (October 2012).**

M. Taboga, *What is a prime bank? A euribor-OIS spread perspective,* International Finance, v. 17, 1, pp. 51-75, **TD No. 895 (January 2013).**

G. Cannone and D. Fantino, *Evaluating the efficacy of european regional funds for R&D,* Rassegna italiana di valutazione, v. 58, pp. 165-196, **TD No. 902 (February 2013).**

L. Gambacorta and F. M. Signoretti, *Should monetary policy lean against the wind? An analysis based on a DSGE model with banking,* Journal of Economic Dynamics and Control, v. 43, pp. 146-74, **TD No. 921 (July 2013).**

M. Barigozzi, Conti A.M. and M. Luciani, *Do euro area countries respond asymmetrically to the common monetary policy?,* Oxford Bulletin of Economics and Statistics, v. 76, 5, pp. 693-714, **TD No. 923 (July 2013).**

U. Albertazzi and M. Bottero, *Foreign bank lending: evidence from the global financial crisis,* Journal of International Economics, v. 92, 1, pp. 22-35, **TD No. 926 (July 2013).**

R. DE BONIS and A. SILVESTRINI, *The Italian financial cycle: 1861-2011,* Cliometrica, v.8, 3, pp. 301-334, **TD No. 936 (October 2013).**

G. BARONE and S. MOCETTI, *Natural disasters, growth and institutions: a tale of two earthquakes,* Journal of Urban Economics, v. 84, pp. 52-66, **TD No. 949 (January 2014).**

D. PIANESELLI and A. ZAGHINI, *The cost of firms' debt financing and the global financial crisis,* Finance Research Letters, v. 11, 2, pp. 74-83, **TD No. 950 (February 2014).**

J. LI and G. ZINNA, *On bank credit risk: sytemic or bank-specific? Evidence from the US and UK,* Journal of Financial and Quantitative Analysis, v. 49, 5/6, pp. 1403-1442, **TD No. 951 (February 2015).**

A. ZAGHINI, *Bank bonds: size, systemic relevance and the sovereign,* International Finance, v. 17, 2, pp. 161-183, **TD No. 966 (July 2014).**

G. SBRANA and A. SILVESTRINI, *Random switching exponential smoothing and inventory forecasting,* International Journal of Production Economics, v. 156, 1, pp. 283-294, **TD No. 971 (October 2014).**

M. SILVIA, *Does issuing equity help R&D activity? Evidence from unlisted Italian high-tech manufacturing firms,* Economics of Innovation and New Technology, v. 23, 8, pp. 825-854, **TD No. 978 (October 2014).**

2015

M. BUGAMELLI, S. FABIANI and E. SETTE, *The age of the dragon: the effect of imports from China on firm-level prices*, Journal of Money, Credit and Banking, v. 47, 6, pp. 1091-1118, **TD No. 737 (January 2010).**

R. BRONZINI, *The effects of extensive and intensive margins of FDI on domestic employment: microeconomic evidence from Italy*, B.E. Journal of Economic Analysis & Policy, v. 15, 4, pp. 2079-2109, **TD No. 769 (July 2010).**

G. BULLIGAN, M. MARCELLINO and F. VENDITTI, *Forecasting economic activity with targeted predictors,* International Journal of Forecasting, v. 31, 1, pp. 188-206, **TD No. 847 (February 2012).**

A. CIARLONE, *House price cycles in emerging economies,* Studies in Economics and Finance, v. 32, 1, **TD No. 863 (May 2012).**

D. FANTINO, A. MORI and D. SCALISE, *Collaboration between firms and universities in Italy: the role of a firm's proximity to top-rated departments,* Rivista Italiana degli economisti, v. 1, 2, pp. 219-251, **TD No. 884 (October 2012).**

D. DEPALO, R. GIORDANO and E. PAPAPETROU, *Public-private wage differentials in euro area countries: evidence from quantile decomposition analysis,* Empirical Economics, v. 49, 3, pp. 985-1115, **TD No. 907 (April 2013).**

G. BARONE and G. NARCISO, *Organized crime and business subsidies: Where does the money go?,* Journal of Urban Economics, v. 86, pp. 98-110, **TD No. 916 (June 2013).**

P. ALESSANDRI and B. NELSON, *Simple banking: profitability and the yield curve,* Journal of Money, Credit and Banking, v. 47, 1, pp. 143-175, **TD No. 945 (January 2014).**

M. TANELI and B. OHL, *Information acquisition and learning from prices over the business cycle,* Journal of Economic Theory, 158 B, pp. 585–633, **TD No. 946 (January 2014).**

R. AABERGE and A. BRANDOLINI, *Multidimensional poverty and inequality,* in A. B. Atkinson and F. Bourguignon (eds.), Handbook of Income Distribution, Volume 2A, Amsterdam, Elsevier, **TD No. 976 (October 2014).**

V. CUCINIELLO and F. M. SIGNORETTI, *Large banks,loan rate markup and monetary policy,* International Journal of Central Banking, v. 11, 3, pp. 141-177, **TD No. 987 (November 2014).**

M. FRATZSCHER, D. RIMEC, L. SARNOB and G. ZINNA, *The scapegoat theory of exchange rates: the first tests,* Journal of Monetary Economics, v. 70, 1, pp. 1-21, **TD No. 991 (November 2014).**

A. NOTARPIETRO and S. SIVIERO, *Optimal monetary policy rules and house prices: the role of financial frictions,* Journal of Money, Credit and Banking, v. 47, S1, pp. 383-410, **TD No. 993 (November 2014).**

R. ANTONIETTI, R. BRONZINI and G. CAINELLI, *Inward greenfield FDI and innovation,* Economia e Politica Industriale, v. 42, 1, pp. 93-116, **TD No. 1006 (March 2015).**

T. CESARONI, *Procyclicality of credit rating systems: how to manage it,* Journal of Economics and Business, v. 82. pp. 62-83, **TD No. 1034 (October 2015).**

M. RIGGI and F. VENDITTI, *The time varying effect of oil price shocks on euro-area exports,* Journal of Economic Dynamics and Control, v. 59, pp. 75-94, **TD No. 1035 (October 2015).**

FORTHCOMING

G. DE BLASIO, D. FANTINO and G. PELLEGRINI, *Evaluating the impact of innovation incentives: evidence from an unexpected shortage of funds,* Industrial and Corporate Change, **TD No. 792 (February 2011).**

A. DI CESARE, A. P. STORK and C. DE VRIES, *Risk measures for autocorrelated hedge fund returns,* Journal of Financial Econometrics, **TD No. 831 (October 2011).**

E. BONACCORSI DI PATTI and E. SETTE, *Did the securitization market freeze affect bank lending during the financial crisis? Evidence from a credit register,* Journal of Financial Intermediation, **TD No. 848 (February 2012).**

M. MARCELLINO, M. PORQUEDDU and F. VENDITTI, *Short-Term GDP Forecasting with a mixed frequency dynamic factor model with stochastic volatility,* Journal of Business & Economic Statistics, **TD No. 896 (January 2013).**

M. ANDINI and G. DE BLASIO, *Local development that money cannot buy: Italy's Contratti di Programma,* Journal of Economic Geography, **TD No. 915 (June 2013).**

F BRIPI, *The role of regulation on entry: evidence from the Italian provinces,* World Bank Economic Review, **TD No. 932 (September 2013).**

G. ALBANESE, G. DE BLASIO and P. SESTITO, *My parents taught me. evidence on the family transmission of values,* Journal of Population Economics, **TD No. 955 (March 2014).**

A. L. MANCINI, C. MONFARDINI and S. PASQUA, *Is a good example the best sermon? Children's imitation of parental reading,* Review of Economics of the Household, **TD No. 958 (April 2014).**

R. BRONZINI and P. PISELLI, *The impact of R&D subsidies on firm innovation,* Research Policy, **TD No. 960 (April 2014).**

L. BURLON, *Public expenditure distribution, voting, and growth,* Journal of Public Economic Theory, **TD No. 961 (April 2014).**

L. BURLON and M. VILALTA-BUFI, *A new look at technical progress and early retirement,* IZA Journal of Labor Policy, **TD No. 963 (June 2014).**

A. BRANDOLINI and E. VIVIANO, *Behind and beyond the (headcount) employment rate,* Journal of the Royal Statistical Society: Series A, **TD No. 965 (July 2015).**

G. ZINNA, *Price pressures on UK real rates: an empirical investigation,* Review of Finance, **TD No. 968 (July 2014).**

A. CALZA and A. ZAGHINI, *Shoe-leather costs in the euro area and the foreign demand for euro banknotes,* International Journal of Central Banking, **TD No. 1039 (December 2015).**