CPB Netherlands Bureau for Economic Policy Analysis

CPB Background Document | March 2017

Labour supply and the business cycle:

Lessons from labour market flows and international forecasting practices

Annette Zeilstra
Karel Boxhoorn

CPB Background Document

Labour supply and the business cycle: lessons from labour market flows and international forecasting practices

Annette Zeilstra
Karel Boxhoorn

Contents

Acknowledgements

We would like to thank Adri den Ouden (CPB Netherlands Bureau for Economic Policy Analysis) and Martijn Souren and Robert de Vries (Statistics Netherlands) for the data they provided. Our thanks also go to the participants in internal CPB meetings and in the Policy Seminar 'Labour supply and the business cycle: lessons from labour market flows and international forecasting practices', particularly the discussant Robert-Paul Berben (Dutch Central Bank). Further thanks go to Anne Gielen for her helpful comments (thesis supervisor: Boxhoorn, K. (2017), The connection between business cycle fluctuations and labour supply: a flow approach, Master Thesis Policy Economics, Erasmus University, Rotterdam). We are indebted to Annemieke Righart (Dunfield Editing) for English-language editing the manuscript, the international experts (survey participants, see Section 2.7) for answering questions during interviews over the telephone, for providing additional information by mail and for their interesting conversations. We thank Adam Elbourne, Henk Kranendonk and Rob Luginbuhl for answering questions relating to time-series analysis. We are grateful to Yvonne Adema, Rob Euwals, Laura van Geest, Marloes de Graaf-Zijl, Albert van der Horst, Henk Kranendonk and Daniël van Vuuren (CPB Netherlands Bureau for Economic Policy Analysis) for their review of all or parts of the manuscript of this report and their useful feedback. Finally, we would like to thank Bart Borsboom, Dick Morks, René Nieuwenhuizen and Jeannette Verbruggen for their work on the layout and publication of this report.

Summary and conclusions

Accurate labour supply forecasting is important for the quality of unemployment forecasts. Many research institutes typically first forecast labour supply and employment and subsequently derive their unemployment forecast from these two underlying projections.

The short-to-medium-term labour supply projections of the 14 research institutes that we surveyed, however, have more in common:

- core of the short-to-medium-term labour supply forecasting model usually consists of a multiplication of population projections and projected participation rates;
- groups are important; usually, the forecasting models are disaggregated into age and gender, and sometimes also according to nationality, education, or region;
- business cycle fluctuations matter, as well; only one institute does not model the effect of these fluctuations on labour supply;
- nearly all institutes incorporate the influence of policy measures on labour supply and pensions, and about half of the forecasting models also include the effects of taxes and social benefits, especially unemployment benefits;
- the labour supply projections that result from the various models are usually manually adjusted, on the basis of expert opinion;
- sometimes, alternative forecasts of labour supply components are made in addition to an institute's central forecast.

There are also differences in labour supply projection methods. Institutes differ, for example, in the way they project participation rates, in the methods they use to incorporate the effects of business cycle fluctuations, and the extent to which models are disaggregated. Analysing these differences showed that there are *several trade-offs*, for example:

- trade-offs between *structure* and *flexibility*: imposing structure instead of using simple filtering techniques can enhance the forecast. However, a drawback of imposing structure is that the structure can be prone to the problem of misspecification of the relevant theoretical relationships and may therefore lead to less-accurate projections.
- trade-offs between *details* and *modelling ease*: including more details may also enhance the forecast; however, it is more difficult to model them in a consistent framework. For example, following a detailed approach may make it difficult to link labour market tightness, at the macro level, to the disaggregate/micro-level components.

The research institutes that participated in our expert survey do not use data on flows between employment, unemployment and non-participation in either their central forecasts or their alternative forecasts of labour supply components.

Although data on labour market flows have not yet been used to construct alternative forecasts in addition to central forecasts, our empirical analysis showed that it may be a promising avenue to pursue, for several reasons:

- the flows to and from non-participation are about 15 times higher than the resulting average absolute change in participation. Therefore, analysing labour market flow data sheds light on the hidden developments behind stock changes and helps us to obtain a better understanding of labour market developments.
- labour market flows exhibit a cyclical pattern that differs between demographic groups. Moreover, cyclical changes in the various labour market flows counteract each other and in part cancel each other out. Therefore, using labour market flow data may help in capturing the underlying cyclical movements in labour supply and improve short-term forecasts.

In addition, our analysis of labour market flows in relation to business cycle movements shows that:

- of the four flows to and from non-participation, those between unemployment and non-participation are the most cyclical, as they drop during economic upswings and rise during downturns.[1]
- groups matter: the flows between unemployment and non-participation are relatively more cyclical for women, and young and low-educated individuals;
- the flows between unemployment and non-participation not only show considerable cyclicality for the groups that do not participate because they are discouraged from doing so, but also for groups that cite other reasons for non-participation, such as education or housekeeping. This finding implies that using survey data on non-participation while only looking at discouragement will lead to underestimation of the total change in the flows.

Practical lessons for CPB's labour supply forecasts, therefore, include:

- when producing alternative labour supply forecasts or components thereof, in addition to central forecasts, data on labour market from could be used, for instance in flow models or BVARs;
- when modelling labour supply, a greater diversity in the types of groups may be of value. For example, in addition to age and gender, other distinctions could be made, such as in country of origin and educational attainment.

[1] During economic downturns, the rise of the flow from unemployment to non-participation signifies higher discouragement, while the rise from non-participation to unemployment is caused by a rise in unsuccessful attempts to enter the labour market, due to lower labour demand.

1 Introduction[2]

Motivation

Forecasting labour supply can be complex, especially when business cycle fluctuations are large. A recession may influence both short-, medium- and long-term labour supply (see e.g. Van den Berge et al., 2014). In times of recession, short-term labour supply may either decrease, increase or remain constant. It may decrease because unemployed workers stop searching for employment when faced with lower probabilities of finding a job due to rising unemployment, and a drop in vacancies, the so-called 'discouraged worker effect.' In contrast, labour supply may increase because of workers entering the labour market to supplement their household income when their spouse becomes or may become unemployed — the so-called 'added worker effect'. Empirical research shows that labour supply, on average, tends to decrease during recessions, but this is not always the case.[3] In the Netherlands, for example, labour supply remained fairly constant during the first phase of the Great Recession (2008–2011), while it increased during the second (2011–2014), and decreased again in 2013 and 2014, the tail end of the recession.

From our experience in making short-term forecasts, business cycle fluctuations may go hand in hand with relatively large fluctuations and unpredictable labour supply movements. This makes it difficult to forecast labour supply and, since unemployment depends on labour supply, this is also true for forecasting unemployment. Thus, to improve short-term forecasts of the unemployment rate, a good understanding of the relationship between labour supply and business cycle fluctuations is useful.

Therefore, the aim of this study is twofold:

1. Improving our short-term forecasts of labour supply.
2. Improving our understanding of the relationship between labour supply and business cycle fluctuations.

Research method

To achieve our first aim, we constructed an overview of short-term labour supply forecast practices by several international institutes, so that we could learn from them. Such an overview not yet existed, therefore, we held a survey among international experts.

To achieve our second aim, we performed a descriptive analysis of the relationship between labour market flows and their respective business cycle and labour market indicators. Although the literature contains many studies on the relationship between labour supply and business cycle movements, to the best of our knowledge, such a descriptive analysis had not been conducted before.

---

[2] New version 24 March 2017: pages 13, 16, 18 and 24 ETLA information update.

[3] See e.g. the study by Duval et al. (2011), who analyse participation rates in 30 countries over the 1960–2008 period. They find a negative effect of severe and very severe downturns on the aggregate participation rate, although they do not find a statistical significant effect for moderate downturns.

In the past, the relationship between labour participation and the business cycle at the micro level, using individual data, has been analysed extensively,[4] as well as that between labour participation and the business cycle on regional and national levels, using stock data.[5] The use of flow data in analysing such a relationship is less common. Usually, flow data are used to analyse unemployment,[6] although Den Butter (1998) analyses employment, as well.

Using gross labour flows between the three labour market states (employment, unemployment and non-participation) sheds light on developments behind stock changes. This helps us to obtain a better understanding of labour market developments. Eventually, labour market flows may be used for making alternative forecasts of labour supply or its components, in addition to CPB's central forecast.

Data

In this study, we used data on gross quarterly labour market flows from Statistics Netherlands (CBS), on the period from 2003-II to 2016-I. The flows are based on survey data and are scaled up by CBS to represent national flows. The flows represent the number of individuals that change from one of the three labour market states (employment, unemployment and nonparticipation) to another, within a given quarter. Data on these changes are available for the total population aged between 15 and 75, as well as separately for men, women, three age groups (15–25, 25–45, 45–75) and three education levels (low, medium and high). Data on cross classifications, such as 'young and highly educated', are not available.

Reader's guide

The outline of the report is as follows. Section 2 provides an overview of the forecasting methods for short-term labour supply by several international institutes. The overview shows large differences in, for example, the trade-off between modelling structure and flexibility, and details and modelling ease. Some institutes use alternative models to check their central labour supply forecast, which may be useful for CPB in developing alternative models to check the central forecast. Section 3 starts with a brief literature overview of both theoretical and empirical studies on the relationship between labour supply and the business cycle. Finally, Section 4 presents a descriptive analysis of the relationship between labour market flows and their respective business cycle and labour market indicators. We found substantial differences in the flows between demographic groups (e.g. age groups and education levels), and conclude that using data on gross labour market flows may be useful for developing alternative models to check our central forecast.

[4] A brief discussion of the literature can be found in Gong (2011), and some recent examples include Triebe (2015), Starr (2014) and a Dutch study by The Netherlands Institute for Social Research (Merens and Josten, 2016).
[5] See, for example, a literature overview of regional labour participation studies by Elhorst (1996), a multi-country study on regional labour participation using both regional and national data by Elhorst and Zeilstra (2007), a multi-country study on labour market adjustment by Decressin and Fatás (1995) and similar study on the Netherlands (Broersma and Van Dijk, 2002) and a recent international study on female labour participation by Thévenon (2013).
[6] See, for example, Gomes (2012), as well as a study comparing four European countries (Burda and Wyplosz, 1994), and a recent Dutch study (Loon, Loog, Van der Horst and Souren, 2014).

References

Broersma, L. and J. van Dijk, 2002, Regional labour market dynamics in the Netherlands, *Papers in Regional Science*, 81, 343–364.

Berge, W. van den, H. Erken, M. de Graaf-Zijl and E. van Loon, 2014, The Dutch labour market during the Great Recession, *CPB Background Document*, June 2014, CPB Netherlands Bureau for Economic Policy Analysis, The Hague.

Burda, M., and C. Wyplosz, 1994, Gross worker and job flows in Europe, *European economic review*, 38, 1287–1315.

Butter, F.A.G, den, and M. van Dijk, 1998, The pace of job creation and destruction, cyclical shocks and employment dynamics, *Labour*, 12, 613–632.

Decressin, J. and A. Fatás, 1995, Regional labor market dynamics in Europe, *European Economic Review*, 39, 1627–1655.

Duval, R., M. Eris and D. Furceri, 2011, The effects of downturns on labour force participation: evidence and causes, *OECD Economics Department Working Papers*, 875.

Elhorst, J. P., 1996, Regional labour market research on participation rates, *Journal of Economic and Social Geography*, 87, 209–221.

Elhorst, J.P. and A.S. Zeilstra, 2007, Labour force participation rates at the regional and national levels of the European Union: An integrated analysis. *Papers in Regional Science*, 86, 525–549.

Gomes, P., 2012, Labour market flows: facts from the United Kingdom, *Labour Economics*, 19, 165–175.

Gong, X., 2011, The Added Worker Effect for Married Women in Australia, *Economic Record*, 87, 414–426.

Loon, E. v., B. Loog, A. van der Horst, and M. Souren, 2014, De oploop van de werkloosheid ontleed, *TPE digitaal,* 8, 65–83.

Merens, A., and E. Josten, 2016, *Werkloos toezien? Gevolgen van de crisis voor emancipatie en welbevinden*, The Netherlands Institute for Social Research (SCP), The Hague.

Starr, M.A., 2014, Gender, added-worker effects, and the 2007–2009 recession: Looking within the household, *Review of Economics of the Household*, 12, 209–235.

Thévenon, O., 2013, Drivers of Female Labour Force Participation in the OECD, *OECD Social, Employment and Migration Working Papers*, 145, OECD Publishing, Paris.

Triebe, D., 2015, The Added Worker Effect Differentiated by Gender and Partnership Status–Evidence from Involuntary Job Loss, *SOEPpapers on Multidisciplinary Panel Data Research*, 740.

2 Labour supply forecasting in practice

2.1 Introduction

To date, no overview was available on how European institutes are forecasting labour supply. Therefore, and in order to learn from the experiences of other institutes, we held a survey among international experts (see list in Section 2.8). The survey was sent to members of the *Association of European Conjuncture Institute (AIECE)*, who are involved in short-term macroeconomic forecasting. In addition, the survey was sent to the Institute for Employment Research (IAB), whose projections of labour supply are used as a baseline projection by some members of AIECE, and to the Dutch Central Bank (DNB). The following institutes were analysed based on survey responses: AP (Association Prometeia; Italy); CPB (CPB Netherlands Bureau for Economic Policy Analysis; Netherlands); DNB (Dutch Central Bank; Netherlands); DØRS (Danish Economic Council; Denmark); ETLA (Research Institute of the Finnish Economy; Finland); FPB (Federal Planning Bureau; Belgium); IAB (Institute for Employment Research; Germany); IFW (Kiel Institute for the World Economy; Germany); KOF (Swiss Economic Institute; Switzerland); NIER (National Institute of Economic Research; Sweden); NIESR (The National Institute of Economic and Social Research; United Kingdom); RWI (Leibniz Institute for Economic Research; Germany); SN (Statistics Norway; Norway); WIFO (The Austrian Institute of Economic Research; Austria).

The information presented here is based on the respondents' answers in interviews over the telephone, as well as on literature and information gathered by e-mail. Moreover, all survey respondents were asked to review the final draft of the tables in Section 2.3.3 and the more elaborate description of the forecasting models in Section 2.4 of this report and check them for correctness.

Almost all institutes have in common that the core of their short-term to medium-term labour supply forecasting model exists of a multiplication of population projections and projected participation rates. Another commonality is a breakdown of the model into different groups; notably age and gender and sometimes nationality, education or region. Nearly all institutes include the influence of pension reforms on projected labour supply to account for the rising participation rate of older workers. Furthermore, about half of the

institutes include the effects on labour supply caused by policy measures related to taxation and social benefits.[7]

In contrast, institutes vary widely in how they project their participation rates. There is also extensive variation in the way institutes take account of business cycle fluctuations and labour market tightness in their labour market projections. However, almost all institutes explicitly take account of the influence of business cycle fluctuations on projected labour supply. This is relevant, since forecasting labour supply is especially complex during large business cycle fluctuations.

The outline of this section is as follows. An overview of the concepts and definitions used is presented in Section 2.2. Section 2.3 contains an overview of the labour supply forecast for all institutes included in the current study, and discusses trade-offs between characteristics of projection methods. More in-depth information on the various forecasting methods of each institute is included in Section 2.4. Section 2.5 contains the summary and conclusions. The names of the international experts who participated in the survey are listed in Section 2.7. Section 2.8 contains the questionnaire as it was sent to the participating international experts in preparation of the telephone interview.

2.2 Glossary of concepts and definitions

As interpretation of the various terms may differ between institutes, this section provides a list of the various definitions. A number of the terms are illustrated in Figure 2.1.

Administrative unemployment

See registered unemployment.

Equilibrium labour supply

Labour supply that would result when the economy is in equilibrium and the output gap on the labour market is closed.

Equilibrium unemployment

Unemployment that would result when the economy is in equilibrium and the output gap on the labour market is closed.

Eurostat unemployment

Eurostat unemployment is unemployment according to the definition by Eurostat. Eurostat uses the ILO definition (see ILO unemployment) and makes it more specific, for example, by specifying age (15–74 years old).

Hidden reserve

The hidden reserve is the number of people of working age who do not have a job and would like to work, but are discouraged to enter the labour market due to an unfavourable labour

[7] Social benefits includes all benefits under the social security system. Institutes that incorporate the influence of social benefits on labour supply usually include at least that of unemployment benefits.

market situation. If the economy is in a situation of full employment, the hidden reserve is zero. See Figure 2.1.

ILO unemployment

ILO unemployment is unemployment according to the definition by *the International Labour Organization* (ILO). It is usually determined by a survey.[8] ILO unemployment relates to persons above a specific age. A person is considered unemployed if he/she is without work, currently available for work and seeking work, that is, if he/she has taken specific steps in a specific, recent period to seek paid employment or self-employment.

Labour participation

Sum of employed and unemployed persons.

Labour participation rate

Sum of employed and unemployed persons divided by the working-age population.

Labour supply

Sum of employed and unemployed persons.

Participation gap

Actual participation (i.e. number of employed and unemployed individuals) minus structural participation.

Potential labour supply

The potential labour supply as estimated by several institutes included in this study is equal to the labour supply that would result when the economy would be in a situation of full employment. Note that, according to this definition, the size of the potential labour supply is *not equal to the number of working-age people*. Potential labour supply does not include working-age persons who do not want to work for reasons other than the labour market situation. In other words, it excludes people who, for example, are pursuing a full-time education, are early retirement recipients, or are disabled. See Figure 2.1.

Potential participation rate

Potential labour supply divided by the working-age population.

Registered unemployment

Registered unemployment is based on administrative data. Registered unemployment is equal to the number of persons registered as being unemployed with the national register of the public employment services of each country. Whether or not a person is registered as being unemployment depends on the national rules and definitions, which differ between countries (see Eurostat, 2006).

[8] The Labour Force Survey (LFS) by Eurostat uses the ILO definition and makes it more specific, for example, by specifying age (15–74 years old).

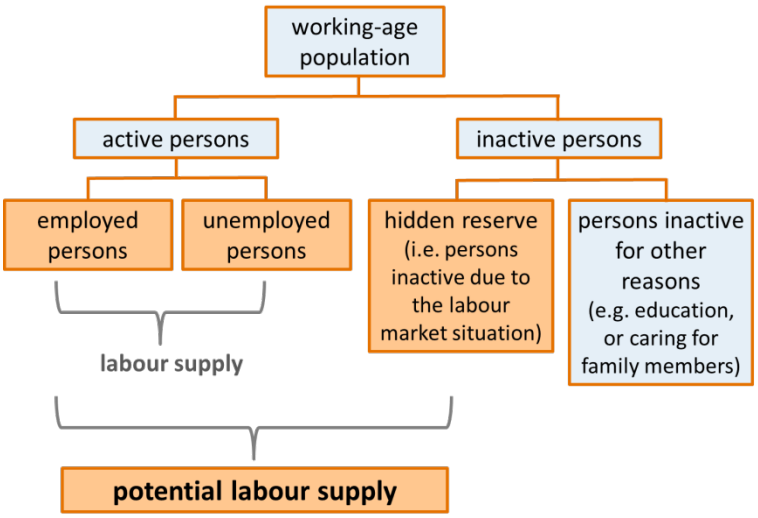
Structural participation
The number of individuals that would participate (i.e. employed plus unemployed) if the output gap on the labour market is equal to zero.

Structural participation rate
The number of individuals that would participate (i.e. employed plus unemployed) if the output gap on the labour market is equal to zero divided by the working-age population.

Unemployment gap
Actual unemployment minus equilibrium unemployment.

Working-age population
Number of working-age persons, usually the population aged between 15 and 74 or 15 and 64.

Figure 2.1 Relation between labour market concepts (adapted from Figure 1 in Graff et al., 2013)



2.3 Overview

This section provides a broad overview and brief discussion of forecasting methods currently used by various institutes to project short-term labour supply (Sections 2.3.1 and 2.3.2). It also contains overview tables with more details on forecasting methods, variables that influence the labour supply forecast (e.g. labour market tightness and policy measures), data used and types of forecasting error analysis (Section 2.3.3). As a rule, medium- and long-term labour supply forecasting models are discussed only when this is necessary for understanding short-term forecasts.

More in-depth information on the different forecasting methods of each institute can be found in Section 2.4.

2.3.1 Short-term labour supply forecasting models: in brief

Most institutes included in this rapport first forecast labour supply and employment and then determine projected unemployment by subtracting employment from labour supply. Exceptions are the institutes ETLA, DØRS, IAB, KOF and WIFO. IAB and KOF first construct a potential labour population projection and then use this as one of the inputs to project both employment and unemployment, the sum of which equals projected labour supply. ETLA first makes a GDP forecast and then uses this forecast and projected population to forecast labour supply.[9] DØRS and WIFO project employment and unemployment and subsequently the sum of both projections equals their labour supply forecast. For details see Table 2.1.[10]

Common model format

Usually, the core of the short-to-medium-term labour supply forecasting model exists of a multiplication of a population projection and projected participation rates. The only exceptions are DØRS and WIFO. DØRS projects employment and unemployment by assessing short-term indicators and policy measures. WIFO projects total labour supply in the short-term by trend extrapolation of employment and unemployment.[11]

Participation rates projections

Though almost all institutes use projected participation rates, institutes differ in the way they project participation rates:

- Three institutes (AP, DNB and NIESR) base their extrapolation of participation rates on error correction models.
- Three institutes (CPB, FPB and NIER) use an extrapolation of filtered historical participation rate time series. NIER uses this extrapolation for all age groups, while CPB and FPB use it for the younger age groups only.
- Two institutes (IAB and KOF) base their extrapolation of participation rates on logistic regression models. In addition, two institutes (IFW and RWI) base their projection indirectly on logistic regression models, since they use IAB's projection as their baseline projection.
- Two institutes (CPB and FPB) use a cohort model to project the participation rate of older age groups. In a cohort model, the labour participation rate of individuals at a certain age is allowed to vary between cohorts.
- SN uses a logit model to project participation rates. ETLA uses a constant labour supply elasticity of the working age population (15–64 years of age) for projection years.
- Finally, to project the participation rates of individuals aged 60 and over, FPB uses a bottom-up approach based on administrative data on transitions between the labour supply of different groups into disability or pension.

[9] ETLA's main focus is to provide information to Finnish firms. Important variables in their forecast are therefore, for example, production per industry, export competiveness per industry and profitability of firms per industry, which are calculated by ETLA's input–output model. Since the labour supply forecast is not their main focus, its projections are less detailed.
[10] SN uses two models to forecast labour supply: the macroeconomic model MODAG and the microsimulation model MOSART, this section focuses on MODAG.
[11] In their long-term projections, however, DØRS and WIFO do calculate projected labour supply by multiplying projected participation rates by the population projection.

For details, see Table 2.2. and Section 2.4.

Population projection

Population projections are usually obtained from the national statistical offices. Exceptions are those by FPB, IAB and KOF, who all make their own population projections.[12] For details, see Table 2.2. and Section 2.4.

Business cycle and labour supply

All institutes take account of the effect of business cycle fluctuations by either explicitly modelling these effects or by adjusting their labour supply forecast using expert judgement based on, for example, recent data and labour market indicators.
Four institutes (IAB, IFW, KOF and RWI) use the concepts of potential participation and hidden reserve in their labour supply forecast. Of these four institutes, IAB and KOF forecast labour supply by projecting employment and unemployment using, among other things, potential participation, business cycle indicators and labour market variables. The other two institutes (IFW and RWI) forecast labour supply by subtracting the hidden reserve from the potential labour supply, where the hidden reserve depends, among other things, on labour market tightness.

Two of the three institutes (AP and DNB) that use error correction models to forecast participation rates let their participation rates depend on an unemployment measure to account for labour market tightness. The third institute (NIESR) does not explicitly model the relation between participation rates and labour market tightness. However, if in their model participation rates deviate from the trend after a macroeconomic shock, then these rates will converge towards their trend after a few years.

Two institutes (CPB and DØRS) use the concept of participation gap in their labour supply forecast. The speed at which this participation gap will dissolve, depends, among other things, on the gap between actual unemployment and equilibrium unemployment, and expert judgement.[13]

In ETLA's short-term forecast, labour supply depends on macroeconomic development, measured by changes in GDP. SN lets its participation rate depend on unemployment and other macroeconomic variables.

Finally, FPB and WIFO do not explicitly model a link between labour market tightness and labour supply in their short-term forecast. FPB's model does not contain such a link, because it is difficult to relate labour market tightness at macro level to the disaggregate/micro-level components of their model. WIFO, does not link labour market tightness to labour supply in their short-term forecast, but does so for the medium term.

For details, see Table 2.5 and Section 2.4.

[12] SN is the statistical office of Norway and also makes its own population forecast.
[13] In addition, in the CPB model, the change in the participation gap also depends on unemployment changes.

Hysteresis

Although the labour supply forecast of all institutes depends on business cycle fluctuations, most institutes do not incorporate hysteresis effects of business cycle fluctuations. However, CPB and NIESR may allow for a permanent withdrawal of older workers from the labour market due to a particularly severe recession. However, in the very long term, individuals who withdrew from the labour market in certain cohorts, will be replaced by others in younger cohorts and participation rates adjust to their structural levels. SN allows the effects of fiscal policy measures on labour supply to depend on the level of unemployment. Finally, RWI allows for hysteresis via an increase in equilibrium unemployment.

For details, see Table 2.9 and Section 2.4.

Policy measures

Almost all institutes take account of the influence of policy measures on projected labour supply, provided that the expected effect on labour supply is sufficiently large.

In their short-term forecasts, nearly all institutes allow for the influence of pension reforms on labour supply. Twelve institutes adjust their baseline forecast to account for pension reforms. One institute (NIESR) implicitly incorporates the effect of the ongoing rise of the pension entitlement age in the ongoing rise of the participation rate of older workers.

About half of the institutes include the effects of tax policy measures on projected labour supply, and the fraction of the institutes that account for the effects of social benefit policy measures is slightly larger. Moreover, about a quarter of the institutes take account of changes in active labour market programmes (ALMP).[14]

For details, see Table 2.6 and Section 2.4.

Other factors: immigration, final data and expert judgement

Nearly all institutes take account of the influence of immigration on labour supply, in their short-term forecast, through its influence on the working-age population. In addition, about half of the institutes adjust their projected participation rates to account for immigration. Generally speaking, the institutes take deviating participation rates of asylum seekers into account; although one institute adjusts their projected participation rates to allow for deviating participation rates of labour immigrants.

Almost all institutes use expert judgement to adjust their labour supply forecast. This expert judgement is usually based, among other things, on recent final labour market data.

For details, see Table 2.7 and Section 2.4.

[14] If individuals participate in an ALMP, they are no longer participating in the labour market.

Groups: aggregation level and demographic variables

Except for WIFO, all institutes include the effects of demographic change on projected short-term labour supply. As mentioned earlier, usually, the core of the short-to medium-term labour supply forecasting model consists of the multiplication of population projections and projected participation rates.[15] This multiplication is usually done for various population sub-groups (mostly age groups by gender). Some institutes also disaggregate the population according to region (FPB), nationality (IAB, IFW, KOF, RWI and WIFO), education (SN), or origin (NIER).

The number of sub-groups included in the short-term labour supply projection models varies widely across institutes and ranges from one to several hundreds. Six institutes (AP, DNB, DØRS, ETLA, NIESR and WIFO) have one or two groups in their short-term model. Six institutes (CPB, IAB, IFW, KOF, SN and RWI) include between 10 and 50 groups, while two institutes (FPB and NIER) have more than a hundred groups.

For details, see Tables 2.3 and 2.4 and Section 2.4.

Survey versus registered data on unemployment

Almost all institutes use survey data on unemployment in their labour supply models. The only two exceptions are DØRS and FPB. However, though FPB uses only administrative data in its model, it does use survey data to check the plausibility of the trend evolution in administrative-based participation rates.

Three institutes use only survey data on unemployment in their model (AP, ETLA, and SN). Seven institutes (CPB, DNB, IAB, IFW, NIER, NIESR and WIFO) use survey data on unemployment as the main input for modelling, while both ILO unemployment and administrative unemployment are forecasted. KOF and RWI use administrative data on unemployment as the main input for modelling, while they forecast both ILO unemployment and administrative unemployment.

For details, see Table 2.8 and Section 2.4.

Forecasting error analysis

All institutes compare recent final data on labour supply with their forecast. In addition, four institutes (AP, FPB, KOF and WIFO) have recently done a more detailed analysis of their forecasting errors of labour supply or its components. Whereas ETLA publishes the average median and median absolute forecasting errors of unemployment in each forecast.

For details, see Table 2.10 and Section 2.4.

Instruments

Five institutes use instruments to check their central forecast of labour supply and/or its components, or are planning to do so in future.

[15] WIFO uses demographic change in their long-term projections of labour supply only. WIFO then disaggregates its population into age groups, per education level for each gender.

As an alternative forecast for employment, DNB applies a simple error correction framework that relates changes and levels of private sector employment to changes and levels of hours worked in temporary jobs and the number of dismissal applications.

CPB and FPB both use a leading indicator model to check the plausibility of the employment forecast. Furthermore, CPB currently is exploring the possibilities of making an alternative forecast of labour supply or its components in addition to the central forecast. More specifically, Bayesian Vector Autoregression (BVAR) models are considered.

KOF developed a large BVAR forecast of the production side of the Swiss economy. This model is currently extended to incorporate employment forecasts, per industry, to enable comparison with its employment projections . Short-term employment and unemployment forecasts are also compared with simple indicator-based projections.
NIER uses both VAR and BVAR models to make alternative employment projections in addition to its central forecast. SN produces alternative scenario projections, among other things, for labour supply, depending on demographic factors such as net migration.

Finally, WIFO constructs alternative forecasts in addition to its central forecasts on employment, such as employment by sector (using a dynamic econometric input-output model) or by occupation.

For details, see Section 2.4.

2.3.2 Discussion

This sub-section contains a brief discussion of the various short-term labour supply forecasting methods, and presents an overview table (Table 2.1). This overview table shows whether or not there is a relationship between the method used to project participation rates and other characteristics of the short-term labour supply forecasting method. More specifically, we try to pinpoint trade-offs between various characteristics of the labour supply forecasting methods.

Table 2.1 Overview and variables used in the short-term forecast

Institute	Projection of participation rates using (a)	Forecast of (b)	Resulting variable (b)	Group numbers/ types (c)	Labour market tightness included (d)	Hysteresis included (d)	Policy measures included in areas (e)
AP (Italy)	ECM	L,E	U	2/G	Y	Y	p,t,b
CPB (Netherlands)	FIL/CM	L,E	U	26/A,G	Y	(Y)	p,t,b
DNB (Netherlands)	ECM	L,E	U	1	Y	N	p
DØRS (Denmark)	N	E,U	L	1	Y	N	p,t,b
ETLA (Finland)	O	GDP/POP	L,E,U	1	Y	N	p,t,b
FPB (Belgium)	FIL/CM/O	L,E	U	366/A,G,R	N	N	p,b
IAB (Germany)	LOG	pot.L	E,U	48/A,G,N	Y	N	p,t,b,a
IFW (Germany)	LOG_B	L,E	U	48/A,G,N	Y	N	p,t,a
KOF (Switzerland)	LOG	pot.L	E,U	16/A,G,N	Y	N	p,b
NIER (Sweden)	FIL	L,E	U	480/A,G,N	Y	N	p,t,b,a
NIESR (United Kingdom)	ECM	L,E	U	2/A	(Y)	(Y)	(p)
RWI (Germany)	LOG_B	L,E	U	48/A,G,N	Y	Y	p,a
SN (Norway)	O	L,E	U	45/A,G,E	Y	Y	p,t,b
WIFO (Austria)	N	E,U	L	2/A	(Y)	(Y)	p,a

(a) FIL: filtering techniques; CM (cohort model); ECM (error correction model); LOG: logistic regression; LOG_B: baseline projection based on logistic regression by IAB; O (other model); OLS (ordinary least squares); N (not in short-term model).
(b) L: labour supply; E: employment; U: unemployment; pot.L: potential labour supply; GDP: gross domestic product; POP: population.
(c) A: age; E: education level; G: gender; N (not in short-term model); NAT: nationality or origin; R: region
(d) Y: if a variable is explicitly modelled; (Y); parenthesis are used if effects are included in the forecast but not explicitly modelled ; N: if effects are not included.
(e) p: pension, t: taxes, b: social benefits, a: active labour market programmes; parenthesis are used if effects are included in the forecast but not explicitly modelled.
Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Trade-off: structure versus flexibility

First of all, the various methods to project labour participation rates show a trade-off between structure and flexibility. Simple filtering techniques impose the least structure and are therefore the most flexible. They do not impose theoretical relationships and let the data speak for themselves. Moreover, it is relatively straightforward to use filtering techniques for a large number of sub-groups. However, if we have a theoretical notion of which variables are relevant to project labour participation rates, we can impose structure on the labour participation rate projection by including these explanatory variables to improve the forecast. Since simple filtering techniques do not allow for the inclusion of explanatory variables, other techniques, such as error correction and logistic models, are needed.[16][17] In both error correction and logistic models, it is possible to include explanatory variables. Another way to impose structure on the labour participation rate projection is to use a cohort model, where it is specified how labour participation rates per age group differ across cohorts.

The advantage of imposing structure on the forecast of labour participation rates is that if the structure is correct, it enhances the forecast. However, a drawback of imposing structure, either by including explanatory variables or by implementing a cohort model, is that the

[16] Note that filtering techniques also have other drawbacks, most notably that of the filtered trend being very sensitive to the final data points, the so-called 'endpoint problem'.
[17] Note that more complex filtering techniques, such as Kalman filters, allow for the inclusion of explanatory variables.

structure can be prone to misspecification of the relevant theoretical relationships. In that case, imposing a misspecified structure may lead to less-accurate projections.

Other ways to impose structure on the labour supply forecast is by adjusting it for changes in policy measures. Adjusting for policy changes can improve the forecast. However, determining the precise effects of policy changes on projected labour supply is difficult. The same holds for determining the effects of former policy changes on past labour supply. The reason being that it is difficult to disentangle the effects of policy changes and other factors on past labour supply, because such effects cannot be measured ex post, but only estimated ex ante. Nonetheless, almost all institutes adjust their labour supply forecast for policy changes. Since it is difficult to determine the precise effects of policy changes on labour supply, institutes usually only adjust their labour supply forecast in case of major policy changes. Examples of such policy changes are changes in pension schemes (e.g. the pension entitlement age) and major changes in the areas of taxation and social welfare benefits. In those cases, the effect of major policy changes on future labour supply are generally estimated outside the labour supply projection model, for example using micro-simulation models or spreadsheets containing several rules of thumb.

Trade-off: details versus modelling ease

Another trade-off that can be seen in Table 2.1 is the one between including more details and modelling ease. For example, it is important to model the labour participation decision of older workers, because those are subject to change. An interesting way of doing this, is by applying a detailed bottom-up approach. This approach uses administrative data on transitions between the labour supply of various groups into disability or pension, to construct participation rates of individuals aged 60 and over. However, a drawback of this detailed approach is that it is difficult to model the link between labour market tightness at the macro level to the disaggregate/micro level components. Therefore, a detailed approach with respect to the labour participation of older workers may cause difficulties in modelling the relation at the aggregate level between labour market tightness and labour supply.

Another example is that of including education in the labour supply forecasting model. Although educational attainment is known to influence labour supply, including the education decision in the labour supply forecasting model is complex. A prerequisite is the availability of a forecast of the development of educational attainment of the population by age groups, over time. Only two institutes have population forecasts by gender, age and education level at their disposal, and use this to forecast long-term labour supply (WIFO) and both short- and long-term labour supply (SN).[18]

2.3.3 Overview tables

Tables 2.2 and 2.3 contain a brief description of the different forecasting methods currently used by various institutes to project labour supply. Tables 2.4 and 2.5 show information on the aggregation level of the model, and on whether – and if so, how – demographic variables play a role in the models. The influence of macroeconomic variables and those on labour

[18] Statistics Norway (SN) produces their own population forecast.

market tightness on the labour supply forecast and whether or not hysteresis is included in the model can be found in Tables 2.6 and 2.10. The policy measures and other factors that influence labour supply forecasts are described in Tables 2.7 and 2.8. Finally, Table 2.11 contains information on the data used to measure unemployment and the extent to which institutes recently analysed their forecasting errors about labour supply.

For a more elaborate description of each institute's forecasting model, see Section 2.4.

Table 2.2 Short-term labour supply forecast: directly forecasted or derived from results

Institute	Forecast of	Resulting variable	Brief description
AP (Italy)	Labour supply; Employment	Unemployment	Forecasts are made for labour supply and employment, from which subsequently unemployment is derived.
CPB (Netherlands)	Labour supply; Employment	Unemployment	Forecasts are made for labour supply and employment, from which subsequently unemployment is derived.
DNB (Netherlands)	Labour supply; Employment	Unemployment	Forecasts are made for labour supply and employment, from which subsequently unemployment is derived.
DØRS (Denmark)	Employment; Unemployment	Labour supply	Forecasts are made for employment and unemployment, from which subsequently labour supply is derived for the first three projection years. In the long run, equilibrium unemployment is determined by demography and structural reform. Hence, employment is the resulting variable in the long run.
ETLA (Finland)	GDP, working-age population	Labour supply, Employment, Unemployment	Forecasts are made for labour supply and employment, using GDP forecasts. Subsequently, unemployment equals labour supply minus labour demand.
FPB (Belgium)	Labour supply; Employment	Unemployment	Forecasts are made for labour supply and employment, from which subsequently unemployment is derived. The forecast for the current year uses a slightly different approach: most recent quarterly final data are used to calibrate employment and unemployment and the derived labour supply.
IAB (Germany)	Potential labour supply	Employment, Unemployment	Forecasts are made for employment and unemployment, using potential labour supply as one of the inputs.
IFW (Germany)	Labour supply; Employment	Unemployment	Forecasts are made for labour supply and employment, from which subsequently unemployment is derived.
KOF (Switzerland)	Potential labour supply	Employment, Unemployment	Forecasts are made for employment and unemployment, using potential labour supply as one of the inputs.
NIER (Sweden)	Labour supply; Employment	Unemployment	Forecasts are made for labour supply and employment, from which subsequently unemployment is derived.
NIESR (United Kingdom)	Labour supply; Employment	Unemployment	Forecasts are made for labour supply and employment, from which subsequently unemployment is derived.
RWI (Germany)	Labour supply; Employment	Unemployment	Forecasts are made for labour supply and employment, from which subsequently unemployment is derived.
SN (Norway) (a)	Labour supply, employment	Unemployment	SN's macroeconomic model (MODAG) is modified to allow for labour market heterogeneity across 5 educational levels. This modified version of

			MODAG provides forecasts for population, employment and unemployment, by educational level and macroeconomic development. For a description of labour supply forecasting in MODAG, see Table 2.3 below.
SN (Norway) (a)	Population forecast, transition probabilities	Labour supply both by level and field of education	Supply of labour (both by level and field of education) is projected by the dynamic microsimulation model MOSART. The labour supply by level and field of education is compared with labour demand by level and field of education. The resulting variables give an indication of direction and size for future imbalances, but do not indicate unemployment because the different mechanisms that tend to counteract future imbalances are not included.
WIFO (Austria)	Employment, Unemployment	Labour supply	Forecasts are made for employment and unemployment, from which subsequently labour supply is derived.

(a) SN uses two models to forecast labour supply, the macroeconomic model MODAG and the microsimulation model MOSART.
Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Table 2.3 Short-term labour supply forecast: brief description

Institute	Brief description
AP (Italy)	Labour supply is determined by multiplying projected population by projected participation rates. The participation rates are projected using a vector error correction model.
CPB (Netherlands)	Labour supply is determined as the sum of structural participation, policy measures and the participation gap. The structural participation rates are projected using different approaches for different age groups; (i) for individuals aged between 15 and 54, an extrapolation of filtered historical time series is used; (ii) for individuals aged 55 and over, a cohort model is used, where the labour participation rate of individuals at a certain age is allowed to vary between cohorts.
DNB (Netherlands)	Labour supply is determined by multiplying projected population by projected participation rates. The projections of the participation rates are made using an error correction model.
DØRS (Denmark)	In the short run, labour supply is determined as the sum of employment and unemployment. Both employment and unemployment are forecasted, based on assessments of various short-term indicators and policy measures. In the medium and long term, it is assumed that employment and unemployment gradually adjust to the structural levels. Their structural levels are obtained by using the equilibrium unemployment rate on the level of the structural labour force. The structural labour force is determined by combining estimates of age-contingent participation rates with a demographic projection of the Danish population.
ETLA (Finland)	First, a GDP forecast is made using a macroeconomic model. The labour demand is determined by its elasticity in relation to GDP. The labour supply forecast is based on two explanatory variables, namely the labour supply elasticity in relation to GDP and the labour supply elasticity of the working age population (15–64 years of age). Subsequently, unemployment equals labour supply minus labour demand.
FPB (Belgium)	Labour supply is determined by multiplying projected population by projected participation rates. The participation rates are projected using different approaches for different age groups; (i) for individuals aged between 15 and 39, an extrapolation of filtered historical time series is used; (ii) for individuals aged between 40 and 59, a cohort model is used, where the labour participation rate of individuals at a certain age is allowed to vary between cohorts; (iii) for individuals aged 60 and over, a bottom-up approach is used on the basis of administrative data on transitions between the labour supply of various groups into disability or pension.
IAB (Germany)	First, potential labour supply is determined by multiplying projected population by participation rates consistent with full employment. Next, employment and unemployment are forecasted using a macroeconometric model, where potential labour supply is one of the inputs.
IFW (Germany)	Labour supply equals potential labour supply minus the hidden reserve. Potential labour supply and the hidden reserve are both determined by (i) the baseline projections by IAB and (ii) adjustments by IFW to those baseline projections. The adjustments are made at the aggregate level (on the totals of potential labour supply and the hidden reserve).
KOF (Switzerland)	First, potential labour supply is determined by multiplying projected population by participation rates

	consistent with full employment for 16 population groups. For each group, participation rates are estimated using predictions from non-linear participation models, relating past trends and business cycle movements to observed changes in participation rates within each population group. Potential participation rates are the predictions from these models evaluated at the past peak of the business cycle indicator. Aggregating these group-specific predictions, employment and unemployment are then forecasted using a medium-scale macroeconometric model, where potential labour supply is one of the inputs.
NIER (Sweden)	First, a baseline projection of labour supply is made to account for trend changes in labour supply due to, for example, demographic developments. These baseline projections are calculated by multiplying projected participation rates by projected population. Next, the baseline projections are adjusted to account for changes in labour supply due to, among other things, business cycle movements and announced policy changes.
NIESR (United Kingdom)	Labour supply is determined by multiplying projected population by projected participation rates. The participation rates are projected using an error correction model.
RWI (Germany)	Labour supply equals potential labour supply minus the hidden reserve. Potential labour supply and the hidden reserve are both determined by (i) the baseline projections by IAB and (ii) adjustments by RWI to those baseline projections. The adjustments are made at the aggregate level (on the totals of potential labour supply and the hidden reverse).
SN (Norway)	Labour supply is determined by multiplying projected population by participation rates, in both the MODAG and MOSART models. In the MOSART model, participation rates are assumed to stay constant at the level observed as an average for the last five years, by age, gender, and level and field of education. In the MODAG model, participation rates for the five aggregate groups per level of education may depend on unemployment rates and wages. However, the distribution of unemployment over the five main groups is exogenous in the MODAG version. In MODAG, the participation rates are projected using a logit model, where participation rates depend on unemployment and after-tax wages.
WIFO (Austria)	The labour supply forecast is part of the regular quarterly economic forecast by WIFO. Employment and unemployment are projected by analysing respective time series and accounting for the overall macroeconomic development, as well as other institutional factors affecting labour supply in the short run, using expert judgement and considering several sub-groups (e.g. employment of foreign workers and employment in the production sector).

Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Table 2.4 Short-term labour supply forecast and aggregation level

Institute	Aggregation level	Brief description
AP (Italy)	aggregated	The model is aggregated; there is no disaggregation into age groups, although a distinction is made between male and female labour supply. As a result, the model contains two groups.
CPB (Netherlands)	disaggregated	The model is disaggregated into groups, according to gender and age (5-year classes for individuals aged 15 to 74 and one class for individuals aged 75 and over). As a result, the model contains 2*13=26 groups.
DNB (Netherlands)	aggregate	The short-term model is aggregated; there is no disaggregation into age group or gender. In contrast, the long-term projections are based on a disaggregate approach, using age groups (5-year classes) for each gender. As a result, the long-term model contains 24 groups.
DØRS (Denmark)	aggregated/ disaggregated	In the short term, labour supply is determined at the aggregate level. When estimating the participation gap, the model is disaggregated into age groups (1-year age groups) for each income transfer group (16 classes). The model is not disaggregated according to gender. As a result, the model contains 55*15 + 1= 826 groups (the outlier being a residually defined group that is not disaggrated into age groups).
ETLA (Finland)	aggregated	The model is aggregated; there is no disaggregation into sub-groups. The model contains 1 group.
FPB (Belgium)	current year: aggregated; thereafter: disaggregated	The forecast for the current year is calibrated on most recent national level data on employment and unemployment; subsequently, forecasts are made using data per age (1-year age classes), per region (Brussels, Flanders, Wallonia) for each gender. As a result, the model contains 61*3*2= 366 groups.
IAB (Germany)	disaggregated	The labour supply model is disaggregated into age groups (5-year classes), for each gender, and two nationality groups (German and other). As a result, the

		model contains 48 groups.
IFW (Germany)	aggregated/ disaggregated	Adjustments to the baseline projections are made at the aggregate level and are therefore not determined per group. The baseline projections, however, are based on a model disaggregated into age groups (5-year classes), for each gender and two nationality groups (German and other). As a result, the baseline model contains 48 groups.
KOF (Switzerland)	disaggregated	The model is disaggregated into 4 age groups, for each gender, and two nationality groups (Swiss and other). As a result, the model contains 16 groups.
NIER (Sweden)	disaggregated	The model is disaggregated into age groups (1-year classes), for each gender, and 4 origin groups (country of birth Sweden, other Nordic countries, European Union or outside Europe). As a result, the model contains 60*2*4= 480 groups.
NIESR (United Kingdom)	disaggregated	The model is disaggregated into two age groups (16 to 64 and 65 and over).
RWI (Germany)	aggregated/ disaggregated	Adjustments to the baseline projections are made at the aggregate level and are therefore not determined per group. The baseline projections, however, are based on a model disaggregated into age groups (5-year classes), for each gender, and two nationality groups (German and other). As a result, the baseline model contains 48 groups.
SN (Norway) (a)	disaggregated	In MODAG, labour supply is modelled for 45 separate groups. SN has 5 educational levels and 9 demographic cells. These cells consist of 2 male-specific age intervals, 3 female-specific age intervals, 4 age intervals without gender heterogeneity. This results in 45 (= 5*(2+3+4)) groups of labour supply.
SN (Norway) (a)	disaggregated	MOSART is specified for all individuals into age groups, for each gender and 5 education groups.
WIFO (Austria)	aggregated	In the short-term and medium-term projections, employment is projected by citizenship (Austrian, non-Austrian), while unemployment is projected at the aggregate level. However, in the medium-long-term projections (covering a 15-year time horizon), the model is disaggregated into age groups (5-year classes), for each education level (4 classes) and gender. As a result, the model contains 10*4*2= 80 groups. The long-term labour supply forecasts (currently up to the year 2070) are disaggregated into 22 sub-groups (5-year age groups by gender)

(a) SN uses two models to forecast labour supply: the macroeconomic model MODAG and the microsimulation model MOSART.
Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Table 2.5 Short-term labour supply forecast and demographic change

Institute	Model uses demographic variables	Brief description
AP (Italy)	Yes	Participation rates and population projections per age for each gender.
CPB (Netherlands)	Yes	Participation rates and population projections per age for each gender.
DNB (Netherlands)	Yes	Participation rates and population projections per age for each gender.
DØRS (Denmark)	Yes	Participation rates and population projections per age. No distinction is made between genders.
ETLA (Finland)	Yes	Elasticity of labour supply is multiplied by the change in the working age population. Labour supply projections from this model are adjusted afterwards. The increase in labour supply due to higher immigration of asylum seekers is added to the baseline projections for labour supply.
FPB (Belgium)	Yes	Participation rates and population projections per age, per region (Brussels, Flanders, Wallonia) and for each gender.
IAB (Germany)	Yes	Participation rates and population projections per age for each gender, and two nationality groups (German and other).
IFW (Germany)	Yes	Participation rates and population projections per age for each gender, and two nationality groups (German and other) are used in the baseline projections.
KOF (Switzerland)	Yes	Potential participation rates and population projections per age, for each gender and nationality groups (Swiss or other).
NIER (Sweden)	Yes	Participation rates and population projections per age, for each gender and 4 origin groups.
NIESR (United Kingdom)	Yes	Participation rates and population projections per age group.
RWI (Germany)	Yes	Participation rates and population projections per age, for each gender and two nationality groups (German and other) are used in the baseline projections.
SN (Norway)	Yes	Participation rates and population projections per age, gender and education are used and are in line with results from Statistics Norway's official population projections by gender and age.
WIFO (Austria)	Yes, though not explicitly modelled	In the short-term projections, labour supply not explicitly depends on demographic variables, but projections are made in accordance with changes in the size of the working age population. In contrast, in the medium-term and medium-to-long-term projections, labour supply explicitly depends on demographic variables.

Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Table 2.6 Short-term labour supply forecast and macroeconomic development/labour market tightness

Institute	Model uses macroeconomic development/ labour market tightness variables	Brief description/reason
AP (Italy)	Yes	Both male and female labour participation rates depend on labour market conditions, measured by employment rate. In case of female participation, an additional indicator of labour market tightness, the overall unemployment rate, is included.
CPB (Netherlands)	Yes	Labour supply depends on the participation gap. In turn, the participation gap depends on unemployment changes and the difference between actual unemployment and equilibrium unemployment.
DNB (Netherlands)	Yes	Labour participation rates depend on unemployment change. Moreover, if labour participation rates are below or above the trend due to the labour market situation, the rates will converge towards their trend after a few years.
DØRS (Denmark)	Yes	The participation gap is estimated using data for unemployment gap and capacity utilisation in the manufacturing sector. Various short-term indicators are used to make discretionary adjustments when forecasting short-term employment and unemployment.
ETLA (Finland)	Yes	Labour supply depends on the changes in GDP and working age population.
FPB (Belgium)	No	The model does not contain a link between labour market tightness and labour supply. The reason for this is that it is difficult to link labour market tightness at the macro level to the disaggregate/micro level components of the model.
IAB (Germany)	Yes	Labour supply depends, among other things, on the hidden reserve, which in turn depends on labour market tightness.
IFW (Germany)	Yes	Labour supply depends, among other things, on the hidden reserve, which in turn depends on labour market tightness.
KOF (Switzerland)	Yes	Unemployment depends on employment relative to potential labour supply, as well as on other business cycle indicators, such as an output gap measure.
NIER (Sweden)	Yes	Labour supply depends on the labour market situation at the start of the projection period and on how rapidly the labour market returns to its equilibrium.
NIESR (United Kingdom)	Not explicitly	Labour participation does not depend explicitly on the labour market situation. For example, it does not depend explicitly on variables that capture labour market tightness. However, if labour participation rates are below or above the trend due to the labour market situation, the rates will converge towards their trend after a few years.
RWI (Germany)	Yes	Labour supply depends, among other things, on the hidden reserve, which in turn depends on labour market tightness.
SN (Norway) (a)	Yes	In the macroeconomic model MODAG, labour participation rates for aggregate groups depend, among other things, on unemployment and, for some groups, also on some other macroeconomic variables.
SN (Norway) (a)	Yes	Transition probabilities in MOSART depend on historical choices of education and may also depend on business cycle movements.
WIFO (Austria)	Yes, though not explicitly modelled	The forecast for labour supply is an integral part of WIFO's quarterly Economic Forecast and is checked for consistency with other parts of the forecast. In the short-term projections, labour supply does not depend explicitly on labour market tightness, but projections are adapted for macroeconomic measures, such as changes in GDP growth and vacancy development. In contrast, in the medium-term projections, labour supply depends explicitly on macroeconomic development.

(a) SN uses two models to forecast labour supply: the macroeconomic model MODAG and the microsimulation model MOSART.
Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Table 2.7 Short-term labour supply forecast: policy measures

Institute	Policy measures are included	Brief description
AP (Italy)	Yes	Participation rates are adjusted for policy measures that are announced on pensions, taxes, social benefits, including unemployment benefits.
CPB (Netherlands)	Yes	Participation rates are adjusted for policy measures that are announced on pensions, taxes, social benefits, including unemployment benefits.
DNB (Netherlands)	Yes	Participation rates are adjusted for policy measures that are announced on pensions.
DØRS (Denmark)	Yes	In the first three projection years, policy measures do not influence labour supply. In contrast, after the first three projection years, participation rates are adjusted for policy measures that are announced on pensions, taxes, and unemployment benefit generosity.
ETLA (Finland)	Yes	The influence of changes in active labour market policies, taxes, social benefits, including unemployment benefits, and pension reforms are taken into account, on the basis of ad-hoc expert judgement, but only if those changes are sufficiently large.
FPB (Belgium)	Yes	Participation rates are adjusted for policy measures that are announced on pensions, early retirement schemes and unemployment benefits.
IAB (Germany)	Yes	Participation rates are adjusted for policy measures that are announced on pensions, social benefits including unemployment benefits and active labour market programmes and for major changes in the tax system. Examples are a gradual increase in retirement age, starting in 2011, and a reform of unemployment benefits (Hartz IV) in 2005.
IFW (Germany)	Yes	Participation rates are adjusted for policy measures that are announced in, areas such as pension schemes, active labour market programmes, immigration rules, and the tax wedge.
KOF (Switzerland)	Yes	Participation rates are adjusted for policy measures that are announced on pensions and unemployment benefits.
NIER (Sweden)	Yes	Participation rates are adjusted for policy measures that are announced on taxation, active labour market programmes, pensions and unemployment benefits.
NIESR (United Kingdom)	Not explicitly	Participation rates are not adjusted for announced policy measures. However, in the model, it is assumed that past trends in labour participation rates will continue in the medium term. Therefore, the influence of the ongoing increase in pension entitlement age on the participation rate of older workers is assumed to continue over the projection period.
RWI (Germany)	Yes	Participation rates are adjusted for policy measures that are announced in the area of pensions. Active labour market programmes may affect the hidden reserve.
SN (Norway) (a)	Yes	Unemployment benefit system is included to calculate the alternative wage of non-employment. Increased unemployment decreases the participation rate through discouraged worker effects. Taxes are also allowed to influence participation rates in MODAG.
SN (Norway) (a)	Yes	Effects from the 2011 pension reform on participation rates among the elderly are included in the MOSART model, and are also exogenously adjusted for in MODAG.
WIFO (Austria)	Yes	Besides unemployment, also the participation in active labour market programmes are forecasted. Thus, in the short-term projections, labour supply also depends on policy measures. Projections are also adapted for other policy measures (e.g. changes in retirement rules). In the medium- and long-term projections, pension reforms explicitly influence labour supply.

(a) SN uses two models to forecast labour supply: the macroeconomic model MODAG and the microsimulation model MOSART.
Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Table 2.8 Short-term labour supply forecast: other factors that influence projected labour supply

Institute	Additional factors that influence labour supply
AP (Italy)	Asylum seekers not necessarily influence projected labour supply, because until now they have not remained in Italy. As for the future, AP is considering to revise this assumption. Another factor that influences the labour supply projections is that of expert judgement in order to take into account more recent phenomena.
CPB (Netherlands)	The immigration forecast (in particular the number of asylum seekers) influences the forecast for both the working age population and participation rates. Other factors that influence the labour supply projections are recent labour market data from Statistics Netherlands and expert judgement.
DNB (Netherlands)	Other factors that influence the labour supply projections are recent labour market data from Statistics Netherlands and expert judgement.
DØRS (Denmark)	The projected immigration influences the population projections in the short and medium term; however, it does not currently explicitly influence projected participation rates. Other factors that influence the labour supply projection are recent labour market data from Statistics Denmark and various short-term indicators.
ETLA (Finland)	The immigration forecast (in particular the number of asylum seekers) influences the baseline projection of labour supply via separate analyses.
FPB (Belgium)	The immigration forecast (in particular the number of asylum seekers) influences the forecast for both the working age population and participation rates. Other factors that influence the labour supply projections are recent labour market data from the Statistics Belgium and expert judgement.
IAB (Germany)	The immigration forecast (in particular the number of asylum seekers) influences the forecast for both the working age population and participation rates. Other factors that influence the labour supply projections are recent labour market data from the Federal Statistical Office and expert judgement.
IFW (Germany)	The immigration forecast (in particular the number of asylum seekers) influences the baseline forecast for both the working age population and participation rates. Other factors that influence the labour supply projections are recent labour market data from the Federal Employment Agency and expert judgement.
KOF (Switzerland)	The immigration forecast (in particular the number of labour migrants) influences the forecast for both the working age population and participation rates. Other factors that influence the labour supply projections are recent labour market data from the Swiss Federal Statistical Office and expert judgement.
NIER (Sweden)	The immigration forecast (people from Nordic countries, EU and outside EU) influences the baseline forecast for both the working age population and participation rates. Other factors that influence the labour supply projections are recent labour market data from the Statistics Sweden and expert judgement.
NIESR (United Kingdom)	The immigration forecast influences the forecast for the working age population and thereby labour supply, but does not influence labour participation rates. Other factors that influence the labour supply projections are recent labour market data from the Office for National Statistics and expert judgement.
RWI (Germany)	The immigration forecast (in particular the number of asylum seekers) influences the baseline forecast for both the working age population and participation rates. Other factors that influence the labour supply projections are recent labour market data from the Federal Employment Agency and the Federal Statistical Office and expert judgement.
SN (Norway)	In their population projection model, immigration is endogenous and depends on Norwegian unemployment and income relative to those of EU countries. Other factors that influence the labour supply projections are recent labour market labour market data and expert judgement.
SN (Norway) (a)	In MODAG, immigration is endogenous and depends on Norwegian unemployment and income relative to those of EU countries. Other factors that influence the labour supply projection are recent labour market data and expert judgement.
SN (Norway) (a)	Although effects from unemployment and income relative to those of EU countries are taken into consideration in the population projection model, the models are run recursively with the population projections first.
WIFO (Austria)	The immigration forecast (in particular the number of asylum seekers and scenarios on the consequences of the implementation of the freedom of movement for workers) influences projected employment and unemployment. Other factors that influence the labour supply projection are recent labour market data from Statistics Austria (e.g. on working time) and expert judgement.

(a) SN uses two models to forecast labour supply: the macroeconomic model MODAG and the microsimulation model MOSART.
Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Table 2.9 Short-term labour supply forecast: types of data used to measure unemployment in labour supply model

Institute	Types of data used in model	Brief description/reason
AP (Italy)	Survey data	Survey data on unemployment are used in the model, but administrative data on the number of people receiving unemployment benefits are not used as they are not a good proxy for actual unemployment.
CPB (Netherlands)	Survey data/administrative data	Both survey data on unemployment and administrative data on unemployment recipients are used. The survey data are the main input for modelling, while both ILO unemployment and administrative unemployment are forecasted.
DNB (Netherlands)	Survey data/administrative data	Both survey data on unemployment and administrative data on unemployment recipients are used. The survey data are the main input for modelling, while both ILO unemployment and administrative unemployment are forecasted.
DØRS (Denmark)	Administrative data	DØRS includes administrative data on recipients of different types of income transfers, including unemployment benefits. Survey data on unemployment are not used. Definitions of employment, unemployment and, hence, labour supply follow those of the National Accounts.
ETLA (Finland)	Survey data	Survey data from the Labour Force Survey are used.
FPB (Belgium)	Administrative data	FPB uses administrative data, because survey data are deemed less stable and because FPB has good access to micro level social security and pensions administrative data. (LFS) Survey data on employment and unemployment are used to check the plausibility of the trend evolution in administrative-based participation rates.
IAB (Germany)	Survey data/administrative data	Both survey data on unemployment and administrative data on unemployment recipients are used. The survey data are the main input for modelling, while both ILO unemployment and administrative unemployment are forecasted.
IFW (Germany)	Survey data/administrative data	Both survey data (ILO unemployment) and administrative data (registered unemployment) are used. The survey data are the main input for modelling, while both ILO unemployment and registered unemployment are forecasted.
KOF (Switzerland)	Survey data/administrative data	Both survey data on unemployment and administrative data on registered unemployment recipients are used. The administrative data are the main input for modelling, while both ILO unemployment and administrative unemployment are forecasted.
NIER (Sweden)	Survey data/administrative data	Both survey data on unemployment and administrative data on unemployment recipients are used. Data from the public employment service are used, as well. The survey data are the main input for modelling, while both ILO unemployment and administrative unemployment are forecasted.
NIESR (United Kingdom)	Survey data/administrative data	Both survey data on unemployment and administrative data on unemployment recipients are used. The survey data are the main input for modelling, while both ILO unemployment and administrative unemployment are forecasted.
RWI (Germany)	Survey data/administrative data	Both survey data on unemployment and administrative data on unemployment recipients are used. The administrative data are the main input for modelling, while both ILO unemployment and administrative unemployment are forecasted.
SN (Norway)	National account, administrative data and survey data	The macro model is based on national accounts. Survey data (on unemployment) are used in the model. Administrative data are used in the micro simulation model.
WIFO (Austria)	Survey data/administrative data	Both survey data on unemployment and administrative data on unemployment recipients are used. Both unemployment according to the EUROSTAT definition and unemployment according to national definitions based on administrative data are forecasted.

Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Table 2.10 Short-term labour supply forecast: incorporation of hysteresis

Institute	Hysteresis after macroeconomic shocks	Brief description
AP (Italy)	Yes	Business cycle movements can have permanent effects on labour supply; indeed, during the recent recession, labour supply increased substantially and is expected to remain on an increasing trend.
CPB (Netherlands)	Usually not	There is no permanent influence of business cycle movements. During particularly severe recessions some groups (older unemployed workers) may permanently leave the labour market. However, in the very long run these cohorts will be replaced by younger ones.
DNB (Netherlands)	No	Hysteresis is not modelled. In the long run, labour supply is exogenous.
DØRS (Denmark)	No	Hysteresis is not modelled.
ETLA (Finland)	No	Hysteresis is not modelled.
FPB (Belgium)	No	Influence of business cycle movement is not explicitly modelled.
IAB (Germany)	No	There is no permanent influence of unemployment on potential labour supply in the model, although there might be effects in case of a very deep and long-lasting recession.
IFW (Germany)	No	Hysteresis is not modelled.
KOF (Switzerland)	No	There is no permanent influence of business cycle movements.
NIER (Sweden)	No	Business cycle movements may have long-lasting effects, but they are not permanent.
NIESR (United Kingdom)	Usually not	Usually, there is no permanent influence of business cycle movements, although there may be some exceptions. For example, if academic evidence suggests that people withdraw permanently from the labour market due to a particularly severe recession, participation rates may manually be adjusted downwards. However, in the very long run, these cohorts will be replaced by younger ones.
RWI (Germany)	Yes	The medium-term economic forecast allows for hysteresis as regards the NAIRU.
SN (Norway) (a)	Yes	The effect of fiscal policy on labour supply depends on the level of unemployment. Labour supply depends on the level of unemployment, i.e. discouraged worker effects in the short and medium term.
SN (Norway) (a)	Yes	The business cycle movements may affect the transition probabilities.
WIFO (Austria)	Yes, although not explicitly modelled	Hysteresis is not explicitly modelled, but it is accounted for by considering lasting effects on unemployment (e.g. due to compositional effects).

(a) SN uses two models to forecast labour supply: the macroeconomic model MODAG and the microsimulation model MOSART.
Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

Table 2.11 Short-term labour supply forecast: forecast versus final numbers

Institute	Have forecasting errors recently been analysed?	Brief description
AP (Italy)	Yes, in-depth	Labour supply was larger than expected during the recession years of 2008 and 2012.
CPB (Netherlands)	Yes, in-depth	When making short-term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections. In 2014 and 2016, the forecasting errors were analysed. Labour supply was found to have been both overestimated and underestimated.
DNB (Netherlands)	Yes	When making short-term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections. Recently, the change in the labour participation rate was found to have been overestimated.
DØRS (Denmark)	Yes	When making short-term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections. A formal error analysis is not carried out on a regular basis.
ETLA (Finland)	Yes	The average median and median absolute forecasting errors of unemployment are published at each forecast.
FPB (Belgium)	Yes, in-depth	Labour supply growth has tended to be overestimated in recent years. The decrease in youth and middle-aged participation rates due to policy measures (extended study; more severe controls on active search behaviour on behalf of unemployed; stricter eligibility criteria for access to unemployment benefits) had been underestimated, whereas the increase in the participation of older age groups due to policy measures (pension reform) had been overestimated. Other factors that also played a role are changes in demographic projections and a larger than expected inflow into disability.
IAB (Germany)	Yes	When making short-term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections. However, final data on the hidden reserve are not available.
IFW (Germany)	Yes	When making short-term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections. However, final data on the hidden reserve are not available.
KOF (Switzerland)	Yes, in-depth	In 2014, the forecasting errors of employment were analysed. The analysis showed an underestimation of employment due to a structural break in the 2002–2006 period. Since then, growth has been more employment-based than before.
NIER (Sweden)	Yes	When making short-term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections.
NIESR (United Kingdom)	Yes	When making short-term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections.
RWI (Germany)	Yes	When making short-term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections. However, final data on the hidden reserve are not available.
SN (Norway)	Yes	When making short-term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections.
WIFO (Austria)	Yes, in-depth	When making short term projections, recent final monthly and quarterly data on employment and unemployment are compared with the projections. During the recent recession, employment decreased by less than projected, in part due to labour hoarding and short-time working policy measures.

Source: Questionnaire concerning labour supply forecasting methods (CPB, 2016).

2.4 Forecasting methods, details per institute

This section presents a more extensive description of the short-term labour supply forecasting models used by the organisations presented in the previous sections. Since the focus of the document is on forecasting short-term labour supply, medium and long-term labour supply forecasting models are discussed only when necessary for understanding the short-term model.

2.4.1 AP – Association Prometeia, Italy

AP's labour supply forecasts and its macroeconomic forecasts are publicly available (upon subscription). They are not used directly by the Italian Government to plan their budget. Instead, the Italian Government uses its own forecast. However, AP's forecast is used by UPB (Italian Budgetary Office) in its supervisory activity on government budgetary plans. In addition to their macroeconomic forecast about Italy, AP also produces macroeconomic forecasts about other countries (e.g. 11 EMU countries, the United States, Japan, other main industrialised countries, and several emerging countries).

AP projects short-term labour supply and employment,[19] and subsequently derives short-term unemployment by subtracting projected employment from projected labour supply.

Labour supply projections are made in two steps:

- First, a baseline projection of labour supply is made to account, among other things, for trend changes in labour supply due to, for example, demographic developments.
- Next, this baseline projection is adjusted to account for changes in labour supply due to announced policy changes, among other things.

To construct *baseline projections of labour supply*, AP works according to the following steps:

- First, AP projects participation rates by gender, for people aged between 15 and 64. The trend in male and female participation rates is calculated as an extrapolation of a vector error correction model (VECM). The VECM for the male participation rate contains population, net real wages, the employment rate and trend. The VECM for the female participation rate contains population, net real wages, and both unemployment and employment rates.
- Second, AP obtains the population projection from the Statistical Office of Italy, for males and females aged between 15 and 64.
- Third, male and female projected participation rates are multiplied by male and female population projections to construct the labour supply forecast for both males and females. The baseline projection of labour supply is then equal to the sum of the male and female labour supply projections.

[19] Employment is projected using a macroeconomic demand-driven model.

After calculating the baseline projections of labour supply, AP makes the following adjustments:

- Projected participation rates are adjusted using expert opinion to take account of announced policy changes related to pensions, income policy and fiscal policy.

Instruments

AP has no other models for making alternative labour supply projections in addition to their central forecasts. However, in order to perform stress test analyses, AP does regularly produce alternative forecasts for all macroeconomic variables (including labour supply, employment and unemployment).

2.4.2 CPB – Netherlands Bureau for Economic Policy Analysis, Netherlands

CPB is an independent government agency operating under the Dutch Ministry of Economic Affairs. The CPB macroeconomic and labour supply forecasts are used by the Dutch Government to plan their budget.

In both their *short-term* and *medium-term* forecasts, CPB begins by projecting labour supply and employment,[20] subsequently deriving unemployment by subtracting projected employment from projected labour supply.

To project labour supply in the *short-to-medium term,* CPB works according to the following steps:

- First, CPB determines projected structural participation rates, per age group[21] for each gender. The trend in most group participation rates is calculated as an extrapolation of a Hodrick Prescott (HP)-filtered historical participation rate time series.[22] Note that, before determining the trend in historical participation rates, these rates are corrected for the influence of policy measures in the fields of taxation, social benefits and pensions on labour supply.[23] Finally, adjustments are made manually, for some groups, on the basis of expert judgement.
- Second, CPB projects structural participation by multiplying projected structural participation rates by the projected population for each group. Population projections are obtained from Statistics Netherlands. Note that, before multiplying structural participation rates by the projected population, the structural participation rates are corrected for the influence of announced policy measures in the fields of taxation, welfare benefits and pensions on labour supply.

[20] Employment is projected using a macroeconomic demand-driven model, see CPB (2010) for details (in Dutch).
[21] There are 13 age groups, divided in 5-year age groups of people between the ages of 15 and 74, and one group of those aged 75 and over.
[22] An exception is made for older age groups (55 and over), for which labour participation rates are projected using a cohort model. In a cohort model, the labour participation rate of individuals at a certain age is allowed to vary between cohorts. The projected structural participation rates by age, therefore, depend on the participation profiles of different cohorts, see Euwals et al. (2014) Appendix B (in Dutch).
[23] The effects of policy measures on labour supply are estimated using several models. The most frequently used model is MICSIM, a behavioural microsimulation model developed to estimate the effects of tax-benefit reforms, see Jongen et al. (2014).

- Third, CPB determines the participation gap for the most recent year for which final data are available. This gap is calculated as actual participation minus structural participation in the most recent year for which final data are available.
- Fourth, CPB determines the pace at which the participation gap will dissolve, by looking at unemployment changes and the difference between actual unemployment and equilibrium unemployment and by using expert judgement.
- Fifth, CPB determines projected labour participation by adding structural participation and the participation gap for each year of the projection period.

Instruments

For employment, a leading indicator model is used to check the plausibility of the econometric forecast. Furthermore, CPB currently is exploring the possibilities of making an alternative forecast for labour supply or its components, in addition to the central forecast. More specifically, Bayesian Vector Autoregressive (BVAR) models are considered.

2.4.3 DNB – Dutch Central Bank, Netherlands

DNB is an independent central bank, and its mission is to safeguard financial stability. DNB's labour supply forecast and its macroeconomic forecast are publicly available. They are not used directly by the Dutch Government to plan their budget. Important components of DNB's macroeconomic model are financial transmission mechanisms, see DNB (2011).

DNB begins its forecasts by projecting short-term labour supply and employment,[24] subsequently deriving the forecast of short-term unemployment by subtracting projected employment from projected labour supply.

To construct labour supply projections for both the *short- and medium-term*, DNB works according to the following steps:

- First, DNB projects aggregate participation rates using an error correction model and historical participation rate time series. Participation rates depend on participation in the previous period, growth rate of gross real wages, change in the unemployment rate and (deviation from) trend. When making these estimations, adjustments can be made manually, for example, to correct for changes in the entitlement age of pension benefits.
- Second, DNB obtains the population projections from Statistics Netherlands.
- Third, the projected aggregate participation rate is multiplied by the population projection to construct the labour supply forecast.

Labour supply projections for the *long term* are based on a disaggregate approach using scenarios for the participation rate by gender and 5-year age groups and a disaggregate population forecast by Statistics Netherlands.

[24] Employment is projected using a macroeconomic demand-driven model with market imperfections and frictions in the short and medium term, see DNB (2011).

Instruments

As an alternative forecast of employment, DNB applies a simple error correction framework that relates changes and levels of private sector employment to changes and levels of hours worked in temporary jobs and the number of dismissal applications.

2.4.4 DØRS – Danish Economic Councils, Denmark

DØRS is an independent, though wholly government-financed institute. The DØRS forecasts on labour supply and the Danish economy are publicly available; however, they are not used directly by the Danish Government in planning their budget. The Danish Government uses its own forecasts for this purpose. In addition to producing economic forecasts, an important task of DØRS is to make an annual assessment of public finances, since they are the Danish 'fiscal watch dog'. Furthermore, it has just been decided that DØRS should monitor the productivity development ,and work out policy proposals to strengthen productivity.

In its short-term forecasting, DØRS first forecasts employment and unemployment based on various short-term indicators. In the medium and long term, employment is determined by labour supply and equilibrium unemployment (which, in turn, is obtained by estimating a Phillips-wage curve).

To project labour supply, DØRS works according to the following steps:[25]

- In the short term, labour supply is the sum of unemployment and employment, which, in turn, are derived from assessing short-term indicators, on the basis of which the outcomes of the macroeconometric model, SMEC, are adjusted.[26]
- In the medium and long term, DØRS determines the structural labour participation rates by age, for one-year age groups of people between 15 and 69 years (55 classes), for the most recent year for which final data are available. The structural participation rates are estimated as trend values by applying ordinary least squares regression (OLS) on historical rates and using the unemployment gap and capacity utilisation in the manufacturing sector to account for cyclical fluctuations.[27]
- Subsequently, DØRS calculates structural participation for the most recent year for which final data are available, by multiplying the structural participation rates by the population for the same one-year age groups, for the most recent year for which final data are available.
- Next, DØRS determines the participation gap by age, for the most recent year for which final data are available. This gap is calculated as actual participation minus structural participation.
- Then, DØRS obtains projected structural participation rates by age, from an independent research group[28] and population projections by age, from Statistics Denmark.

[25] For details on the macroeconomic demand driven model SMEC, see http://www.dors.dk/oevrige-publikationer/arbejdspapir/smec-modelbeskrivelse-modelegenskaber-2006.
[26] For details on the macroeconomic demand driven model SMEC, see Andersen (1991).
[27] The structural participation rates are determined as a residual and are equal to one minus the structural rates of non-participating groups. The non-participating groups are, for example, individuals receiving different types of income transfers (excluding unemployment benefits).
[28] The Danish Institute for Economic Modelling and Forecasting, DREAM, see http://www.dreammodel.dk/.

Subsequently, DØRS projects structural participation by multiplying the projected structural participation rates by the projected population by age.
- Finally, DØRS determines how rapidly the participation gap will close, by looking at the difference between actual unemployment and equilibrium unemployment and using discretionary judgement.

Instruments

DØRS does not construct an alternative forecast next to its central forecast for labour supply or its components (i.e. employment and unemployment).

2.4.5 ETLA – Research Institute of the Finnish Economy, Finland

ETLA publishes its macroeconomic and labour market forecasts twice per year and independently of Finnish Government budget plans. The Finnish Government, instead, uses its own forecast. ETLA's main focus is on providing information to Finnish firms.[29] Important variables in the forecasts by ETLA , therefore, include production per industry, export competitiveness per industry, and profitability of firms per industry, which are calculated by ETLA's input-output model. Since the labour supply forecast is not their main focus, its projection is less detailed.

Labour market forecast depends on outcome macroeconomic model

ETLA uses a Keynesian macroeconomic model to forecast GDP and production, per industry, in the short-term and medium-term. The model encompasses the total Finnish economy, and the variable with the largest impact on GDP is that of exports per industry.

Once the GDP forecast has been made, baseline labour demand is derived using its elasticity to GDP. Labour supply is estimated by using its elasticities to GDP and to the working age population. More precisely, labour supply at year *t+1* is equal to labour supply in year *t* plus the elasticity of labour supply multiplied by the change in GDP[30] and elasticity of labour supply multiplied by the change in the working age population.[31][32] The baseline forecast of labour demand is determined analogously. Subsequently, baseline unemployment is forecasted by subtracting the labour demand forecast from the labour supply forecast.

Note that, although the baseline labour supply forecast for the short- and medium-term is modelled by the elasticity method, this baseline is usually adjusted afterwards to take account of, for example, policy changes. The same holds for the labour demand forecast. Adjustments are made according to separate analyses of variables with a substantial impact on labour supply and by subsequently lowering or increasing the baseline forecast. An example is migration; ETLA has analysed the impact of the increase in asylum seekers on expected labour supply and added this effect to the baseline projection of labour supply. The influence of pension age reform on labour supply has not been taken into account, because the pension age increases gradually due to the reform, and the preliminary evaluations show rather small effects.

[29] A quarter of ETLA's budget is funded by the Confederation of Finnish Industries and its Fund (TT-fund).
[30] GDP at time *t+1* minus GDP at time *t*.
[31] Working age population *t+1* minus working age population at time.
[32] The population forecast is obtained from Statistics Finland.

Instruments

ETLA has no concrete plans yet to construct an alternative forecast in addition to its central forecast for labour supply or its components (i.e. employment and unemployment).

2.4.6 FPB – Federal Planning Bureau, Belgium

FPB is an independent public agency whose macroeconomic forecasts are used by both regional and national government as input for their budget planning. The FPB uses four models that rely on an exogenous forecast of labour supply:

- short-term quarterly model (for year t, t+1);
- two versions of a medium-term annual model (for year t, t+1, ..., t+4, t+5): a national level and a regional level variant;
- long-term annual model (end year: 2060).

In both its *short-term* and *medium-term* forecasts, FPB begins by projecting labour supply and employment,[33] subsequently deriving the unemployment forecast by subtracting projected employment from projected labour supply.

For both forecasts, FPB calculates the *baseline projection* of labour supply by multiplying projected participation rates by the population projections[34] for each population group. The population groups are cross-classified by gender, age (one year classes), and region (Brussels, Flanders, Wallonia). The method used for projecting labour participation rates differs per age group:

- Participation rates of individuals aged between 15 and 39 are determined as an extrapolation of filtered historical time series;
- Participation rates of individuals aged between 40 and 59 are calculated using a *cohort model*. In a cohort model, the labour participation rate of individuals at a certain age is allowed to vary between cohorts. The projected structural participation rates by age, therefore, depend on the participation profiles of the various cohorts.[35]
- Participation rates of individuals aged 60 and over are constructed bottom-up, using administrative data on transitions from labour supply to disability or pension, for the various groups[36].

Subsequently, the baseline projection is adjusted to account for changes in labour supply due to, among other things, immigration and announced policy changes. These adjustments are based on expert judgement and additional calculations, such as those on the number of people who have to delay their retirement or early retirement, or the number of unemployed

[33] Employment is projected using a macroeconomic demand-driven model, see Hertveldt and Lebrun (2003) and Ketelbutter et al. (2014).
[34] The population projection is made by the FPB; while population data are provided by the Federal bureau of statistics (Statistics Belgium).
[35] As an example, in a cohort model, participation rate (p) at age (a) and time (t) can be defined as: $p_{at}=\alpha p_{a-1,t-1} + (1-\alpha)p_{a,t-1}$, where participation at age a at time t depends in part (α) on participation of the same cohort one year earlier and,in part ($1-\alpha$) on participation of people aged a in the previous period.
[36] The groups are divided into civil servants, the self-employed, otherwise employed, unemployed, unemployed with additional pre-pension benefits (“bruggepensioneerden”) and people in full-time carreer break.scheme.

affected by the policy measure. Finally, the current year is calibrated using the most recent quarterly national level data on employment and unemployment, the model outcome for employment and expert judgement. Therefore, for at least a subset of quarters in the current year, employment and unemployment are observed or projected, from which the labour supply can be derived.

Instruments

For employment, a leading indicator model is used to check the plausibility of the econometric forecast.

2.4.7 IAB – Institute for Employment Research, Germany

IAB is part of the German Employment Agency and its labour supply forecast is used by other institutes and by governmental agencies as a baseline projection (e.g. see Sections 2.4.8 and 2.4.12).

IAB uses a macroeconometric model[37] to project employment and unemployment, where potential labour supply is one of the inputs. Other inputs include, for example, business cycle indicators (e.g. industry production and new orders) and labour market variables (e.g. policy measures).

Potential labour supply

The potential labour supply estimated by IAB equals the labour supply that would result when the economy is in a situation of full employment. Note that potential labour supply can be written as:

Potential labour supply = Labour supply (employment + unemployment) + hidden reserve.

Determination of potential labour supply

To project the *potential labour supply*, IAB works according to the following steps:

- First, IAB constructs its own population projections per age year, for each gender, and nationality (two groups: German and other).[38] Then, 5-year age brackets are constructed to be used in the fourth step.
- Second, IAB projects participation rates for the same groups, where participation is defined as employment plus unemployment. The participation rates per group are projected by first regressing historical participation rates on, for example, unemployment and changes in the pension system, and birth rates (for women), part time rates, and other variables.[39]

[37] The model (*integrierte Arbeitsmarktmodell*, IAB-IAM) contains both the product market and the labour market and interactions between both markets, and uses Kalman-filter techniques.
[38] See Fuchs et al. (2016).
[39] The regression uses a logistic function; for details see Fuchs and Weber (2010).

- Third, future *potential* participation rates are obtained by extrapolating the estimated participation rates using the *unemployment rate consistent with full employment*[40] and the projected birth rates. During these extrapolations, additional information is used, for example, on the expected impact of changes in the pension system, and expert judgement.
- Fourth, for each group, the population projections are multiplied by the projected *potential* participation rate of that group.

For the short-term projections, the *hidden reserve* is determined as the residual between potential labour supply and the sum of employment and unemployment. This residual can be verified in the light of other statistics, such as on the number of non-working participants in active labour market programmes.

Instruments

IAB has no concrete plans to construct an alternative forecast in addition to its central forecast for labour supply or its components (i.e. employment and unemployment).

2.4.8 IFW – Kiel Institute for the World Economy, Germany

The IFW forecasts are used indirectly by the government to plan their budget. The IFW forecasts and those by other institutes are input for the joint forecasts (*Gemeinschaftsdiagnose*) made by the Joint Economic Forecast Project Group. Those joint forecasts are used by the German Government to plan their budget.

IFW begins by projecting short-term labour supply and employment; subsequently deriving the short-term unemployment forecast by subtracting projected employment from projected labour supply.

Labour supply components

The formula that determines projected labour supply is:

Labour supply = potential labour supply – hidden reserve.

Baseline projection and adjustments

The baseline for the IFW forecasts is the IAB potential labour supply forecast (see Section 2.4.7). IFW deviates from this baseline by adjusting the forecasts of potential labour supply and the hidden reserve. These adjustments are made when changes have occurred after the IAB forecast was made and because the IFW sometimes has a different assessment of the components of potential labour supply. Regular adjustments to baseline projections of potential labour supply are made with respect to migration (e.g. if the IFW forecast of the number of EU immigrants or asylum seekers differs from that in the IAB baseline).

[40] The unemployment rate consistent with full employment is not determined for each group, but it does differ per gender, for young people and for non-German nationals. This unemployment rate is determined by observing both historical data and current regional unemployment rates, since certain German regions, currently, are approaching a situation of full employment.

Adjustments to the baseline hidden reserve forecast are less frequent. However, IFW occasionally adjusts this baseline; for example, when distinct changes are expected in the number of individuals who take part in active labour market programmes by the Federal Employment Agency.

Adjustments to both the potential labour supply and the hidden reserve baseline are made at the aggregate level, on the basis of expert judgement and using new information. Nevertheless, the IFW projections are basically the result of disaggregate forecasting methods, since those projections are based on forecasts by the disaggregate model of IAB.

Instruments

IFW intends to construct an alternative central forecast using an age cohort model with cohort-specific participation rates.

2.4.9 KOF – Swiss Economic Institute

The KOF labour supply forecasts and its macroeconomic forecasts are not used directly by the Swiss Government to plan their budget. Instead, the Swiss Government uses a forecast made by its own forecasting group[41]. However, KOF forecasts are influential within Switzerland; they are widely discussed in the media and used by governmental bodies and the national bank. Moreover, KOF is a member of the Joint Economic Forecast Project Group whose joint macroeconomic forecasts for the World and the German economy are used by the German Government to plan their budget. The KOF forecasts and those by the other member institutes are input for the joint forecasts (*Gemeinschaftsdiagnose*) made by the Joint Economic Forecast Project Group.

KOF mainly uses a medium-scale Keynesian macroeconomic model for its short-term economic forecasts. Employment is demand-driven and depends heavily on foreign GDP which influences both foreign and Swiss demand. Unemployment follows an autoregressive process of order one, and, among other things, depends on the output gap and employment relative to potential labour supply. Therefore, instead of using a deterministic relation for unemployment, where it equals labour supply minus labour demand, unemployment depends, among other things, on potential labour supply. How potential labour supply is determined is described in detail below.

Potential labour supply

The potential labour supply estimated by KOF equals the labour supply that would result when the economy is in a situation of full employment. Note that potential labour supply can be written as:

Potential labour supply = Labour supply (employment + unemployment) + hidden reserve.

[41] Members of this group include experts from the Swiss National Bank and the Swiss Federal Statistical Office.

Determination of potential labour supply

To project *potential labour supply* over a time horizon of 4 to 5 years, used as an exogenous input in the macroeconomic model, KOF works according to the following steps:

- First, KOF constructs its own population projections per age group (4 classes), for each gender and two nationality groups (Swiss or other), by adjusting the population projections by the Swiss Federal Statistical Office with respect to immigration.[42]
- Second, KOF projects participation rates for the same groups, where participation is defined as employment plus unemployment (using the ILO definition of unemployment). The participation rates per group are projected by first regressing historical participation rates on, among other things, an economic indicator, representing the principal component of several labour market indicators.[43] This economic indicator is constructed in such a way that the peak of the indicator coincides with a peak in the business cycle.
- Third, future *potential* participation rates are obtained by extrapolating the estimated participation rates using, among other things, the *peak value of the economic indicator.* For these extrapolations, additional information is used, for example, on the expected impact of changes in the unemployment benefit system or changes in the retirement age.
- Fourth, for each group, the population projections are multiplied by the projected po*tential* participation rate of that group.

In the short-term projections, the *hidden reserve* is determined as the residual between potential labour supply and the sum of employment and unemployment.

Instruments

KOF has developed a large BVAR forecast of the production side of the Swiss economy. This model is currently extended to incorporate employment forecasts by industry, for comparison with its employment projection. Short-term employment and unemployment forecasts are also compared with simple indicator-based projections, using, among other things, information on planned employment of firms as stated in the monthly and quarterly KOF business cycle surveys.

2.4.10 NIER – National Institute of Economic Research, Sweden

NIER is an independent government agency operating under the Swedish Ministry of Finance. The NIER forecasts of labour supply and of the Swedish and international economy are publicly available. They are not used directly by the Swedish Government to plan their budget. The Swedish Government uses its own forecasts, instead.

NIER begins by projecting short-term labour supply and employment,[44] subsequently deriving the short-term unemployment forecast by subtracting projected employment from projected labour supply.

[42] KOF usually projects higher labour immigration.
[43] The regression uses a logistic function, for details see Graff, Mannino, and Siegenthaler (2013).
[44] Employment is projected using a macroeconomic demand-driven model.

The labour supply projection is made in two steps:

- First, a baseline projection of labour supply is made to account for trend changes in labour supply due to, for example, demographic developments.
- Next, the baseline projection is adjusted to account for changes in labour supply, due to, among other things, business cycle movements and announced policy changes.

To construct the *baseline projection of labour supply*, NIER takes the following steps:

- First, NIER projects participation rates by age groups (1-year classes), for each gender and 4 groups of origin (people born in Sweden, other Nordic countries, European Union or outside Europe). The trend in the group participation rate is calculated as an extrapolation of a Hodrick Prescott (HP)-filtered historical participation rate time series.
- Second, NIER obtains the population projections from Statistics Sweden for the same groups as mentioned above.
- Third, for each group, the projected participation rate is multiplied by the population projections to construct labour supply forecasts per group. The baseline projection of labour supply is then equal to the sum of all group projections.

The baseline projection only takes account of trend developments in labour supply. Therefore, after calculating the baseline projection of labour supply, NIER makes the following adjustments:

- projected participation rates are adjusted to take account of business cycle changes. For example, suppose the economy was in a recession at the start of the projection period and actual participation rates were therefore relatively low. The baseline projection of the participation rates would then need to be corrected upwards to allow for these rates to return to their equilibrium levels. The pace at which the business cycle component of the participation rate adjusts to its equilibrium level depends, among other things, on the macroeconomic and labour market situation, the difference between actual and equilibrium unemployment, and on expert judgement.
- projected participation rates are adjusted to take account of announced policy changes, for example, announced changes in active labour market policy, unemployment benefits and taxes. The expected impact of these policy measures on projected participation rates is determined outside the labour supply model by additional research and using additional models.

Instruments

NIER uses both VAR and BVAR models to make alternative employment projections in addition to their central forecast.

2.4.11 NIESR – The National Institute of Economic and Social Research, United Kingdom.

NIESR is an independent research institute that carries out research commissioned by, for example, government departments and agencies, the Economic and Social Research Council, the European Commission, charitable foundations, and the private sector. NIESR's economic

forecasts are not used directly by the UK Government to plan their budget. The UK Government uses the forecasts of the Office for Budget Responsibility (OBR), instead. In addition to their macroeconomic forecasts for the United Kingdom, NIESR also produces macroeconomic forecasts for 43 other countries and 6 regional aggregates to produce consistent forecasts of the global economy.

NIESR begins their forecasts by projecting short-term labour supply and employment,[45] subsequently deriving the short-term unemployment forecast by subtracting projected employment from projected labour supply.

Once in a while, NIESR constructs a *baseline projection* of labour supply for both the *short term and medium term,* using a disaggregate approach. This baseline forecast is then updated for each quarterly forecast, on the basis of an aggregate approach.

To construct the *baseline projection of labour supply* for both the *short term and medium term*, NIESR works according to the following steps:

- First, NIESR projects participation rates, per age group (16–25 years; 26–35 years; 36–45 years; 46–55 years; 56–58 years; 59 years and over) for each gender. The reasoning behind this group classification is that it reflects differences in labour force participation dynamics and differences in labour participation responses to policy changes. The projections for the group participation rates are made using an error correction model and historical participation rate time series. When making these estimations, some manual corrections can be made if necessary; for example, in case of changes in the trend of the historical participation rates, only part of the data is taken into account when determining the trend in the participation rates.
- Second, NIESR obtains the population projections from the Office for National Statistics for the same groups as mentioned above. Note that changes in expected immigration influence the population forecasts, but that they do not change projected participation rates.[46]
- Third, for each group, the projected participation rate is multiplied by the population projections to construct labour supply forecasts per group. The baseline projection of labour supply is then equal to the sum of all group projections.

The baseline projection is updated in each quarterly forecast on the basis of the same procedure, but only for two age groups (16–64 years and 65 years and over).

Instruments

NIESR does not construct an alternative forecast next to its central forecast for labour supply or its components (i.e. employment and unemployment). However, NIESR regularly produces alternative forecasts of employment and unemployment, based on simulations of both policy and risk scenarios.

[45] Employment is projected using a macroeconomic model named the National Institute's Global Econometric Model (NiGEM). This model is demand-driven in both the short term and the medium term.
[46] See Kirby and Lisenkova (2012) for net migration variants and labour force participation in the NIESR forecast.

2.4.12 RWI – Leibniz Institute for Economic Research, Germany

The RWI forecasts and those by other research institutes provide input for the joint forecast (*Gemeinschaftsdiagnose)* made by the Joint Economic Forecast Project Group. The joint forecast serves as a reference for the forecast by the German Government on which it bases its budget projections.

From its macroeconomic forecast, RWI derives a forecast of labour demand defined as total hours worked. In a subsequent step, labour demand is divided into the number of workers and the number of hours worked per worker. The estimated number of hours worked per worker depends on a trend factor, capacity utilisation and a working day effect. Given the short-term labour supply, unemployment is the difference between projected employment and projected labour supply. Since data on employment and unemployment are available on a monthly basis, but labour demand is estimated on a quarterly basis, the forecast of labour demand and hence unemployment is modified by using the most recent monthly figures. The forecasts are made iteratively to take into account the influence of employment and unemployment on income and thus on aggregate demand.

Labour supply components

The formula that determines projected labour supply is:

Labour supply = potential labour supply – hidden reserve.

Baseline projection and adjustments

The baseline for the RWI forecast is the IAB labour supply forecast (see Section 2.4.7). RWI deviates from this baseline by adjusting the forecasts of potential labour supply and the hidden reserve. These adjustments are made when changes have occurred after the IAB forecast has been made, but also because the institutes sometimes have different assessments of the components of potential labour supply.

RWI regularly adjusts the baseline projection of potential labour supply with respect to:

- migration (e.g. additional information on asylum seekers);
- demography (e.g. a new population projection by the Federal Statistical Office of Germany);
- labour participation rates (e.g. new information on final quarterly participation rates by the Federal Statistical Office of Germany).

The baseline hidden-reserve forecast is revised less frequently. However, RWI occasionally adjusts the baseline, for example, when active labour market programmes of the federal employment agency are modified, markedly.

Both the adjustments to the potential labour supply and the hidden-reserve baseline are made at the aggregate level, on the basis of expert judgement and using new information. Nevertheless, their forecast is basically the result of disaggregate forecasting methods, since those are based on the disaggregate model of IAB.

Instruments

RWI has no concrete plans to construct an alternative forecast in addition to its central forecast of labour supply or its components (i.e. employment and unemployment).

2.4.13 SN – Statistics Norway, Norway

SN is the statistical office of Norway. The SN labour supply forecasts and the forecasts of the Norwegian economy are publicly available. Although they are not used directly by the Norwegian Government to plan their budget, the SN forecasts are in line with those made by the government. In addition to producing statistics and economic forecasts, an important task of SN is to forecast any mismatches in employment and labour supply, by education level and type of industry, 20 to 30 years into the future.

To project employment, the multi-sector macroeconomic model (MODAG) is used. This model captures linkages between industries to project labour demand. SN then extends this model by including the labour demand for five educational groups for each type of industry (ADMOD). The five groups are partly substitutes within each industry, and the employment shares depend on relative wages and trends (which SN interprets as demand effects of technological change). In addition, there is a sub-model that disaggregates employment by education level and type of industry into employment by 28 different fields of education. Previously observed trends are used to divide the projected labour demand for the five groups into the 28 fields, given the projected development for each type of industry from ADMOD. Labour supply in MODAG is projected by multiplying projected participation rates[47] by projected population per age group for each educational group and gender, using a logit model.

Labour supply in the 28 different fields of education is projected by using the dynamic micro-simulation model MOSART, for details see Gjefsen (2013).[48] The simulation model contains the whole Norwegian population and starts with a projection of educational choices. Subsequently, educational attainment influences labour force participation and retirement. In 2014, the information on the educational background of immigrants was improved and included in the projections. Statistics Norway carried out a survey in 2011 to obtain information on the educational background of immigrants. The results from the survey were entered into the register, which contains the educational background of all individuals in Norway. The new information was extrapolated from the year 2011 back to the entry year of the immigrant. The lack of information on the educational background of immigrants is now mainly restricted to individuals who entered Norway after 2011. From a base year, MOSART simulates the future life course for each person in the Norwegian population, by using estimated transition probabilities. In the projections, the transition probabilities are kept constant. This implies that educational propensities and labour force participation rates are constant, as well. The replacement demand is therefore implicitly calculated in the total supply of labour, by skill.

[47] SN uses a logit model to project these participation rates.
[48] For details on their forecast of long term labour demand, see Haraldsen et al. (2015).

SN forecasts labour supply in both the short-to-medium term and in the long term, and uses different forecasting methods for each forecast horizon. In both their *short-to-medium-term* and *long-term* forecasts, SN first projects labour supply and employment, from which subsequently unemployment is derived.[49]

To project labour supply in MOSART, SN works according to the following steps:

- First, population projections by level and field of education are made using the MOSART model.
- Second, for each group, the projected participation rate[50] is multiplied by the population projections to construct the labour supply forecast, per group. The baseline projections of labour supply are then equal to the sum of all group projections.

Instruments

SN produces alternative scenario projections for employment, labour supply and unemployment, dependent on demographic factors such as net immigration, fertility and mortality. The effects of the 2011 pension reform on labour supply among the elderly are also included.

2.4.14 WIFO – The Austrian Institute of Economic Research, Austria

WIFO is an independent research institute whose macroeconomic forecasts are used by the Austrian Government to plan their budget. Furthermore, this forecast is the official forecast to be sent to the European Commission, the OECD and the IMF. In addition, WIFO is a member of the Joint Economic Forecast Project Group, whose joint macroeconomic forecast for the World and the German economy is used by the German Government to plan their budget. WIFO's forecasts and those by the other member institutes are input for the joint forecast (*Gemeinschaftsdiagnose)* made by the Joint Economic Forecast Project Group, the so-called.

WIFO forecasts Austrian labour supply for the short term, medium term, the medium-to-long term, as well as the long term, and uses different forecasting methods for each time horizon. In their *short-term* forecast, WIFO calculates the trend in both employment and unemployment as an extrapolation of filtered historical time series.[51] Subsequently, the projected labour supply in the short term equals the sum of projected employment and unemployment. For their forecast of short-term employment and unemployment, WIFO adjusts the trend extrapolations using expert judgement. This expert judgement uses several inputs, for example, data on working-time trends and population projections by Statistics Austria, policy reforms, recent data on immigration, and information from meetings between WIFO forecasting experts on other macroeconomic variables.

[49] Employment is projected using a macroeconomic demand driven model with 20 industries.
[50] In the MOSART model participation rates are assumed to stay constant at the level observed as an average for the last five years by age, gender and level and field of education.
[51] Where the short term is defined as the current and the following year.

In their *medium-term* forecast, WIFO projects both employment and unemployment, using a demand-driven macroeconomic model.[52] The projected labour supply equals the sum of projected employment and unemployment. In this model, employment depends on real GDP growth and the change in relative factor prices of labour and capital. Unemployment depends on both supply and demand factors, such as number of jobs created, changes in the number of early retirees and the working age population, and in the share of foreign workers in the number of total employees. Finally, the difference between actual and trend unemployment is used as a proxy for labour market tightness in the wage equation.

In their *medium-to-long term* forecasts, WIFO makes disaggregated projections of labour supply per age, education level and gender, to account for differences in the development of participation rates between those groups. These are calculated by multiplying projected participation rates by the population projections made by Statistics Austria for each population group. The population groups are cross-classified by gender, age (five year categories), and education (four classes). WIFO adjusts the long-term labour supply forecast for pension reforms. The effect of pension reforms on labour supply is determined using a simulation model. For details, see Horvath and Mahringer (2016, 2014).

WIFO's long-term forecasts project the labour force participation rates some 60 years ahead, using a dynamic cohort model. The dynamic cohort method (Scherer, 2002) is based on a model that calculates labour market entry and exit rates for each cohort over the preceding five years and assumes that future lifetime participation profiles have the same dynamics as those observed in the preceding five years. The projections from the dynamic model cohort are adjusted for the expected consequences of already implemented pension reforms. For details, see Kaniovski et al. (2014). Labour supply follows from multiplying these participation rates by those of corresponding cohorts from the population projection made by Statistics Austria. Long-term projections are produced for 5-year age cohorts by gender (22 groups in total).

Instruments

WIFO constructs alternative forecasts in addition to its central forecasts on employment, such as employment by sector (applying a dynamic econometric input-output model (Dynamic new Keynesian Model - DYNK)) or by occupation, applying trend estimations of occupation by sector employment shares matrices, in combination with sectoral forecasts. WIFO also regularly forecasts regional employment and unemployment for Vienna, by applying an ARIMA-X model. Finally, WIFO also performs different employment and unemployment forecasts depending on specific research requirements.

[52] See Baumgartner et al. (2004).

2.5 Summary and conclusions

To date, no overview was available on how European institutes forecast labour supply in practise. This rapport contains an overview of the short-term to medium-term forecasts of labour supply made by fourteen institutes: twelve members of the *Association of European Conjuncture Institutes (AIECE),* IAB whose projection of labour supply is used as a baseline projection by some members of AIECE, and the Dutch Central Bank (DNB).

Almost all institutes have in common that the core of their short-term to medium-term labour supply forecasting model consists of a multiplication of a population projection and projected participation rates. In contrast, the institutes vary widely in the way they project their participation rates. About half of them base their extrapolation of participation rates on either error correction models or an extrapolation of filtered historical participation rate time series.

Another commonality is the breakdown of the model into different groups; notably, according to age and gender, and sometimes nationality, education or region. The number of groups included in the models varies widely from one or two groups up to more than a hundred.

Nearly all institutes incorporate the influence of pension reforms on projected labour supply, which may be important to account for the rising participation rates among older workers.

Almost all institutes explicitly take account of the influence of business cycle fluctuations on projected labour supply. However, there is extensive variation in the way institutes take account of these fluctuations and labour market tightness in their labour market projections. Exploring different ways to include the influence of business cycle fluctuations is relevant, since forecasting labour supply is especially complex during large business cycle fluctuations.

About half of the institutes include the effects of policy measures on tax or social benefits if these effects are sufficiently large. In addition, most institutes incorporate the effect of immigration on both the working-age population and participation rates. And nearly all institutes apply adjustments on the basis of expert judgement that, for example, is based on recent final labour market data.

Some institutes use instruments to check their central forecasts of labour supply or its components, or are planning to do so in future. Examples are an alternative forecast for employment using a simple error correction framework, and leading indicator models to check the plausibility of the employment and/or unemployment forecast. Other examples include the use or planned use of BVAR forecasts of, for example, employment.

Finally, this overview shows two trade-offs. The first is between structure and flexibility, and the second between including more details and modelling ease. Imposing structure can enhances the forecast. However, a drawback of imposing structure is that the structure can

be prone to the problem of misspecification of the relevant theoretical relationships. Including more details may also enhance the forecast; however, it is more difficult to model them in a consistent framework.

References

Baumgartner, J., F. Breuss, and S. Kaniovski, 2004, WIFO-Macromod. An Econometric Model of the Austrian Economy, *WIFO Working Papers*, No. 241 Austrian Institute of Economic Research (WIFO), Vienna, Austria.

CPB, 2010, SAFFIER II: 1 model voor de Nederlandse economie, in 2 hoedanigheden, voor 3 toepassingen, *CPB Document*, No 217, The Hague, Netherlands.

DNB, 2011, DELFI DNB's Macroeconomic Policy Model of the Netherlands, *DNB Occasional Studies*, 9(1), DNB, Amsterdam, Netherlands.

Eurostat , 2006, Registered unemployment (RU) compared with harmonised unemployed (LFS), *Working papers and studies,* Eurostat, Luxembourg.

Euwals, R., M. de Graaf-Zijl, and A. den Ouden, 2014, Arbeidsaanbod tot 2060, *CPB Achtergronddocument*, 3 juli 2014, CPB, The Hague, Netherlands.

Fuchs, J. and Weber, B., 2010, Umfang und Struktur der westdeutschen Stillen Reserve. Aktualisierte Schätzungen, *IAB-Forschungsbericht* 11/2010, Nürnberg.

Fuchs, J., D. Söhnlein, B. Weber and E. Weber, 2016, Ein integriertes Modell zur Schätzung von Arbeitskräfteangebot und Bevölkerung, *IAB-Forschungsbericht, 10/2016*, Nürnberg. (An English discussion paper will be published soon).

Gjefsen, H. M., 2013, Educational behavior in the dynamic micro-simulation model MOSART, *Reports Statistics Norway,* 15.

Graff, M., M. Mannino, and M. Siegenthaler, 2013, Die neue Schätzung des schweizerischen Erwerbspersonenpotenzials an der KOF, *KOF Analysen*, Nr. 4 Winter – SA2*,* KOF Swiss Economic Institute, ETH Zurich, Switzerland.

Haraldsen, K.W., R. Hammersland, and V. Sparrman, 2015, Wage equations and labour demand by education, *Reports Statistics Norway,* 49.

Hertveldt, B. and I. Lebrun MODTRIM II, 2003, A quarterly model for the Belgian economy, *FPB Working paper*, 6-03, Brussels, Belgium.

Horvath,T. and H. Mahringer, 2016, Entwicklung der Erwerbsbeteiligung bis 2030 unter Berücksichtigung von Änderungen im Bildungsverhalten und rezenter Pensionsreformen: Ein Update, *WIFO Working Papers*, No. 523, Austrian Institute of Economic Research (WIFO), Vienna, Austria.

Horvath, T. and H. Mahringer, 2014, Entwicklung der Erwerbsbeteiligung bis 2030 unter Berücksichtigung von Änderungen im Bildungsverhalten und rezenter Pensionsreformen, *WIFO Working Papers*, No 470, Austrian Institute of Economic Research (WIFO), Vienna, Austria.

Jongen, E., H.-W. de Boer, and P. Dekker, 2014, MICSIM - A behavioural microsimulation model for the analysis of tax-benefit reform in the Netherlands, *CPB Background Document,* 27 November 2014, CPB, The Hague, Netherlands.

Kaniovski, S. ,Url, T.,(WIFO), Hofer, H., Müllbacher, S., (IHS), 2014, A Long-run Macroeconomic Model of the Austrian Economy (A-LMM). New Results (2014)-Austrian Institute of Economic Research (WIFO), Vienna, Austria.

Ketelbutter, B. de, L. Dobbelaere, I. Lebrun, and F. Vanhorebeek, 2014, A new version of MODTRIM II: An overview of the model for short-term forecasts, *FPB Working paper*, 5-14, Brussels, Belgium.

Kirby, S. and K. Lisenkova, 2012, The future path of the UK labour force, *National Institute Economic Review,* No. 222, F61–F64.

Linaa, J. G. and S. Andersen, 2016, Beregning af strukturel arbejdsstyrke. Dokumentation. *Notatet dokumenterer beregningen af De Økonomiske Råds Sekretariats vurdering af den strukturelle arbejdsstyrke*, 23.05.2016, De Økonomiske Råd, Copenhagen, Denmark.

Scherer, P. , 2002, Age of Withdrawal from the Labour Market in OECD Countries, *OECD Labour Market and Social Policy – Occasional Papers*, No. 49, OECD Publishing, Paris, France.

Consulted experts

Mr R.-P. Berben, DNB – Dutch Central Bank, Netherlands.

Mr K. Hendrickx, FPB – Federal Planning Bureau, Belgium.

Mr J. Fuchs, IAB – Institute for Employment Research, Germany.

Ms A. Fuest, RWI – Leibniz Institute for Economic Research, Germany.

Mr D. Groll, IFW – Kiel Institute for the World Economy, Germany.

Mr J. G. Linaa, DØRS – Danish Economic Councils, Denmark.

Mr T. Horvath, WIFO – The Austrian Institute of Economic Research, Austria

Mr H. Kaseva, ETLA – Research Institute of the Finnish Economy, Finland.

Mr S. Kirby, NIESR – The National Institute of Economic and Social Research, United Kingdom.

Mr G. Marthin, NIER – National Institute of Economic Research, Sweden.

Mr A. den Ouden, CPB –Netherlands Bureau of Economic for Policy Analysis, Netherlands.

Ms Å. Segendorf, NIER – National Institute of Economic Research, Sweden.

Mr M. Siegenthaler, KOF – Swiss Economic Institute, Switzerland.

Ms V. Sparrman, SN – Statistics Norway, Norway.

Ms S. Tomasini, AP – Association Prometeia, Italy.

Ms A. Westlund, NIER – National Institute of Economic Research, Sweden.

Expert survey

Expert Survey

The labour market department of CPB Netherlands Bureau for Economic Policy Analysis is currently working on the improvement of our short-term forecast of aggregate labour supply. To this end, we are hoping to learn from forecasting methods at other institutions. Therefore we interview experts at other institutions, using the questions below.

Questionnaire concerning labour supply forecasting methods

1. Could you provide a brief description of the way you forecast short-term labour supply, defined by employment plus unemployment? (Please see questions below.)
2. Do you forecast employment and unemployment and is labour supply the resulting sum, or do you forecast labour supply and employment and is unemployment determined by the difference between the two?
3. In determining future labour supply, do you take account of demographic developments (e.g. population growth)? If so, how?
4. In determining future labour supply, do you take account of expected changes in future participation rates? If so, how?

5. In determining future labour supply, do you take account of labour market tightness or macroeconomic developments? If so, how?
6. Are there any other factors that influence future labour supply?
7. Do you take an aggregate or disaggregate approach? For example, do you use data only on total labour supply or by age and gender?
8. Do you use flow data to forecast labour supply? Idem survey data & administrative data for unemployment.
9. Do you take account of hysteresis in your labour supply model? Do recessions have medium or long-term effect on labour supply?
10. Do you study the deviation between the labour supply forecast and the final numbers? And if so, how were the results the past few years?

3 A review of the literature: labour supply and cyclical fluctuations

This chapter provides an overview of the existing theory and literature on cyclical labour supply (in persons). The first section discusses the main theoretical insights into the relation between the business cycle and labour supply. Section 2.2 discusses recent empirical findings on the cyclicality of labour supply and labour market flows.

3.1 Theoretical background

3.1.1 Neoclassical model

To understand how the business cycle influences labour supply, we must first understand how people decide whether they want to work and the number of hours they prefer to do so. Our starting point is the neoclassical individual labour supply model (Cahuc et al., 2014). According to this theoretical model, individuals divide their time between paid employment (in order to be able to consume) and leisure. The amount of labour supplied depends on wage rate and the utility they obtain from leisure versus consumption. Based on their wage level and personal preference for leisure versus consumption, individuals choose the number of hours they need to be working. In this way, they obtain an optimal bundle of consumption and leisure. In this model, labour supply depends positively on the wage rate and individual preferences with respect to consumption and leisure.

The neoclassical model of individual labour supply is of limited value for determining the influence of macroeconomic developments on labour supply. In this model, changes in labour supply can only be explained either by wage changes or changes in the preference between leisure and consumption. The effect of lower wages during economic downturns on individual labour supply decisions can be derived, but we know that this is not the only channel through which the business cycle influences the labour supply decision. Other

channels, such as a lower probability of finding a job or the effect of spousal job loss, are not included in the neoclassical model.

3.1.2 Job search model

The neoclassical model abstracts from the fact that searching for work is costly. These search costs depend on the state of the business cycle, since it is easier to find a job when the economy is booming than when it is in recession. Job search models (see Cahuc et al., 2014) explicitly model the job search process. They model how unemployed individuals choose between searching for work or not to participate in the labour force, depending on the value of both states. If they decide not to participate, they derive utility from an alternative source of income, for example unemployment benefits. If individuals search for a job, the expected utility gained by doing so depends on the costs related to that search, the probability of finding a job and the expected wage. If there are many vacancies per unemployed job seeker, and the expected wage is well above the social benefit level, labour market participation will be the more attractive option. If, however, search costs (both financially and psychologically) are too high, the probability of finding a job too low, or the expected wages not much higher than the alternative income, individuals are likely will decide not to participate in the labour market. Labour demand is an important channel through which the business cycle influences the labour supply decision in the job search model.

The discouraged worker effect

In job search models, the discouraged worker effect arises during economic downturns because there are fewer vacancies per unemployed job seeker. As a result, some of the unemployed expect that they are so unlikely to find a job that their job search is no longer worth the effort. They become discouraged and cease to actively offer their labour on the job market; they are no longer labelled as 'unemployed' but considered 'inactive'. More specifically, these discouraged workers are individuals that would like to work for the current market wage, but for whom the probability of finding employment is so small that the expected utility of not searching for work is higher than that of searching (Cahuc et al., 2014). In short, because an economic downturn reduces the chance of finding a job and, thus, extends the expected search period , a certain number of unemployed people will withdraw from the labour market.

3.1.3 Household model

The neoclassical and the job search model both determine labour supply from an individual perspective, ignoring the fact that people live in households that often consist of more than one person. In reality, people determine their labour supply in accordance with their household composition, which means the possible income of another household member also plays a role. Household models explicitly model labour supply decisions in the context of the household.

In the most basic form, the unitary household model treats the household as one agent that determines the labour supply of both partners jointly. In this model, there is a trade-off between work, leisure, and household work (also called non-market income) within the household. Household work consists of pursuits (except employment) that are beneficial to

the household, such as housekeeping and taking care of children. Since this non-earned income also adds utility to the household, household members devote some or even all of their time to household work instead of paid employment. The balance between labour supply and household work is affected in case an employed member of the household suffers a job loss. To counterbalance this job loss, the other household member or members may start searching for a job, or attempt to increase their hours of employment. This situation is what is called the added worker effect.

The added worker effect

The added worker effect describes the increase in individual labour supply when one of the household members becomes unemployed. When a household member becomes unemployed, this decreases the household's disposable income. This changes the optimal mix between consumption, household work and leisure. Such a decline in household income stimulates other household members to award more time to earning an income on the labour market instead of on housekeeping or leisure (Cahuc et al., 2014). Thus, the unemployment of one household member can raise the labour supply of the rest of the household. This is where the effect of the business cycle can be seen; during economic downturns, more individuals are laid off, increasing the added worker effect. The added worker effect, therefore, has the opposite effect of that of the discouraged worker effect; the added worker effect causes labour supply to increase during economic downturns and to decrease during upswings. The effect can influence labour supply both in terms of number of people and in number of hours worked, depending on whether or not people who are increasing their labour supply were previously inactive. In theory, this affects the labour supply of women more, since they are more often the secondary earner or inactive household member (England, 2005).

3.1.4 Macro search and matching model

Business cycle effects on labour supply can also be modelled on a macro level, using a macro search and matching model (Pissarides, 2000). The macro search and matching model simultaneously models the labour supply decisions by individuals and firms' decisions to offer vacancies. Using this macro model, the added and discouraged worker effects can be derived in a way that is parallel to the derivation in the micro models.

In the basic version of this model, there is no labour supply decision, since all workers participate in the labour market, either in employment or as a job seeker. During the job search process, unemployed workers fill vacancies that are posted by firms. Both workers and firms seek to optimise the present value of their income, given an exogenous discount rate. Job seekers and vacancies are matched according to a matching function that describes how the number of job matches depends on the number of vacancies and on the number of unemployed job seekers. In this basic model, only unemployed workers search for jobs[53] and the search intensity is fixed for both firms and the unemployed. The number of matches depends positively both on the number of vacancies and on the number of unemployed workers. Also, the ratio between vacancies and unemployed workers determines how easily

[53] There are extensions to this model with on-the-job search.

firms and the unemployed may find a match. If there is a rise in the number of vacancies, unemployed workers find a match more easily. If, on the other hand, unemployment increases exogenously, employers can fill their vacancies more easily. When a vacancy and an unemployed worker are a match, the firm and the worker negotiate the wage level. If they reach an agreement, they enter into a productive relationship, until an exogenous breakup point. If they are unable to reach an agreement, the worker remains unemployed and the vacancy remains open.

In this framework, the worker does not decide whether to participate in the labour market, but only whether or not to accept a job offer during the wage bargaining process. The worker accepts the job if the present value of the job-related income is higher than the present value of remaining unemployed and waiting for a possibly higher paid, future match. The employer has two decision moments. First, the employer decides whether or not to post a vacancy. Firms try to hire workers until hiring additional workers no longer would yield a profit. Then, the employer participates in the wage negotiations.

In this model, the cyclical fluctuations enter as a sudden change in labour productivity. During an economic downturn, labour productivity drops; therefore, the value of a vacancy decreases and firms post fewer vacancies. The number of unemployed workers grows because it takes them longer to find a suitable match.[54] This explains the negative correlation between vacancies and unemployment, the so-called Beveridge curve. When the vacancy-to-unemployment ratio changes, the bargaining position of employees versus employers changes, as well, and this causes wage levels to drop during economic downturns (and to rise during upswings).

To incorporate the added worker and discouraged worker effects in this model, it is necessary to add the state of non-participation to the basic model. This state also yields utility, because it enables the individual to engage in time-consuming non-market activities, such as travelling, housekeeping and taking care of children. When they are active on the labour market, either as being employed or unemployed, they are less able to spend time on these activities due to time constraints.

In this expanded matching model, the discouraged worker effect arises when a negative business cycle fluctuation causes a drop in the number of vacancies. This, in turn, causes the pool of unemployed individuals to grow and lowers the probability of them finding a match. Therefore, the expected job search duration increases, which in turn lowers the expected utility of participating in the labour market. Because of this, some of the unemployed will withdraw from the labour market into non-participation.

The added worker effect arises via the value of non-participation. If a household member loses his job, his expected lifetime labour income decreases. This lowers the value of non-participation for any other household members. As a result, the other household members'

[54] The break-up rate of matches is constant in this basic version of the model, lower labour productivity will therefore not result in more layoffs.

reservation utility for entering the labour market decreases, which increases the probability that non-participating household members will start to search for a job.

3.2 Empirical findings

This section presents recent empirical findings regarding the level of labour supply, labour market flows and the added worker and discouraged worker effects. First, Section 1.2.1 discusses findings on a macro level, that is the level of labour supply and the labour market flows behind it. Next, Section 1.2.2 presents group differences regarding the level of labour supply and the labour market flows. Finally, Section 1.2.3 discusses the evidence on the discouraged worker and added worker effects, at the micro level.

3.2.1 Labour supply and labour market flows over the business cycle: macro evidence

Labour supply stock: macro discouragement

Cyclical labour supply can be regarded as a change in the numbers of employed and unemployed individuals. Most studies that follow this macro approach indicate that aggregate labour supply increases during economic upswings and decreases during downturns.[55] These results are in line with the theoretical notion that a decrease in the demand for labour also negatively affects labour supply. This overall decrease in labour supply during economic downturns is an indication that, on a macro level, the discouraged worker effect dominates over the added worker effect.[56]

Even though the literature is unanimous in the finding that labour supply is positively correlated to the business cycle, they differ substantially in their estimates of the size of the effect. In the United States, for example, the labour force participation rate dropped by 3.1 percentage points between 2007 and 2014. Different studies that investigated this drop in participation during all or some of this period came to estimates for the cyclical part of this decline that ranged from 16% to 60% of the total change (CEA, 2014).[57] Part of this variation can be explained by differences within the investigated time period, but the type of method and model assumptions have a substantial impact, as well.

Even though this approach provides a rather clear picture of the changes in total labour supply in response to aggregate shocks, it tells us little about the underlying dynamics and mechanisms. It is therefore useful to look beyond the macro level evidence and investigate the labour market flows behind them.

[55] Recent examples of studies that found a positive correlation between labour supply and the business cycle are Vendrik and Cörvers (2009), using data on the Netherlands, Kesselring and Bremmer (2015) and the U.S. Council of Economic Advisors (CEA) for the United States, and Duval, Eris and Furceri (2011) using a panel of OECD countries.
[56] See also Kesselring and Bremmer (2015).
[57] The CEA itself estimated that half of the decline is caused by population ageing, a sixth of the decline is cyclical and one third is due to other factors. These other factors might be a demographic trend, but could also be caused by the severity of the Great Recession compared to other recessions (CEA, 2014).

Labour market flows

Changes in labour supply can be broken down into changes in the gross flows or flow rates[58] between employment, unemployment and non-participation. These gross labour market flows provide insight into the flows underlying such changes on a macro level. They tell us, for example, whether the decrease in labour supply during a recession is due to an increased flow from employment/unemployment to non-participation or a decrease in the outflow from non-participation to employment/unemployment, or a combination of the two. The key findings on the cyclicality of the labour market flows in the literature are summarised in Table 2.1.

Table 3.1 Summary of findings in previous literature on the cyclicality of the flows

Flow	Correlation with the business cycle	Mechanism
Unemployment to non-participation	Negative	Effect of discouragement during economic downturns
Non-participation to unemployment	Negative	More difficult labour market entry during economic downturns. Also, most of the added workers flow from non-participation to unemployment (Merens and Josten, 2016)
Employment to non-participation	None/ weakly positive	No clear theoretical explanation, from a labour market perspective
Non-participation to employment	Positive	Easier labour market entry during economic upswings; higher labour demand causes more individuals to find employment immediately upon entering the labour market

When interpreting flow analyses, two potential drawbacks should be kept in mind. Firstly, flows cannot be aggregated to fully represent the changes in the various groups, since flow analyses implicitly assume that the three states are a closed system. However, people enter and leave the potential labour force due to demographic changes. As a result, aggregating the flows only provides an approximation for the changes in the groups. Studying the flows is therefore no substitute for studying changes in the aggregate labour stock, but rather is complementary to it. Secondly, compared with analyses of the various groups, flow studies that use survey data on labour market status are more susceptible to misclassification of labour market status.[59]

A common finding from flow analyses is that both the flow from unemployment to non-participation and vice versa increase during economic downturns and decrease during upswings.[60] These two opposing flows have the same cyclical pattern, because they are driven by different effects. The cyclicalicty of the flow from unemployment to non-participation is linked to discouragement (see Section 1.1.2), whereas the cyclicality of the flow from non-participation to unemployment is linked to the added worker effect (see

[58] Flow rates are typically defined as the flow from status i to j in period t divided by the number of people in i at the beginning of the period.
[59] See Elsby et al. (2015) for more information.
[60] Examples of studies that find this result are two studies using data from the United Kingdom (Gomes, 2012; Sutton, 2013) as well as an older study comparing four European countries (Burda and Wyplosz, 1994) and a more recent Dutch study (Van Loon et al., 2014).

Section 1.1.3) and to cyclical changes in how successful labour market entrants are in finding employment (Burda and Wyplosz, 1994).

The cyclical variation in the flows from employment to non-participation, and vice versa, is less clear than the cyclical variation between unemployment and non-particpation. Studies are unanimous in the finding that the flow from non-participation to employment is positively related to the business cycle. During economic upswings, there are more successful labour market entrances. Regarding the flow from employment to non-participation, results differ; some studies find that the flow from employment to non-participation does not show significant cyclical movement (e.g. Gomes, 2012), while others find a weak positive correlation with the cycle (e.g. Krussel et al., 2012; Sutton, 2013).[61] This difference might be due to the time span studied.[62]

There are also studies that look at flow rates instead of gross flows. The two flow rates between employment and non-participation, as well as the flow rate from non-participation to unemployment, show a pattern over the business cycle that is similar to that of the corresponding gross flows (Gomes, 2012). However, this is not the case for the flow rate from unemployment to nonparticipation. The flow rate from unemployment to non-participation is positively correlated with the business cycle, whereas the corresponding gross flow is negatively correlated. This difference between the flow and the flow rate is due to compositional changes in the group of unemployed over the cycle[63] (Elsby, Hobijn and Şahin, 2015; Krueger, Cramer and Cho, 2014).

3.2.2 Group differences: meso evidence

Cyclical labour supply variations differ by gender, age and education level. The main group differences are summarised in Table 2.2.

The difference between men and women is somewhat unclear. Some macro-level studies show more cyclical fluctuations in labour supply for men than for women, but this is in contrast with micro evidence (presented in Section 1.2.3), which points in the opposite direction.[64] Kesselring and Bremmer (2015), for instance, found that, for the United States, the labour supply response to changes in total unemployment was more pronounced for

[61] According to Gomes (2012), the flow from non-participation to employment has a slight positive correlation with the business cycle, whereas that from employment to non-participation does not show significant cyclical movement. According to Krussel et al. (2012), the flow rate from non-participation to employment, in the United States, has a strong positive correlation with the business cycle, whereas the flow rate from employment to non-participation exhibits a weak positive correlation with the cycle (2012).
[62] Gomes (2012) uses a data set from 1993 Q2 to 2010 Q4, Sutton (2013) uses a data set from 1997 Q2 to 2010 Q1 and splits this data set at 2004. Before 2004, Sutton finds no significant correlation of the flows from employment to non-participation, but after 2004, and for the total sample, he does.
[63] The flow from unemployment to non-participation increases during economic downturns because of an increase in the number of unemployed. However, the individuals that flow from employment to unemployment in an economic downturn have a stronger connection with the labour market than the unemployed in more positive economic times; they become discouraged less quickly. Therefore the flow rate from unemployment to non-participation drops during economic downturns while the flow itself rises.
[64] This difference between the micro and macro levels likely originates from the fact that micro-studies usually correct for more economic and demographic factors than do macro-studies. For example: the study by Hotchkiss and Robertson (2006) controls for variables such as education, number of children and regional effects, while the studies by Duval (2011) and Kesselring and Bremmer (2015) do not control for these factors. Therefore, the higher net effect of discouragement on men at the macro level may be caused by an omitted variable bias.

men than for women, indicating a higher net effect of discouragement on men. Duval et al. (2011) also found a slightly larger labour supply reaction to economic downturns for men than for women, in their study covering 30 countries over the 1960–2008 period. Vendrik and Cörvers (2009) found substantial effects of cyclical changes in labour demand on short-term participation, for both men and women in the Netherlands, but long-term effects were only found for men.

Table 3.2 Summary of findings in previous literature on group differences

Demographic distinction	Labour supply/ flow differences	Mechanism
Gender	There is an unclear effect on labour supply; the studies by Duval (2011) and Kesselring and Bremmer (2015) indicate that the labour supply of men is more sensitive to cyclical fluctuations, but the study by Hotchkiss and Robertson (2006) finds an opposite effect.	
Age	Older and possibly also young individuals are more affected by cyclical fluctuations in their labour participation decision.	For older individuals, the higher responsiveness is linked to the availability of retirement and early retirement schemes, making a labour market exit more attractive for this group than for other age categories.
Education	Overall, less-cyclical fluctuations in flow probabilities, both for the flows between non-participation and unemployment and those between non-participation and employment for higher educated individuals.	Stronger effects of the business cycle on labour market outcomes for lower educated individuals.

Regarding age, theoretically, both young and older people may be expected to become discouraged more easily than middle-aged people, because they have more options to exit the labour force. [65] Young people can choose to go back to school, or postpone their labour market entrance by extending their education. Older people have options to retire early. Duval et al. (2011) indeed find the most substantial labour supply changes during economic downturns in the youngest (aged 15–24) and the oldest (aged 60–64) groups of workers (Duval et al. 2011). Kesselring and Bremmer (2015) confirm that older married people (aged 51–65) are most easily discouraged. In their study, the effects for single or divorced older people do not differ significantly from those for other age groups.

A third important distinction is that of education level. People with a higher education are less sensitive to the business cycle. Both unemployment rates and non-participation rates decrease with education level. According to Gomes (2012), there are less-cyclical fluctuations in the transition probabilities between non-participation and unemployment as well as in those between non-participation and employment for higher educated individuals than for lower educated individuals. A likely explanation for these differences is that the higher educated generally perform better on the labour market and are therefore less affected by business cycle fluctuations (Mukoyama and Şahin, 2010).

[65] There are also other age-related effects for specific demographic groups. For example: Bredtmann (2014) finds that the added worker effect is less strong for women with young children, a group consisting mainly of women between the ages of 30 and 45.

Apart from these demographic differences, the cyclical variations in labour supply differ by country and region. Broersma and Van Dijk (2002), for instance, found differences in cyclical labour supply between regions in the Netherlands. [66]

3.2.3 Micro evidence

The added worker effect

The added worker effect can only be investigated by analysing micro data, in which the labour supply of both partners within a household is determined. Many studies investigating the added worker effect use a difference-in-difference approach where they compare individuals whose partner has just become unemployed with those whose partner has remained employed. A disadvantage of this approach is that it only looks at actual job loss and ignores the possibility of the partner reacting to a higher expected probability of spousal unemployment. Examples of such studies using a difference-in-difference approach are Merens and Josten (2016) and Triebe (2015). Merens and Josten found an added worker effect for women whose partner became unemployed, but not for men in the same situation.[67] The positive effect on the extensive margin only lasted for a short period of time, which may be due to the fact that most of these women who entered the labour market, failed to find a job, which soon discouraged them. Triebe (2015) also finds that the added worker effect is mainly present in terms of hours worked (the intensive margin) and not so much in the extensive margin. Triebe also indicates that the preferred number of hours increases by more than the actual hours worked.

The difference between men and women in this respect is unclear. The Dutch study by Merens and Josten (2016) only found an added worker effect for women and not for men. Triebe (2015), however, did find an added worker effect for both men and women. This might indicate a national difference, but it might also be due to the fact that Merens and Josten included people who work fulltime in their sample, while Triebe did not. The added worker effect is stronger for people who work part-time, as they are more likely to increase their hours than those that work full-time. Since more men work full-time (CBS, 2016), including full-time workers in the sample affects the estimates for men more than for women.

There is less information available on differences between age groups and education levels. Starr (2014) analysed the difference in the added worker effect between age groups in the United States during the Great Recession, and found a stronger added worker effect for young females than for other age groups. Starr explains this by the fact that young couples have fewer savings and, therefore, find themselves in a financially tight position more quickly.

[66] Other examples of studies that use regional data are Elhorst and Zeilstra (2007) and Decressin and Fatás (1995).
[67] This increase in labour supply takes the form of higher labour market participation (an increase in the extensive margin) as well as more hours worked (an increase in the intensive margin). Employed women whose partner became unemployed, on average worked one hour per week more, compared to women with an employed partner. 16% of previously non-participating women started searching for work in the period in which their partner became unemployed, compared to 12% of those in the control group, but this effect disappeared after three months.

People appear to react stronger to the job loss of their partners during a recession than during an upturn. The influence of the business cycle on the added worker effect has been analysed by Mattingly and Smith (2010) for the United States, and by Bredtmann et al. (2014) for 28 European countries. Mattingly and Smith found that, during the Great Recession (2008 and 2009), there was an added worker effect for women in response to the unemployment of their partners, which was not present in the years before the recession (2004 and 2005). Bredtmann et al. (2014) found that the added worker effect for such women is stronger when unemployment is high, but the intensity of the added worker effect does not change with fluctuations in GDP growth.

Theoretically, the added worker effect may be expected to be stronger in countries with less generous welfare regimes. Under a more generous welfare system, household income drops by less as a consequence of one of the partners becoming unemployed, which decreases the necessity for the other partner to enter the labour market or search for more working hours. The results of Bredtmann et al. (2014) correspond with this theoretical notion. They find that the added worker effect is less strong in countries with a more generous welfare regime.

The discouraged worker effect

There is less micro-evidence for the discouraged worker effect than for the added worker effect, but the existing micro-econometric literature confirms that job seekers are indeed discouraged when the economy is in a recession. Using Dutch data, Bloemen (2005) found that a decrease in the number of job opportunities available per individual decreases the intensity of their job search. For Norway, Dagsvik et al. (2013) also found a significant discouraged worker effect.[68]

Micro-evidence of the differences in cyclicality of labour supply between different groups indicates that gender, education level and age are important for the extent to which individuals are discouraged. A US study by Hotchkiss and Robertson (2006) found that women, low educated and older individuals are more affected in their participation decision when the probability of finding employment changes.

The gender difference found by Hotchkiss and Robertson (2006) is opposite to the findings by Kesselring and Bremmer (2015), who also studied the United States. There are multiple factors that could explain this difference. Firstly, the study by Hotchkiss and Robertson controls for marital status, which could filter out the added worker effect from the estimate of cyclicality. As the added worker effect seems more important for married women than for married men, this could explain why the study by Hotchkiss and Robertson finds relatively stronger effects of the business cycle on the participation decision of women. They also study the effects of changes in local unemployment, which might yield different results than if national unemployment rates are used instead, like in the study by Kesselring and Bremmer. Thirdly, there is a difference in time span between the studies; the study by Hotchkiss and Robertson looks at data from 1994 to 2005, whereas Kesselring and Bremmer analyse data from 1976 until 2012.

[68] Dagsvik et al. (2013) use cross-sectional data over multiple years in combination with a multi-stage probit model.

3.2.4 Summary

Overall, there is clear empirical evidence for both the discouraged worker and the added worker effect, although the size of the added worker effect in the Netherlands appears to be quite small. The effects of discouragement, on the aggregate level, are larger than the added worker effect. Total labour supply, therefore, moves in the same direction as the business cycle.

Both young and older people react more strongly in their labour supply to cyclical changes. The differences between men and women mostly concern the added worker effect, which is stronger for women. With respect to education level, all flow probabilities in and out of the labour market are less cyclical for higher educated individuals.

Regarding labour market flows, the literature shows a clear negative correlation with the business cycle for those between unemployment and non-participation. The flow from non-participation to employment seems to have a smaller but positive correlation with the cycle. Cyclical effects in the flow from employment to non-participation are found either to be slightly positive or absent.

4 Empirical analysis for the Netherlands

In this chapter, we analyse labour supply behaviour in the Netherlands. We do so by studying the various groups related to the labour market and the labour flows in the period from 2003 to 2016. The sizes of these groups and flows are influenced by demographic trends, changes in social norms, policy changes and the business cycle. Since the focus of this paper is on the cyclicality, the empirical analyses in this chapter are focussed on the dynamics in the flows. If only the changes in the sizes of the groups would be considered, one would miss the underlying dynamics that perhaps cancel each other out within the groups.[69]

The main data used in this chapter are data on levels and flows, obtained from Statistics Netherlands (CBS). The first group of data represents data on the number of individuals that are either employment, unemployment or non-participating. The flow data represent the number of individuals that move between employment, unemployment and non-participation, within a given quarter. These data are available for the total population aged between 15 and 75, as well as for men and women, three age groups (15–25, 25–45, 45–75) and three education levels (low, intermediate and high). Combined classifications, such as 'young and highly educated', are not available. We use data on employment, unemployment and non-participation levels from the first quarter of 2003 to the first quarter of 2016, and

[69] The flows to and from non-participation are about 15 times higher than the resulting average absolute change in participation.

flow data from the second quarter of 2003 to the first quarter of 2016. The data are based on the Dutch Labour Force Survey (*Enquête Beroepsbevolking*) and are scaled up by Statistics Netherlands to obtain national representative volumes.

Section 3.1 first describes the development in the level of employment, unemployment and non-participation. Section 3.2, subsequently, discusses the gross labour market flows between non-participation, unemployment and employment. Section 3.3 analyses the relation of between these flows and the business cycle and Section 3.4 concludes.

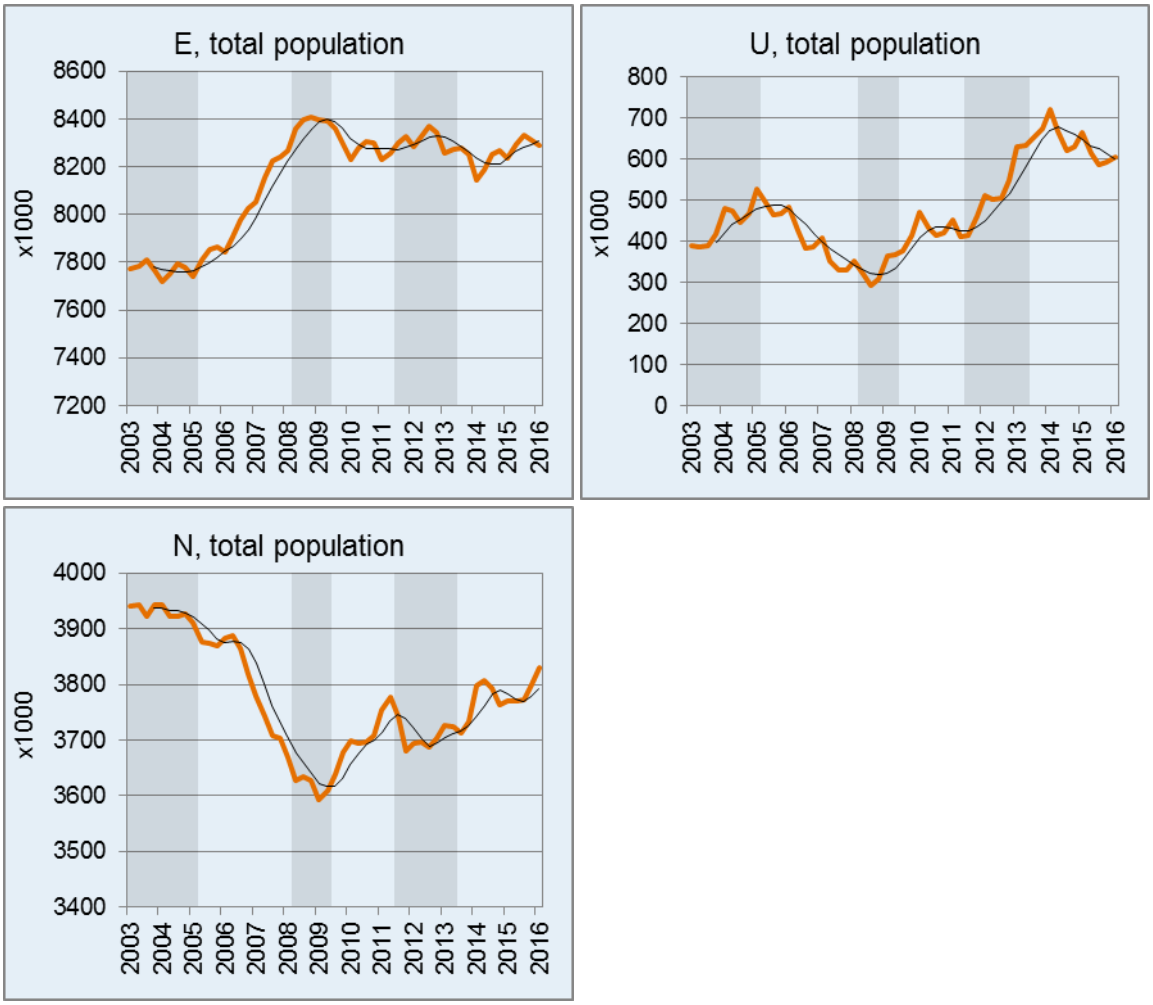
4.1 Employment, unemployment and non-participation levels

Short-term fluctuations in the level of employment (E), unemployment (U) and non-participation (N) are sizable, in comparison to the average size of these groups. The standard deviation of non-participation and employment is 3% of the average value; for unemployment, this is 23% (see Table 4.1). A considerable part of this fluctuation appears to be cyclical (see Figure 4.1). All three states have a peak (for E) or trough (for N and U) around the start of the Great Recession, at the end of 2008 or beginning of 2009. The employment level shows a rise between 2005 and 2009, when there was mostly economic growth. After 2009, there is a slight average decline. The level of non-participation also moves in a cyclical way; it drops from 2003 until 2009, followed by an average rise. Lastly, the unemployment level also has a clear cyclical pattern; it rises between 2003 and 2005, drops from 2005 until 2009 and then rises again, with a peak in 2014.

Table 4.1 Descriptive statistics on non-participation, employment and unemployment.

X 1000	N	E	U
Mean	3773.4	8145.8	473.4
Maximum	3948.2	8434.7	680.7
Minimum	3592.4	7754.3	308.9
Std. Dev.	100.9	224.1	108.6

Figure 4.1 Employment, unemployment and non-participation (including a four-quarter moving average and recession shading).



Note: Shaded areas indicate the area following the peak through the trough in the OECD Composite Leading Indicator Series (OECD, 2016). Source: CBS Statline, OECD.

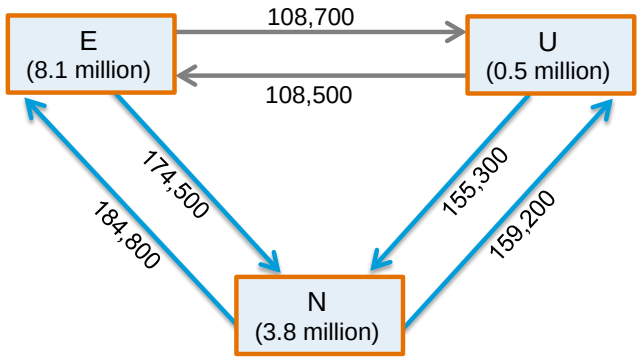
Demographic groups exhibit substantially different developments in labour market status, over time (see Appendix 7.1):

- The employment level for men shows a clear drop after 2009, which cannot be seen for women. The unemployment level shows a similar pattern for men and women, but with stronger fluctuations for men.
- Due to the general increase in education levels, the levels of E and N increase for the highly educated, while they decline for the lower educated. For the level of U , this holds to a lesser extent; this variable follows roughly the same pattern for all education levels.
- Due to the ageing of the labour force, the level of E declines, over time, for the 25–45 age group, while it rises for the 45–75 group. The level of N decreases for both these age groups until 2009 and then rises thereafter, but more strongly so for the 45–75 group. Fluctuations in the level of U are stronger for those aged 24–45 and 45–75 than for the 15–25 age group.

4.2 Flows

Underlying the changes in employment, unemployment and non-participation levels, as presented in Section 4.1, are labour market flows between E, U and N. Because the flows between E and U do not result in a change in labour supply, we will focus on the flows between N and E or U. These are the flows in and out of the labour market, and therefore the ones that directly affect labour supply. The flows are influenced not only by the business cycle, but also by demographic and policy changes. As mentioned before, we focus on the cyclical aspects of the flows. Graphs for the gross and net flows of all groups are available in Appendices 7.2 and 7.3.

Figure 4.2 Seasonally corrected average flows between employment, unemployment and non-participation, over the 2003Q2–2016Q1 period. (a)



(a) Employment, unemployment and non-participation levels shown in parentheses. Source: CBS StatLine.

Every quarter, a considerable number of individuals change their labour market status, as can be seen in Table 4.2 and Figure 4.3. The flows between N and E, on average, are larger than those between N and U. Also, the average flows towards the labour market (from N to E or U) are slightly larger than those in the opposite direction, during the period investigated.

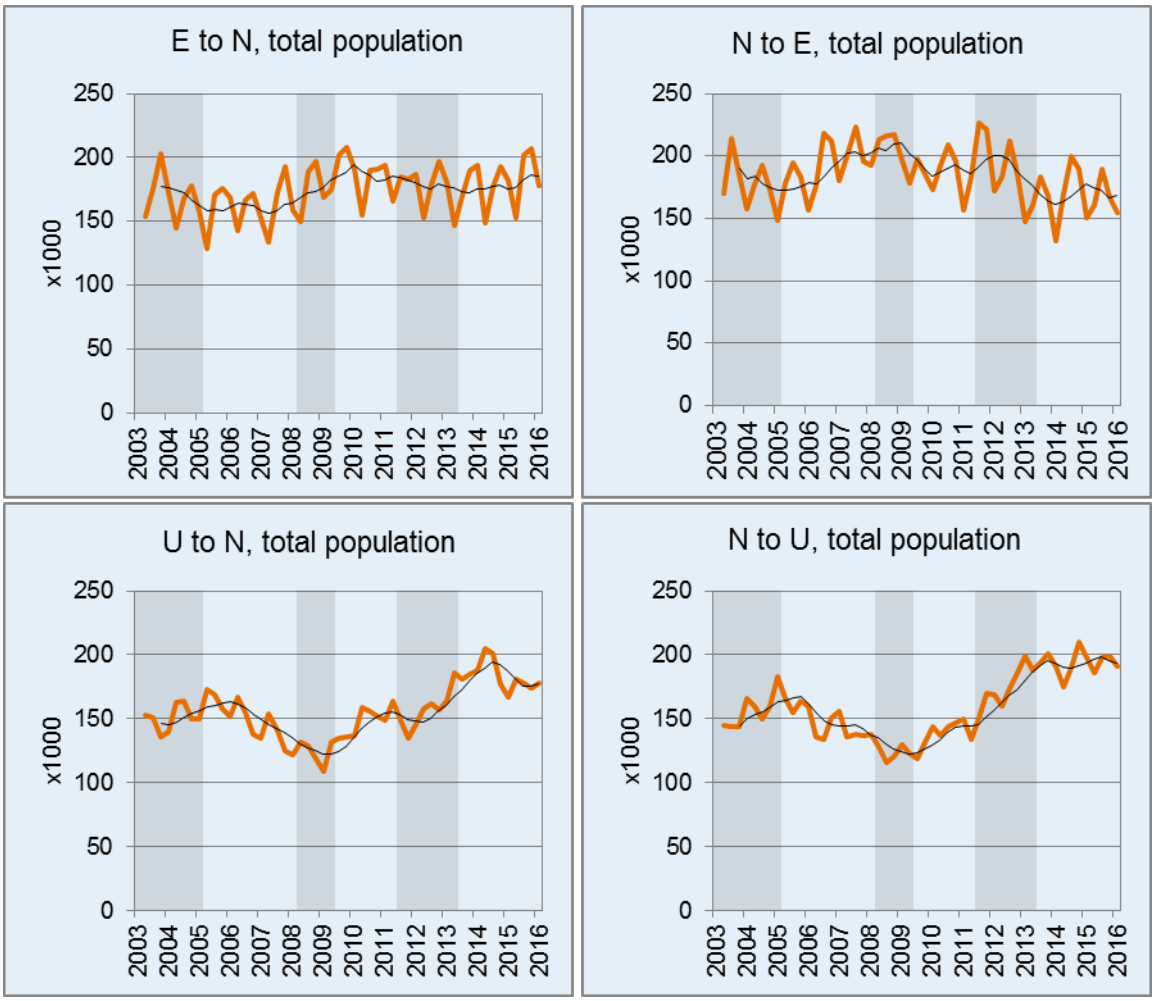
Table 4.2 Descriptive statistics on the flows

Flows x1000	U to N	N to U	E to N	N to E
Mean	155.3	159.2	174.5	184.8
Maximum	196.2	201.3	201.8	219.8
Minimum	115.5	118.8	151.9	153.6
Std. Dev.	20.0	24.4	11.6	15.8

The flows between N and U exhibit a stronger cyclical pattern than those between N and E (Figure 4.3). The flows from N to U and from U to N both show cyclicality, they decrease during the 2005–2009 period and rise again thereafter. Since these flows have roughly the same pattern over time, the effects of their increase or decreases on unemployment and non-participation levels partially cancel each other out. The flows, therefore, exhibit more labour market dynamics than expected, on the basis of the changes in unemployment and non-participation levels. The flow from N to E also shows a cyclical pattern, but weaker than that

of the flows between N and U. The flow from E to N appears the least cyclical of all the flows, since it changes only slightly over time.

Figure 4.3 Gross flows (including a four-quarter moving average and recession shading[70]



Source: CBS Statline, OECD.

Similar to the employment, unemployment and non-participation levels, labour market flows also develop differently for various demographic groups. Appendix 7.3 provides an overview of the flows by age, education and gender. Main differences are the following:

- All four flows to and from non-participation are larger for women than for men. This contrasts with the development in the unemployment level, which fluctuates more for men (see Section 4.1).
- In line with the finding from Gomes (2012), the flows between N and U and N and E have a more cyclical pattern for the low and intermediate levels of education than for the higher education level.

[70] Shaded areas indicate the area following the peak through the trough in the OECD Composite Leading Indicator Series (OECD, 2016).

- The flows between N and U are more cyclical for the young and middle-aged than for older people. For the oldest age group, the flows increase after 2009, probably in part due to changes in the retirement age; these flows do not change by much before the year 2009 . This result does not correspond with results from previous literature (Duval et al., 2011; Kesselring and Bremmer 2015), who find that the people in the oldest age group have more options to retire early and, therefore, the flow towards N fluctuates more. For the flow from N to E, the middle-age group has a more cyclical pattern than the two other groups.

4.3 Flows and business cycle

Looking at the labour market flows in the previous section, we concluded that various labour market flows exhibit a cyclical pattern that differs between demographic groups. To investigate the short-term movement of the flows more closely, and to obtain a better view of the group differences, we empirically investigate the relation between the flows and a number of variables related to the economic cycle.

Because the flows probably move with a certain delay after economic fluctuations, we first investigate this delay. We do so by performing cross-correlations between the flows (total population) and the lags of the various indicators. We then take the lag with the highest correlation and use this in a regression for the sub-groups. For the total flows, we also graphically show the outcome of regressions with a number of other lags. To take into account the possibility of heteroscedasticity and autocorrelation, Newey-West standard errors are used in these regressions.

4.3.1 Labour market flows and GDP growth

Since the growth rate of real GDP is clearly related to the business cycle, this variable is a natural starting point to investigate the cyclicality of the flows.

Cross-correlations

Cross-correlations show that the flows show the highest correlation with varying lags of GDP growth (Table 4.3). Some are in line with the theory and previous literature presented in Section 1, but others are not. The negative correlations between GDP growth and labour market flows between N and U are in line with the results from previous literature that show the flow from U to N is be negatively correlated to the business cycle due to discouragement (Burda and Wyplosz, 1994). For the flow from U to N, the negative correlation is caused by a mix of increasing unsuccessful attempts to enter the labour market during economic downturns and the added worker effect.

The positive correlation between the flow from N to E and GDP growth is also in line with the literature. According to the literature, this positive correlation is due to an increase in successful labour market entries during economic upswings. However, the negative correlation between the flow from E to N and GDP growth is unexpected. Previous literature indicates that this flow has either a positive cyclical fluctuation or no cyclical fluctuation at all (Gomes, 2012; Sutton, 2013; Burda and Wyplosz, 1994).

The magnitude of some of the correlations and the long optimal lag cast doubt on the usability of real GDP growth as a variable to capture short-term flow changes. For example, on the basis of the flow graphs, the flow from N to U would not be expected to have the lowest correlation with the business cycle. And the lag of GDP growth with the highest correlation with the flow from N to U is rather long. Therefore, we also show the point estimates using various lags.

Table 4.3 Correlation of flows with GDP growth

	U to N	N to U	E to N	N to E
GDP growth	-0.44 (8)	-0.34 (11)	-0.41 (1)	0.36 (5)

The lag (in quarters) used is shown in parentheses.

Analysis

In our regression analysis, we use the lags of GDP growth with the highest correlation to study their relation to the flows for the total working age population and its sub-groups. The main result is that the regressions on the total flows and the different groups generally have a low adjusted R-squared. These low values for the R-squares indicate that real GDP growth is a relatively weak indicator to determine the short-term movements in the flows. Moreover, the regressions on the sub-groups mostly show insignificant results and low R-squares (Table 4.4). Because of this, it is difficult to relate the outcomes of the regressions to previous theory and literature.

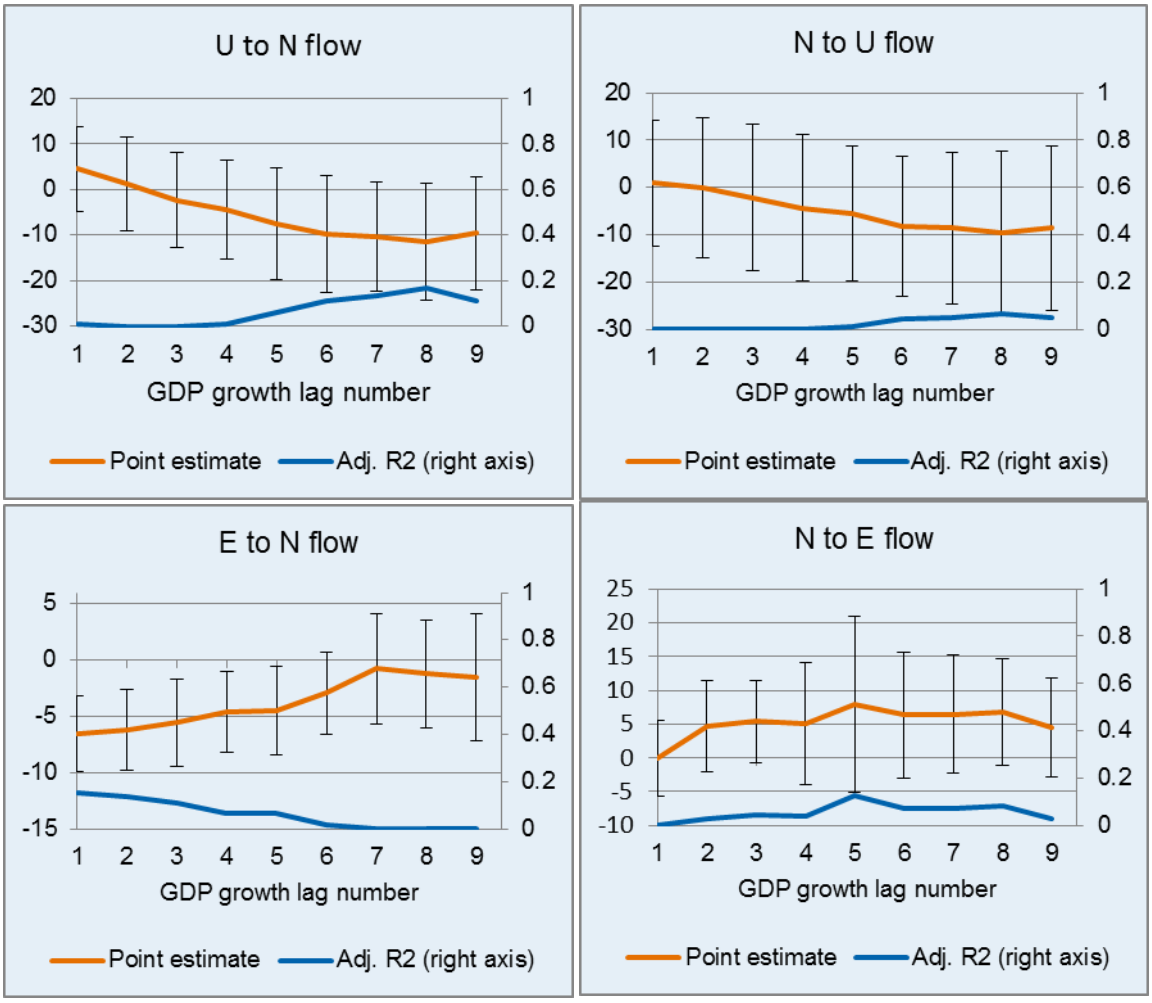
The co-movement of the flows with GDP growth is generally small for most lags. This can be seen in Figure 4.4, where we compare the regression results discussed above with the results found when using other lags. This figure shows that, for three of the four main flows, no lag of GDP growth has a co-movement that is significant at a 95%-confidence level. The flow from E to N, however, has a significant co-movement with small lags of GDP growth.

Table 4.4 Regression results for the flows with GDP growth as regressor

U to N flow N=52	Total	Men	Women	Aged 15–25	Aged 25–45	Aged 45–75	Low educated	Medium educated	Highly educated
GDP growth (lag=8)	-11.542*	-4.439	-7.026**	-5.976***	-3.012	-2.054	-6.280***	-3.671	-1.216
Adj. R2	0.17	0.08	0.18	0.23	0.05	0.01	0.30	0.05	0.03
N to U flow N=52	**Total**	**Men**	**Women**	**Aged 15–25**	**Aged 25–45**	**Aged 45–75**	**Low educated**	**Medium educated**	**Highly educated**
GDP growth (lag= 11)	-11.254	-5.216	-5.897	-5.815**	-2.392	-3.145	-4.377	-4.939	-1.934
Adj. R2	0.10	0.07	0.10	0.11	0.02	0.02	0.08	0.08	0.08
E to N flow N=52	**Total**	**Men**	**Women**	**Aged 15–25**	**Aged 25–45**	**Aged 45–75**	**Low educated**	**Medium educated**	**Highly educated**
GDP growth (lag= 1)	-6.503***	-4.383***	-1.692	-1.878	-2.413***	-2.092	-2.076	-2.680***	-1.635
Adj. R2	0.15	0.20	0.01	0.04	0.10	0.02	0.03	0.12	0.04
N to E flow N=52	**Total**	**Men**	**Women**	**Aged 15–25**	**Aged 25–45**	**Aged 45–75**	**Low educated**	**Medium educated**	**Highly educated**
GDP growth (lag= 5)	7.974	2.795	5.382	5.389*	2.608	0.268	3.946	2.686	1.248
Adj. R2	0.13	0.06	0.13	0.19	0.08	0	0.09	0.08	0.05

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Figure 4.4 Point estimates for GDP growth and corresponding adjusted R-squared. Bars indicate the 95%-confidence interval around the point estimates[71]



4.3.2 The output gap

We performed the same analysis using the output gap[72] instead of real GDP growth as a business cycle indicator. The output gap measures whether the growth is above or below its potential. Therefore, the output gap only measures business cycle changes and excludes the long-term trend in economic growth which is present in GDP growth. The output gap may therefore be a more suitable indicator for the business cycle. However, the downside of using output gap is that it is a construct based on an HP-filter. It therefore comes with the downsides of mechanical detrending[73].

[71] The figure shows the point estimates and adjusted R-squares of the regressions with a flow as y-variable and a lag (1 through 9) of GDP growth as the x-variable. The estimated equation is y=a+b*x, where b is the point estimate of the co-movement between the flow and GDP growth, The bars indicate the estimate plus/minus 1.96 times the standard deviation of the estimate, corresponding to a 95%-confidence interval.
[72] We measure output gap using an index of real, seasonally corrected GDP and HP-filtering for this index with λ=1600. The output gap is then defined as (index - hp filtered index)/(hp filtered index). The index covers the period from 1996Q1 to 2016Q1.
[73] See, for example, Harvey and Jaeger (1993) for a critique on HP-filtering.

Cross-correlations

The output gap exhibits a stronger correlation with labour market flows than the GDP growth did (Table 4.5). In addition, the sign of all four correlations corresponds with the the type of (positive or negative) cyclicality found in previous studies (Gomes, 2012; Burda and Wyplosz, 1994). The flows between U and N are negatively correlated with output gap, they rise during economic downturns and drop during upswings. The flows between E and N show the opposite movement.

Table 4.5 Correlation between flows and the output gap

	U to N	N to U	E to N	N to E
Output gap	-0.57 (3)	-0.40 (4)	0.47 (7)	0.62 (2)

The lag (in quarters) used is shown in parentheses.

Analysis

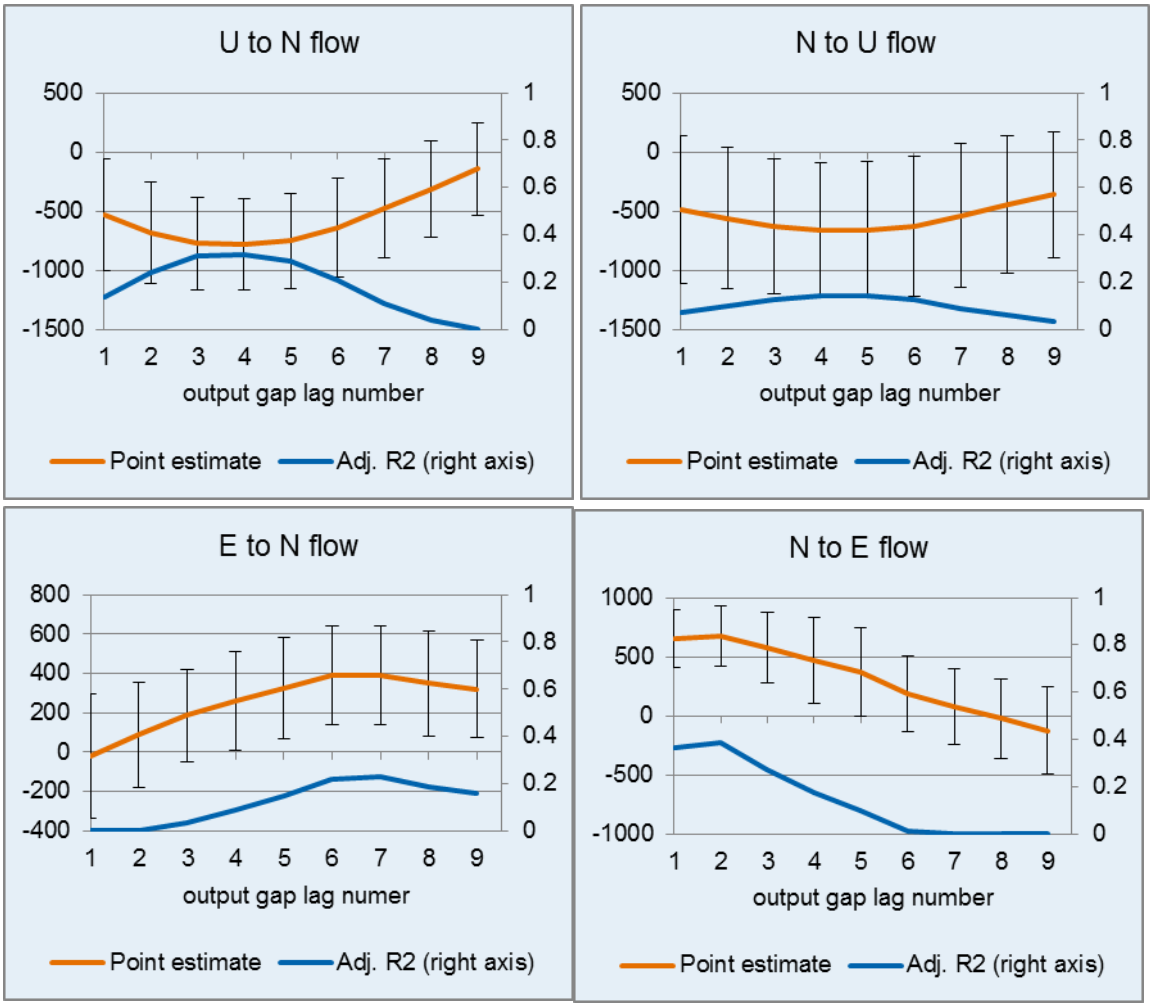
Table 4.6 shows the regression results using the highest correlated lag of the output gap. Some results are in line with the literature, but there are some unexpected results, as well. The sign of the cyclical relation (i.e. a positive or negative coefficient) corresponds to the sign of the cross-correlations. Figure 4.5 shows that the R-squared is highest for the lag of output growth that had the highest cross-correlation with the flows. The regressions on the flows between N and U, show a rise in the R-squared until a lag of three to four quarters, after which it gradually drops. The R-squared of the regressions on the flow from N to E drops after two quarters; the movement in the flow from N to E is linked to shorter lags of the output gap than those between N and U. Lastly, the regressions on the flow from E to N show a rising R-squared for seven quarters, after which it drops.

Table 4.6 provides results for different sub-groups. The cyclicality[74] of the flows differs between sub-groups, as can be seen by the differences in adjusted R-squared. The most interesting results are the following:

- All flows for women, except for the flow from E to N, show more cyclicality that those for men.
- The flows from U to N, N to E and E to N show less cyclicality for the higher educated than for the low and medium educated groups, as indicated by a lower R-squared in Table 4.5. For the flow from N to U, this is not the case.
- The group aged between 25 and 45 shows more cyclical fluctuation than the groups of the young and older people, except for the flow from N to E.
- The flow from N to U seems to be less cyclical in its fluctuations than the other flows. This result is not in line with previous literature, as those studies found considerable cyclicality for this flow (Elsby, Hobijn and Şahin, 2015; Gomes, 2012).

[74] We interpret the cyclicality of the flows as the amount of co-movement between the flows and a cyclical indicator (in this case, the output gap). However, we cannot rule out the possibility that part of this co-movement was due to demographic or policy changes that may have affected the flow if they occurred simultaneously with business cycle fluctuations in the investigated period.

Figure 4.5 Point estimates for output gap and corresponding adjusted R-squared. Bars indicate the 95%-confidence interval around the point estimates[75]



[75] The figure shows the point estimates and adjusted R-squares of the regressions with a flow as y-variable and a lag (1 through 9) of output gap as the x-variable. The estimated equation is y=a+b*x, where b is the point estimate of the co-movement between the flow and output gap, The bars indicate the estimate plus/minus 1.96 times the standard deviation of the estimate, corresponding to a 95%-confidence interval.

Table 4.6 Regression results for the flows with output gap as regressor

U to N flow N=52	Total	Men	Women	Aged 15–25	Aged 25–45	Aged 45–75	Low educated	Medium educated	Highly educated
Output gap (3)	-775.361***	-329.017***	-438.255***	-263.051**	-446.157***	-61.014	-382.288***	-283.018**	-82.006**
Adj. R2	0.31	0.19	0.29	0.17	0.54	-0.01	0.45	0.15	0.07
N to U flow N=52	**Total**	**Men**	**Women**	**Aged 15–25**	**Aged 25–45**	**Aged 45–75**	**Low educated**	**Medium educated**	**Highly educated**
Output gap (4)	-659.200**	-247.404	-417.946***	-250.110	-337.498***	-82.653	-292.554**	-220.196	-123.542***
Adj. R2	0.14	0.06	0.21	0.07	0.27	0.00	0.16	0.05	0.14
E to N flow N=52	**Total**	**Men**	**Women**	**Aged 15–25**	**Aged 25–45**	**Aged 45–75**	**Low educated**	**Medium educated**	**Highly educated**
Output gap (7)	390.188***	252.022***	135.701*	177.178***	159.354***	56.794	248.031***	120.521**	28.591
Adj. R2	0.23	0.27	0.07	0.19	0.18	0.00	0.27	0.09	0.00
N to E flow N=52	**Total**	**Men**	**Women**	**Aged 15–25**	**Aged 25–45**	**Aged 45–75**	**Low educated**	**Medium educated**	**Highly educated**
Output gap (2)	673.509***	222.861***	461.546***	358.235***	138.901**	170.980***	343.980***	208.992***	117.054***
Adj. R2	0.38	0.18	0.39	0.34	0.09	0.23	0.31	0.22	0.22

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

4.3.3 Adding labour market indicators

To investigate the underlying mechanisms behind the results in the previous section, we repeat the analysis using the output gap but also add three labour market indicators. The link between the fluctuations in labour market flows and the output gap, shown in the previous section, may run via changes in the labour market instead of directly (Vendrik and Córvers, 2009). The discouraged worker effect, for instance, is probably not so much driven by changes in the output gap itself, but rather by the low job finding probabilities that are due to low labour demand. The added worker effect is also caused by labour market variables, such as unemployment, and not so much by the output gap itself. Previous empirical literature also found that, in comparison to labour market related variables, GDP-related variables capture less of the short-term variations in labour market flows.[76]

We use vacancies, consumers' willingness to buy and bankruptcies as the indicators that might cause changes in labour market flows. The number of vacancies is used to capture labour market tightness. An alternative for this indicator would be unemployment or the ratio between vacancies and unemployment (the V/U ratio). We do not use these because the flows in and out of unemployment are, by definition, closely related to the unemployment levels. The second indicator we use is consumers' willingness to buy. There are two reasons why this variable is useful. Firstly, it is an indicator for the demand-side of the economy. And secondly, it is theoretically related to the added worker effect, as a drop in household income (the cause of the added worker effect) influences people's willingness to buy. The third indicator is the number of bankruptcies. Bankruptcies indicate the general state of the

[76] Examples are Vendrik and Córvers (2009), Gomez (2012) and Sutton (2013).

producer-side of the economy, and also give an indication of the financial tightness at companies, which may affect their hiring policy.

The regression results cannot be interpreted as causal relationships, since there may be underlying confounding factors at play, or intermediate factors that interact between the flows and the right-hand-side variables.

Cross-correlations

The lags of the indicators with the highest correlation with the flows show a clear pattern for three of the four flows (see Table 4.7). For the flows between N and U, the highest correlation with the indicators occurs with lags from a year to a year and a half. Those for the flow from N to E are lower: two to three quarters of a year. This corresponds roughly to the lags used for the output gap. The lag with the highest correlation for the flow from E to N, however, differs greatly between indicators. This is an unexpected result. A possible explanation could be that the indicators work less well on this specific flow because it is less cyclical, as was found by Gomes (2012).

Also for the sign of the correlations between flows and indicators, we find expected results for the same three of the four flows. The flows between N and U have a positive correlation with bankruptcies and negative correlations with willingness to buy and vacancies. This shows that these flows drop during economic upswings (when willingness to buy and vacancies go up) and rise during downturns (when bankruptcies increase). The opposite can be seen for correlations of the indicators with the flow from N to E; this flow has a negative correlation with bankruptcies and a positive correlation with willingness to buy and vacancies. The type of cyclicality of these three flows corresponds to the results obtained using the output gap as an indicator, as well as to the findings in previous research (Gomes, 2012; Burda and Wyplosz, 1994). In addition to these expected results, there is also one result that is difficult to explain: that of the flow from E to N being positively correlated with all three indicators. This makes it difficult to interpret the cyclicality of the flow. As mentioned above, a possible explanation is that this flow is less cyclical. This makes the labour market indicators work less well with this flow.

Table 4.7 Correlation of the flows with the three labour market indicators

	U to N	N to U	N to E	E to N
Vacancies	-0.83 (4)	-0.80 (6)	0.73 (2)	0.42 (11)
Willingness to buy	-0.66 (5)	-0.57 (6)	0.63 (3)	0.46 (6)
Bankruptcies	0.85 (5)	0.80 (6)	-0.61 (3)	0.40 (0)

The lag (in quarters) used is shown in parentheses.

Analysis with output gap and labour market indicators

From the cross-correlation, we obtained the lags for both the output gap and the labour market indicators to use in the regressions. Because the flow from E to N shows no clear cyclical pattern with the labour market indicators, we will not look into the group differences for this flow. We do however run a regression on the total flow.

Using both the output gap and the three labour market indicators as regressors, we generally obtain a much higher adjusted R-squared than when the output gap is used as the only regressor (Tables 4.8 to 4.11). Both total flows between N and U now show a high R-squared. The total flow from N to E has a slightly lower R-squared and the flow from E to N has a much lower R-squared. These results on the cyclicality of the flows correspond to those from previous research (Gomes, 2012).

An interesting result is that, in nearly all of the regressions, the effect of the output gap is no longer significant. This might indicate that the output gap fluctuations influence the flows through changes in the labour market, captured by the three labour market variables, as would be expected based on theory. There is, however, considerable multicollinearity between the output gap and the other regressors. On the one hand, this indicates that the fluctuations in the labour market indicators are closely connected to the fluctuations in the output gap. On the other hand, the multicollinearity makes it difficult to interpret the significance or insignificance of the point estimates for the output gap. To see if the labour market indicators really make output gap superfluous as a regressor, we perform the regressions again, using only the labour market indicators as regressors in the next section.

Table 4.8 Regression results for U to N flows with labour market indicators and output gap as regressors

U to N flow N=52	Total	Men	Women	Aged 15–25	Aged 25–45	Aged 45–75	Low educated	Medium educated	Highly educated
Output gap (3)	110.472	51.069	57.424	11.612	-89.013	194.817	-144.573	203.063	57.336
Vacancies (4)	-0.131	-0.063	-0.067	-0.036**	-0.125***	0.030	-0.063**	-0.047	-0.031
Willingness to buy (5)	-0.587*	-0.179	-0.386**	0.076	-0.414**	-0.252	0.041	-0.500**	-0.047
Bankruptcies (5)	0.027***	0.013**	0.015***	0.019***	-0.012***	0.020***	0.009***	0.014***	0.004
Adj. R2	0.82	0.54	0.73	0.81	0.69	0.50	0.74	0.71	0.34

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Table 4.9 Regression results for N to U flows with labour market indicators and output gap as regressors

N to U flow N=52	Total	Men	Women	Aged 15–25	Aged 25–45	Aged 45–75	Low educated	Medium educated	Highly educated
Output gap (4)	439.460	231.788	211.125	204.142	32.576	190.359**	137.188	301.832*	16.235
Vacancies (6)	-0.300***	-0.128**	-0.170***	-0.077	-0.190***	-0.033	-0.123***	-0.110*	-0.064***
Willingness to buy (6)	-0.346	0.067	-0.444*	-0.071	-0.263	-0.020	-0.076	-0.340	0.048
Bankruptcies (6)	0.023*	0.019**	0.004	0.022***	-0.015***	0.016***	0.010**	0.011	0.001
Adj. R2	0.72	0.67	0.71	0.68	0.58	0.61	0.69	0.54	0.42

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Table 4.10 Regression results for N to E flows with labour market indicators and output gap as regressors

N to E flow N=52	Total	Men	Women	Aged 15–25	Aged 25–45	Aged 45–75	Low educated	Medium educated	Highly educated
Output gap (2)	31.314	53.582	-0.796	115.526	-184.980***	103.389	-3.124	-58.378	90.344**
Vacancies (2)	0.150	0.021	0.119*	0.027	0.092***	0.018	0.033	0.069*	0.036*
Willingness to buy (3)	0.587**	0.302*	0.290*	0.269	0.062	0.276*	0.391*	0.201**	0.029
Bankruptcies (3)	-0.001	0.001	-0.003	-0.005	-0.005	0.007***	-0.008	-0.001	0.006**
Adj. R2	0.55	0.21	0.62	0.42	0.55	0.37	0.51	0.41	0.30

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Table 4.11 Regression results for E to N flows with labour market indicators and output gap as regressors

E to N flow	Total
Output gap (7)	82.618
Vacancies (11)	0.032
Willingness to buy (6)	0.509**
Bankruptcies (0)	0.010**
Adj. R2	0.38

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Analysis using only labour market indicators

Using only the labour market indicators as regressors does not change the fit of the model (see Tables 4.12 to 4.15). The adjusted R-squared does not substantially change in any of the regressions. From this, we conclude that the labour market indicators and output gap are related, but that the labour market indicators provide a more direct indication for the short-term fluctuations in the flows. Excluding the output gap has decreased the multicollinearity, which made the other regressors (especially vacancies) more often statistically significant. However, there is still multicollinearity between the labour market indicators, making it difficult to interpret the strength of each indicator.

For the coefficients of the indicators, we find expected results for the total flows between N and U, and for the total flow from N to E. The flows between N and U have a positive sign for bankruptcies and negative signs for willingness to buy and vacancies. For the flow from U to N, these signs are what we would expect, based on the discouraged worker effect. For the flow from N to U, the signs are in line with the added worker effect, as well as with a rise in unsuccessful attempts to enter the labour market that occur during economic downturns because there is less labour demand.

The opposite holds for the signs of the indicators for the flow from N to E; this flow has a negative sign for bankruptcies and positive signs for willingness to buy and vacancies. These signs correspond with a rise in successful labour market entries during economic upswings because of higher labour demand. The type of cyclicality of these three flows corresponds to

the results obtained using output gap as an indicator, as well as to the findings in previous research (Gomes, 2012; Burda and Wyplosz, 1994).

In addition to these results that are in line with previous literature, there is also one result that is difficult to explain: that is, the flow from E to N having a positive sign for all three indicators. This result corresponds to the previously found positive correlation between this flow and all three indicators.

Between the groups, there are again some clear differences. A number of these are the same as those found using the output gap as a regressor, others are different:

- A recurring difference is that between men and women. The flows for women show a larger cyclicality than those for men, as is indicated by higher adjusted R-squares in the regressions on the flows for women. For the flow from U to N, this effect can be linked to a higher effect of discouragement on women, as was also found by Hotchkiss and Robertson (2006).
- For the age groups, the results differ somewhat from those obtained by using the output gap. The cyclicality of the flows between U and N drops with increasing age, whereas, for the flows from N to E, it is highest for the group aged between 25 and 45. In contrast, when using the output gap, for the flows between U and N, we found the highest cyclicality, and for the flows from N to E we found the lowest cyclicality for this age group. For the flow from U to N, the current results partially correspond to the results from previous studies. According to the literature, young people become discouraged more quickly, because they often have the option to go back to school. This can explain the high cyclicality of the flow from U to N for the young age group (Duval et al., 2011). The study by Duval et al. (2011), however, found that older people also become discouraged more quickly, which does not show in our regressions.
- Regarding the education levels, the cyclicality of the flows decreases as education level rises. For the U to N and N to E flows, this result corresponds to what was found using the output gap as a regressor. The less cyclical flows for the higher education level correspond to results found by Gomes (2012) for the United Kingdom.
- Lastly, there are some unexpected results for some groups in the signs of the regression coefficients. For the totals and most groups, the signs of the regression coefficients are the same as those for the correlations between the indicators and the total flows. However, for some groups, the signs differ from the total flows and are significant. Examples of this are the sign of vacancies for the 45–75 age group in the flow from U to N, and the sign of bankruptcies in the 25–45 age group in the flow from N to U.

In general, we can conclude that using the labour market indicators enables us to capture more of the variation in the flows compared to using only the output gap. This is indicated by the higher R-squared of the regressions using the labour market indicators. Also, using the labour market indicators, we find that the flows between N and U are the most cyclical, followed by the flow from N to E. The flow from N to E is the least cyclical. This is a result that is in line with previous studies and something that we did not find using output gap as the only regressor.

Table 4.12 Regression results for U to N flows with labour market indicators as regressors

U to N flow	Total	Men	Women	Aged 15–25	Aged 25–45	Aged 45–75	Low educated	Medium educated	Highly educated
Vacancies (4)	-0.106***	-0.051	-0.054**	-0.033**	-0.146***	0.074***	-0.096***	-0.001	-0.018
Willingness to buy (5)	-0.508*	-0.143	-0.345***	0.085	-0.478***	-0.112	-0.063	-0.354*	-0.006
Bankruptcies (5)	0.029***	0.014**	0.015***	0.019***	-0.013***	0.023***	0.006**	0.017***	0.005**
Adj. R2	0.82	0.55	0.73	0.81	0.69	0.48	0.72	0.69	0.34

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Table 4.13 Regression results for N to U flows with labour market indicators as regressors

N to U flow	Total	Men	Women	Aged 15–25	Aged 25–45	Aged 45–75	Low educated	Medium educated	Highly educated
Vacancies (6)	-0.221***	-0.086**	-0.132***	-0.040	-0.184***	0.001	-0.099***	-0.056*	-0.061***
Willingness to buy (6)	-0.070	0.213	-0.311	0.058	-0.242	0.100	0.011	-0.150	0.058
Bankruptcies (6)	0.027**	0.021***	0.007	0.024***	-0.015***	0.018***	0.011**	0.014*	0.001
Adj. R2	0.69	0.64	0.69	0.66	0.59	0.56	0.68	0.48	0.43

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Table 4.14 Regression results for N to E flows with labour market indicators as regressors

N to E flow	Total	Men	Women	Aged 15–25	Aged 25–45	Aged 45–75	Low educated	Medium educated	Highly educated
Vacancies (2)	0.156**	0.031	0.118***	0.048	0.058*	0.037	0.033	0.058**	0.053
Willingness to buy (3)	0.609*	0.340**	0.290	0.351*	-0.069	0.350***	0.389*	0.159	0.093
Bankruptcies (3)	-0.001	0.001	-0.003	-0.004	-0.006*	0.008***	-0.008	-0.001	0.007***
Adj. R2	0.56	0.22	0.63	0.42	0.49	0.35	0.52	0.41	0.27

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Table 4.15 Regression results for E to N flows with labour market indicators as regressors

E to N flow	Total
Vacancies (11)	0.037
Willingness to buy (6)	0.569**
Bankruptcies (0)	0.012***
Adj. R2	0.38

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

4.3.4 Non-participation, by reason and labour market indicators

Behind the flows between activity and inactivity, there are many different individuals with different reasons for starting or ceasing to participate. For some of these reasons (e.g. discouragement) we would expect high cyclicality, but other reasons for non-participation

(e.g. education) might also be influenced by the business cycle. To analyse these differences, we repeat the previous analysis for the flows between U and N, separated according to reason for non-participation. The reason for specifically analysing the flows between U and N is that these are the most relevant when viewed from the discouraged worker and added worker effect. The added worker effect can also affect the flow from N to E, but recent results for this effect in the Netherlands show that most added workers start on the labour market from a position of unemployment (Merens and Josten, 2016).

To be labelled unemployed, a jobless individual must be actively searching for work and be available to start working in the nearby future. Therefore, there are three main groups within the non-participation category: those that are available for work, but are not searching for work; those that do search but are not available for work; and those that are neither available nor searching for work. Within these groups, there are a number of sub-groups, as can be seen in Table 4.16.

Table 4.16 Reasons for non-participation by size

	Main groups	Sub-groups	N to U flow avg.	U to N flow avg.
1	Available, did not search		60.0	58.3
1a	↳	Discouraged	13.3	14.6
1b	↳	Other reasons	46.7	43.7
2	Did search, was not available.		25.7	25.2
3	Did not search, was not available.		73.8	71.9
3a	↳	Wants to work	19.7	15.7
3b	↳	Not willing or not able to work	54.1	56.2
3bi		↳ Was not available because of family care or housekeeping	6.5	6.4
3bii		↳ Was not available because of education/study	31.9	24.4
3biii		↳Was not available because of retirement/ high age	0.01	4.0
3biv		↳ Was not available because of illness/disability	7.5	11.4
3bv		↳ Was not available because of other reasons	8.2	10.0

The flow sizes differ between the various reasons for non-participation, as can be seen in Table 4.16. Of the main groups, the group that ‘did search but was not available’ clearly has smaller flows than the other two groups. This group mostly consists of people that are not readily available for work for reasons such doing volunteer work or being on holiday (Souren, 2016). We can also see that within the group ‘available, did not search’, the discouraged are a minority in the flows between N and U.

There are some clear differences in the cyclicality of the flows between the various reasons for non-participation (Tables 4.17 and 4.18). In the U to N flow, the highest cyclicality is found for the group that ‘did search but was not available’. For the flow from N to U, this group and the group that ‘did not search and was not available’ are the two most cyclical.

For the two groups of individuals that were available, but did not search (1a and 1b), it is interesting to see that the discouraged group is more cyclical in the flow from U to N but not

in the flow from N to U. A possible explanation for this would be that a share of the non-participating, discouraged individuals will only start participating again after they are no longer discouraged. This has a dampening effect on the cyclicality of the flow from N to U for discouraged individuals, and would therefore explain why the U to N flow for the discouraged is larger and more cyclical than the flow from N to U.

Interestingly, many of the sub-groups that did not search for work and were not available (3) also show quite some cyclicality in their flows. An example is the group of those that were not available because of family care and housekeeping. It is also interesting to see that the flow from U to N for individuals that are pursuing an education (3bii) is not more cyclical than for some of the other groups. This seems to be an indication that the effect of discouragement for this group is not larger than for other groups, despite the possibility of withdrawing from the labour market to continue their education. This is also the case with respect to the decision to retire. The cyclicality of the U to N flow for individuals that do not participate because of retirement is very low compared to the other groups. It seems that retirement is not a reason for older unemployed workers to withdraw from the labour market during economic downturns.

Overall, we see that looking only at the discouraged individuals would underestimate the cyclical effect on the inflows and outflows regarding non-participation. The flows of many non-participating groups are cyclical, not just those of the discouraged individuals. For these other groups, the effects of a more difficult job market will likely also play a role in their decision not to participate, but they do not cite this as their main reason for non-participation.

Table 4.17 Regression results for U to N flows split by reason for non-participation, with labour market indicators as regressors

U to N flow N=51	1	1a	1b	2	3	3a	3b	3bi	3bii	3biii	3biv	3bv
Did search	No	No	No	Yes	No	No	No	No	No	No	No	No
Reason for not searching	Total	Discouraged	Other reasons									
Available	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
Sub-group	-			-	-	Willing to work	Not willing or not able to work	Was not available because of family care	Was not available because of education	Was not available because of retirement /high age	Was not available because of illness/disability	Was not available because of other reasons
Vacancies (4)	-0.079**	-0.002	-0.077***	0.046**	-0.051**	0.010	-0.061***	-0.028***	-0.030**	0.013**	-0.022***	0.007
Willingness to buy (5)	-0.199	-0.046	-0.154	0.008	-0.406***	-0.061	-0.348***	-0.107***	-0.040	-0.056***	-0.084**	-0.071
Bankruptcies (5)	0.009***	0.011***	-0.002	0.022	0.000	0.006**	-0.006**	-0.006***	0.002	0.000	-0.001	-0.001
Adj. R2	0.64	0.53	0.42	0.73	0.54	0.29	0.50	0.47	0.34	0.08	0.37	0.02

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Table 4.18 Regression results for N to U flow split by reason for non-participation, with labour market indicators as regressors

N to U flow N=51	1	1a	1b	2	3	3a	3b	3bi	3bii	3biii	3biv	3bv
Did search	No	No	No	Yes	No	No	No	No	No	No	No	No
Reason for not searching	Total	Discouraged	Other reasons									
Available	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
Sub-group	-			-	-	Willing to work	Not willing or not able to work	Was not available because of family care	Was not available because of education	Was not available because of retirement /high age	Was not available because of illness/disability	Was not available because of other reasons
Vacancies (6)	-0.093**	-0.007	-0.085**	0.013	-0.125***	0.001	-0.129***	-0.048***	-0.053**		-0.010	-0.020***
Willingness to buy (6)	-0.507**	-0.045	-0.465***	0.133	0.206	-0.018	0.223	0.024	0.161		0.038	0.005
Bankruptcies (6)	-0.007*	0.007**	-0.014***	0.023**	0.013**	0.005**	0.007	-0.005***	0.012***		0.004***	-0.003***
Adj. R2	0.61	0.38	0.62	0.65	0.65	0.30	0.62	0.46	0.64		0.47	0.15

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

4.3.5 Sensitivity analyses and discussion

To verify the results found using the three labour market indicators, we perform two sensitivity analyses. Firstly, we compute transition probabilities, and repeat the analysis from Section 4.3.3 (with the three labour market indicators) for the totals using the transition probabilities instead of the flows. Secondly, we repeat the analysis from Section 4.3.3 for the total flows, but using one lag lower and higher than the lag used in Section 4.3.3 to verify the robustness of the results. After this, we analyse the relation between the gross and net flows. Finally, we discuss strengths and limitations of using flow data.

Flows versus transition probabilities

The flows from one labour market state to another can be converted into transition probabilities. This is done by dividing the gross flow from state 1 to state 2 in period *t* by the amount of people that were in state 1 at the beginning of this period. The advantage of transition probabilities is that they are controlled for the size of the groups. Hence, transition probabilities are a useful tool for the sensitivity analysis. Note that, however, the flow probabilities can give results that differ from those of the gross flows because they are influenced not only by the gross flow (the numerator) but also by composition changes in the population in a certain labour market state (the denominator).

As a sensitivity check, we perform the regressions from Section 4.3.3 also on the transition probabilities. To do this, we first need to ascertain which lags of the labour market indicators have the highest correlation with the transition probabilities. As can be seen in Table 4.19, these lags for the transition probabilities never deviate by more than one quarter from the lags that are most correlated with the flows, except the lag of vacancies in the flow from E to N. Here, the most correlated lag changes from 11 to 0. This last result is another indication that the flow from E to N does not work well with the labour market indicators.

Table 4.19 Highest correlated lags for the flow probabilities

	UN	NU	N E	EN
Bankruptcies	4	6	4	1
Willingness to buy	5	6	3	7
Vacancies	3	5	3	0

Using the flow probabilities in the regressions with the three labour market indicators does not cause large differences in cyclicality between the flows and the flow rates. The signs of the point estimates for the flow probabilities are mostly expected, but some results changed compared to the results of the analyses on flows. The flow rate from N to U has the same signs as the flow, which is what we would expect.

For the flow probability from U to N, however, the signs are the opposite from those for the gross flow. While the flow from U to N rises during economic downturns (and drops during upswings), the flow probability drops (and rises during upswings). This contrast between flow and flow rate is also found in other studies (Krueger, Cramer and Cho, 2014; Elsby, Hobijn and Şahin, 2015). The cause of the difference lies in a change in the composition of the pool of unemploymed workers over the business cycle. During an economic downturn, a

larger number of individuals are unemployed, causing the flow from U to N to rise. However, also during an economic downturn, the composition of the pool of unemployed workers shifts towards individuals with a stronger connection to the labour market. This implies that a higher percentage of unemployed stay in the labour market during such downturns. This causes the flow rate from U to N to drop.

In the regression on the flow rate from N to E, the signs are mostly the same as those for the gross flow, with the exception of bankruptcies. For bankruptcies, the sign is positive and significant at the 10% level, while for the flow this was negative and insignificant.
For the flow rate from E to N, the sign of willingness to buy remains the same, but the signs for vacancies and bankruptcies change from positive to (insignificant) negative. This change in signs likely has to do with the different lag used for vacancies and the fact that this flow does not show much cyclicality.

Overall, our results do not change unexpectedly when using the transition probabilities. For the flow probabilities from N to U and N to E, the results are as expected, except for the sign of bankruptcies in the N to E flow probability. The flow probability from N to U has a different movement over the cycle than the corresponding gross flow, but this is in line with the results from previous studies. Lastly, the flow rate from E to N shows low cyclicality, a result that we also found for the gross flow.

Table 4.20 Regression output for flow probabilities

Flow probabilities	UN	NU	EN	NE
Vacancies	9.14E-05	-3.27E-05***	-9.82E-06	5.49E-05***
Willingness to buy	8.69E-04	-1.03E-05	4.50E-05**	2.35E-04**
Bankruptcies	-5.71E-05***	1.02E-05***	-1.63E-07	2.13E-06*
Adj. R2	0.68	0.66	0.31	0.64

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level.

Different lags

In our analysis, we used the lag with the highest correlation to perform regressions. To check how the lag used affects the results, we perform two sensitivity checks. Firstly, the results of regressions on the total flows with six lags of the output gap or GDP growth as regressors are performed to show how this affects the fit of the model. Secondly, we repeat the analysis with the three labour market indicators using a lag higher or lower for all indicators.

Performing regressions on the total flows using lags one to six of GDP growth as regressors yields a lower adjusted R-squared than the original specification with one lag for three of the four flows (Table 4.21). For the flows between N and U, the adjusted R-squared is considerably lower. In the original specification, long lags were used in the regressions on these flows, which explains why the R-squared in the current specification with shorter lags is so low. For the flow from N to E, the adjusted R-squared is slightly lower and for the flow from E to N it is higher. Both in the original specification and in the current one, using GDP

growth as a regressor yields a low R-squared for most flows; GDP growth does not capture the short-term fluctuations in the labour market flows.

Table 4.21 R2 of regressions on the four main flows using lags 1 to 6 of GDP growth as regressors

R2 using lags 1 to 6 of GDP growth	U to N	N to U	E to N	N to E
Adj. R2	0.08	0	0.23	0.12

Using the output gap as regressor, the specification with lags one to six results in an adjusted R-squared comparable to the original specification with one lag (Table 4.22). Only for the flow from E to N, the adjusted R-squared drops considerably.

Table 4.22 R2 of regressions on the four main flows using lags 1 to 6 of output gap as regressors

R2 using lags 1 to 6 of output gap	U to N	N to U	E to N	N to E
Adj. R2	0.32	0.13	0.15	0.36

The second check, using a higher or lower lag for the labour market indicators, does not change the results to a large extent, as can be seen in Tables 4.23 and 4.24.

Table 4.23 Regression output for total flows using one lag higher

Lag +1	U to N		N to U		E to N		N to E	
Vacancies	-0.160***	(5)	-0.240***	(7)	0.022	(3)	0.177***	(12)
Willingness to buy	-0.308	(6)	0.154	(7)	0.602***	(4)	0.451	(7)
Bankruptcies	0.023***	(6)	0.028*	(7)	0.012***	(4)	0.001	(1)
Adj. R2	0.77		0.66		0.37		0.49	

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Table 4.24 Regression output for total flows using one lag lower

Lag -1	U to N		N to U		E to N		N to E	
Vacancies	-0.043	(3)	-0.204***	(5)	0.032	(1)	0.135*	(10)
Willingness to buy	-0.671**	(4)	-0.188	(5)	0.476*	(2)	0.505	(5)
Bankruptcies	0.034***	(4)	0.028**	(5)	0.013***	(2)	-0.005	(-1)
Adj. R2	0.80		0.68		0.34		0.49	

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Net flows

When investigating labour market state changes, one can choose to look not only at the gross flows, but also at the net flows. These net flows can be defined as the gross flow from state *a* to state *b* minus the gross flow from state b to state a. For the total net flows from N to E and

N to U, we repeat the analysis from Section 4.3.3. The results from this analysis can be found in Appendix 6.1.

The net flow from N to E is positively correlated with the business cycle, whereas for the net flow from N to U, this correlation is negative. These findings entail that the net flow from N to U drops during economic upswings and rises during downturns. The net flow from N to E moves in the opposite direction as it rises during economic upswings and drops during downturns.

The R-squared of the net flow regressions are lower than those of the gross flows. This is especially true for the net flow from N to U. Moreover, for this flow, the most correlated lags of the indicators diverge more. The lower R-squared and diverging lags are likely caused by the composition of the net flows; they consist of two gross flows that run in opposite directions. Especially the net flow from N to U is comprised of two very cyclical gross flows that partially cancel each other out in the net flow.

Because the gross flows partially cancel each other out, the net flows do not provide as much information on labour market dynamics as the gross flows do. Looking only at the net flows, it is not possible to see which of the underlying gross flows causes a change in the net flow. This makes looking at the gross flows more suitable for analyses where an understanding of the dynamics is important, such as for example in forecasting.

The net flows, however, also provide information that the gross flows cannot provide. While the gross flows give a better understanding of the dynamics, the net flows show us the net change between the labour market states. This is of course also very useful information.

Discussion

The previous comparison of the gross flows with the net flows shows that only analysing the net flows provides far less information about the dynamics of the labour market than the gross flows do. Analysing only the employment, unemployment and non-participation levels would provide even less information about underlying labour market dynamics. Because the gross flows provide more detailed information, they are a very useful tool for understanding these dynamics.

The use of gross flow data also has its drawbacks. The first of these is that it is not possible to make causal inference with these kinds of macro data. To be able to make causal inferences about the flows, micro data are needed. The second drawback is that the labour market flows cannot be fully aggregated to employment, unemployment and non-participation. This is not possible because, in reality, the system is not closed; individuals flow into the system when they turn 15 and flow out when they turn 75 or when they pass away. In our data, this distortion causes non-participation level to deviate from the results obtained by taking the level of non-participation of the previous period and adding and subtracting the relevant labour market flows. While this distortion is not especially large, it makes it impossible to directly link flows and levels. Because of this, the aggregate of the flow data only approximately corresponds to non-participation level.

4.4 Conclusions

In this chapter, we investigated the link between the business cycle and labour supply by analysing labour market data on levels and flows. The focus on labour market flows enabled us to analyse the dynamics behind the changes in labour supply and the differences in these dynamics between demographic groups. Our analysis shows that cyclical fluctuations have a bigger impact on the gross flows than on the net flows, because the gross flows partially cancel each other out when aggregated. Therefore, we conclude that analysing gross labour market flows provides more information on the labour market dynamics than what is possible with an analysis of the changes in the net labour market flows or levels. Consequently, using data on gross labour market flows may be useful for developing alternative models to check our central forecast.

In our analysis, we identified three labour market and consumption indicators that captured more of the dynamics in the flows than the two indicators that measure the business cycle directly (GDP growth and output gap). This is reflected by the higher R-squared in the regressions with the labour market indicators, which indicate that the dynamics in the flows are more directly connected to fluctuations in the labour market and consumers' willingness to buy than to GDP or the output gap. This result is in line with the theory of the added worker and discouraged worker effects, as well as with empirical findings of earlier studies.

Of the four flows to and from non-participation, three show clear cyclical movements. The flows between U and N are the most cyclical. These flows have the same development over the business cycle; they drop during economic upswings and rise during downturns. These results correspond with theory and previous research. During economic downturns, the rise of the flow from U to N signifies higher discouragement, while the rise from N to U is caused by a rise in unsuccessful attempts to enter the labour market, due to lower labour demand.

The flow from N to E moves cyclically as well, but slightly less so than those between N and U. The flow from N to E drops during economic downturns and rises during upswings. The cyclical changes in this flow are caused by successful labour market entries. The least cyclical flow is the one from E to N. The cyclicality of this flow is difficult to interpret. It shows a positive correlation with GDP growth, a negative correlation with the output gap, and no clear pattern in the correlation with the labour market indicators. The lack of a clear cyclical pattern in this flow is in line with the results found in previous research.

All flows are more cyclical for women than for men. This is probably due to the fact that men, on average, are attached more strongly to the labour market. The cyclicality decreases with educational level, which is probably due to the fact that higher educated individuals have a better position on the labour market. The pattern in labour market flows per age group is less clear. A recurring result is that the flows are less cyclical for the higher age group (45–75).

Separating the flows between N and U by reason for non-participation provided some interesting results, as well. Firstly, contrary to expectations based on previous literature, the

flow from U to N does not show higher cyclicality for young people returning to education or for older people retiring than for other groups. Secondly, the flows between U and N not only show considerable cyclicality for the groups that do not participate because they are discouraged from doing so, but also for groups that cite other reasons for non-participation, such as education or housekeeping. The implication of this finding is using survey data on non-participation while only looking at discouragement will lead to underestimation of the total change in the flows.

References

Bloemen, H. G., 2005, Job Search, Search Intensity, and Labor Market Transitions an Empirical Analysis, *Journal of Human resources*, 40.1, 232-269.

Bradbury, K., 2005, Additional slack in the economy: The poor recovery in labor force participation during this business cycle, *FRB of Boston Public Policy Brief*, 05-2.

Bredtmann, J., S. Otten, and C. Rulff, 2014, Husband's Unemployment and Wife's Labor Supply–The Added Worker Effect across Europe, *Ruhr Economic Paper*, 484.

Burda, M. and C. Wyplosz, 1994, Gross worker and job flows in Europe, *European Economic Review*, 38(6), 1287-1315.

Cahuc, P., S. Carcillo, A. Zylberberg, A. and W. McCuaig, 2014, *Labor Economics*, MIT press.

CBS, 2016, Banen en lonen; werknemers 15 tot 65 jaar, onderwijsniveau en baankenmerken. Retrieved from:
http://statline.cbs.nl/Statweb/selection/?DM=SLNL&PA=82049NED&VW=T

Council of Economic Advisers (2014), The Labor Force Participation Rate Since 2007: Causes and Policy Implications.

Dagsvik, J.K., T. Kornstad, and T. Skjerpen, 2013, Labor force participation and the discouraged worker effect, *Empirical Economics*, 45.1, 401-433.

Duval, R., M. Eris and D, Furceri, 2011, the effects of downturns on labour force participation: evidence and causes, *OECD Economics Department Working Papers*, 875.

Elsby, M. W., B. Hobijn and A. Şahin, 2015, On the importance of the participation margin for labor market fluctuations, *Journal of Monetary Economics*, 72, 64-82.

England, P, 2005, Gender inequality in labor markets: The role of motherhood and segregation, *Social Politics: International Studies in Gender, State & Society*, 12(2), 264-288.

Fujita, S., 2014, On the causes of declines in the labor force participation rate, *Research Rap Special Report*, Federal Reserve Bank of Philadelphia, 6.

Gomes, P, 2012, Labour market flows: facts from the United Kingdom, *Labour Economics*, 19(2), 165-175.

Harvey, A. C. and A, Jaeger, 1993, Detrending, stylized facts and the business cycle, *Journal of Applied Econometrics*, 8(3), 231-247.

Hotchkiss, J. L. and J. C. Robertson, 2006, Asymmetric labor force participation decisions over the business cycle: evidence from US microdata, *Working Paper, Federal Reserve Bank of Atlanta*, No. 2006-08.

Kesselring, R. and D. Bremmer, 2015, Discouraged vs. added workers: Variation by gender, age, and marital status, *The Social Science Journal*, 52(3), 374-385.

Krueger, A. B., J. Cramer and D. Cho, 2014, Are the long-term unemployed on the margins of the labor market?, *Brookings Papers on Economic Activity*, 2014(1), 229-299.

Krusell, P., T. Mukoyama, R. Rogerson and A. Şahin, 2012, Is Labor Supply Important for Business Cycles?, *Working Paper*, No. 17779, National Bureau of Economic Research.

Loon, E. v., B. Loog, A. van der Horst and M. Souren, 2014, De oploop van de werkloosheid ontleed, *TPE digitaal*, 8(1), 65-83.

Mattingly, M. J. and K. E. Smith,2010, Changes in Wives' Employment When HusbandsStop Working: A Recession-Prosperity Comparison, *Family Relations*, 59.4, 343-357.

Merens, A. and E. Josten, 2016, *Werkloos toezien?*, SCP, The Hague.

Mukoyama, T. and A. Şahin, 2006, Costs of business cycles for unskilled workers, *Journal of Monetary Economics*, 53.8, 2179-2193.

OECD, 2016,OECD Composite Leading Indicators: Reference Turning Points and Component Series", Retrieved from: http://www.oecd.org/std/leading-indicators/oecdcompositeleadingindicatorsreferenceturningpointsandcomponentseries.htm

Souren, M., 2016, Redenen om niet actief te zijn op de arbeidsmarkt, *Sociaaleconomische trends,* 2016-05.

Starr, M. A., 2014, Gender, added-worker effects, and the 2007–2009 recession: Looking within the household, *Review of Economics of the Household*, 12(2), 209-235.

Sutton, A, 2013, On the determinants of UK unemployment and the Great Recession: analysing the gross flows data, *Applied Economics,* 45.25, 3599-3616.

Triebe, D., 2015, The Added Worker Effect Differentiated by Gender and Partnership Status–Evidence from Involuntary Job Loss, *SOEPpapers on Multidisciplinary Panel Data Research*, 740.

Vendrik, M. and F. Cörvers, 2009, Male and female labour force participation: the role of dynamic adjustments to changes in labour demand, government policies and autonomous trends, *IZA Discussion Paper*, 4397.

5 Appendix: data used in Chapter 4

All data used in the analysis in Chapter 4 originate form Statistics Netherlands (CBS). The level and flow data are based on a labour force survey with a quarterly frequency (*Enquête Beroepsbevolking*). Based on that survey, CBS constructs national level and flow data. In our study, both the groups and the flows are seasonally adjusted using the X-13ARIMA-SEATS Seasonal Adjustment Program of the United States Census Bureau.

5.1 Employment, unemployment and non-participation levels

The data set on labour market levels spans from 2003 Q1 to 2016 Q1 and is available on CBS StatLine. In this data set, the following definitions are used:

- Employed: individuals between 15 and 75 years of age who are in paid employment.
- Unemployed: individuals between 15 and 75 years of age who are not employed but are available for work and have searched for work, recently.
- Not participating: individuals aged between 15 and 75 who are not employed, and are either not available for work and/or have not searched for work, recently.

These data can be divided, on the basis of gender, age and education, into the following sub-groups:

- Total of all individuals
- Men
- Women
- Highest completed education level; Low: primary education, preparatory secondary vocational education (VMBO), first three years of higher general secondary education (HAVO)/pre-university education (VWO) or intermediate secondary vocational education (MBO-1).
- Highest completed education level; Intermediate (medium): more than three years of HAVO/VWO, and MBO 2 to 4
- Highest completed education level; High: higher vocational education (HBO) or University.
- Age 15 to 25
- Age 25 to 45
- Age 45 to 75

5.2 Flows

The gross labour market flows between employment, unemployment and non-participation are also available on CBS StatLine. The used data set on the flows spans the period from 2003 Q2 to 2016 Q1. These flows are divided in the same way as the groups.

The data set used for the analysis of the flows for sub-groups based on reasons for non-participation is also provided by CBS, but not available on StatLine. This data set spans the period from 2003 Q3 to 2016 Q1.
In this data set, the following reasons for non-participation are distinguished:

	Main groups	Sub-groups
1	Available, did not search	
1a	↳	Discouraged
1b	↳	Other reasons
2	Did search, was not available	
3	Did not search, was not available	
3a	↳	Willing to work
3b	↳	Not willing or not able to work
3bi		↳Not available because of family care or housekeeping
3bii		↳Not available because of education/study
3biii		↳Not available because of retirement/high age
3biv		↳Not available because of illness/disability
3bv		↳Not available for other reasons

5.3 Indicators

The source of the indicators is also CBS StatLine. The data set on the indicators is also quarterly and spans the period from 2001 Q1 to 2016 Q1 (except for output gap). The definition of the indicators is as follows:

GDP growth: seasonally corrected volume mutation in real GDP relative to the previous period

Output gap: the output gap is based on an index of real, seasonally corrected GDP, ranging from 1996 Q1 to 2016 Q1 and with 1996Q1 as the base quarter. Potential GDP is approximated by HP-filtering this index with smoothing parameter λ=1600. The output gap is then defined as *(index - hp filtered index)/hp filtered index*. The index covers the period from 1996Q1 to 2016Q1, because this longer time period results in a more accurately filtered series.

Bankruptcies: number of companies and institutions that are declared bankrupt in a given quarter. Seasonally adjusted, using the US X-13ARIMA-SEATS Seasonal Adjustment Program.

Willingness to buy: consumers' willingness to buy is defined as an index based on three questions about a household's current financial situation, future financial situation and future purchases of durable goods. The index is the average of the balance of positive and negative answers (as a percentage of the total answers) on each of the three questions. For this study, the index is seasonally adjusted, using the US X-13ARIMA-SEATS Seasonal Adjustment Program.

Vacancies: number of outstanding vacancies in a given quarter, seasonally adjusted.

6 Appendix: regression outputs

6.1 Regressions on net flows with labour market indicators

Table 6.1 Correlation of net flows with optimal lag of the indicators. Optimal lag in parentheses.

Cross-corr. table	Net NU	Net NE
Vacancies	-0.45 (10)	0.68 (1)
Willingness to buy	-0.25 (0)	0.36 (3)
Bankruptcies	0.56 (10)	-0.64 (2)

Table 6.2 Regression output for net N to U flow

Net N to U flow	Total
Vacancies (10)	-0.002
Willingness to buy (0)	-0.444***
Bankruptcies (10)	0.017**
Adj. R2	0.31

*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

Table 6.3 Regression output for net N to E flow

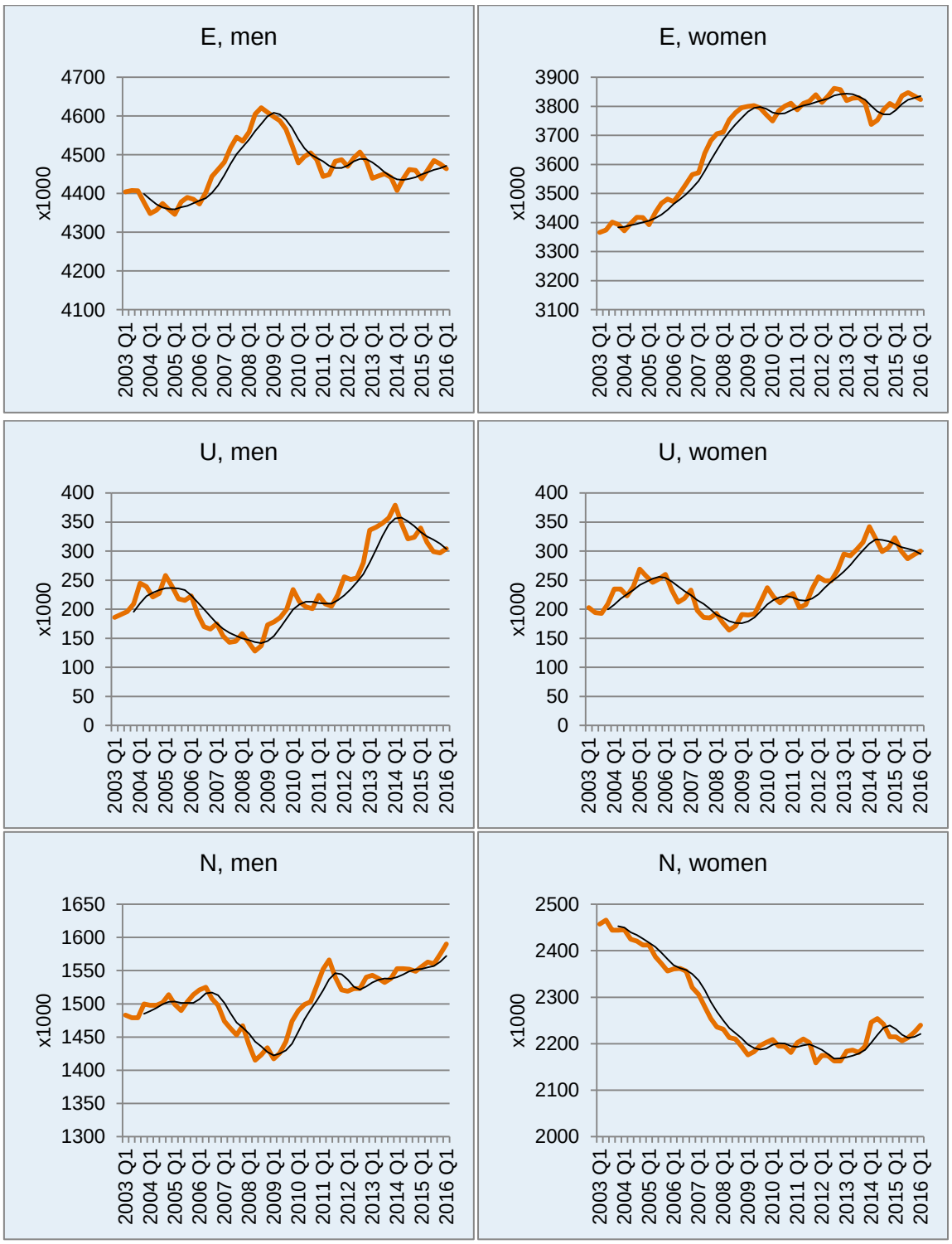
Net N to E flow	Total
Vacancies (1)	0.249***
Willingness to buy (3)	-0.202
Bankruptcies (2)	-0.012
Adj. R2	0.46

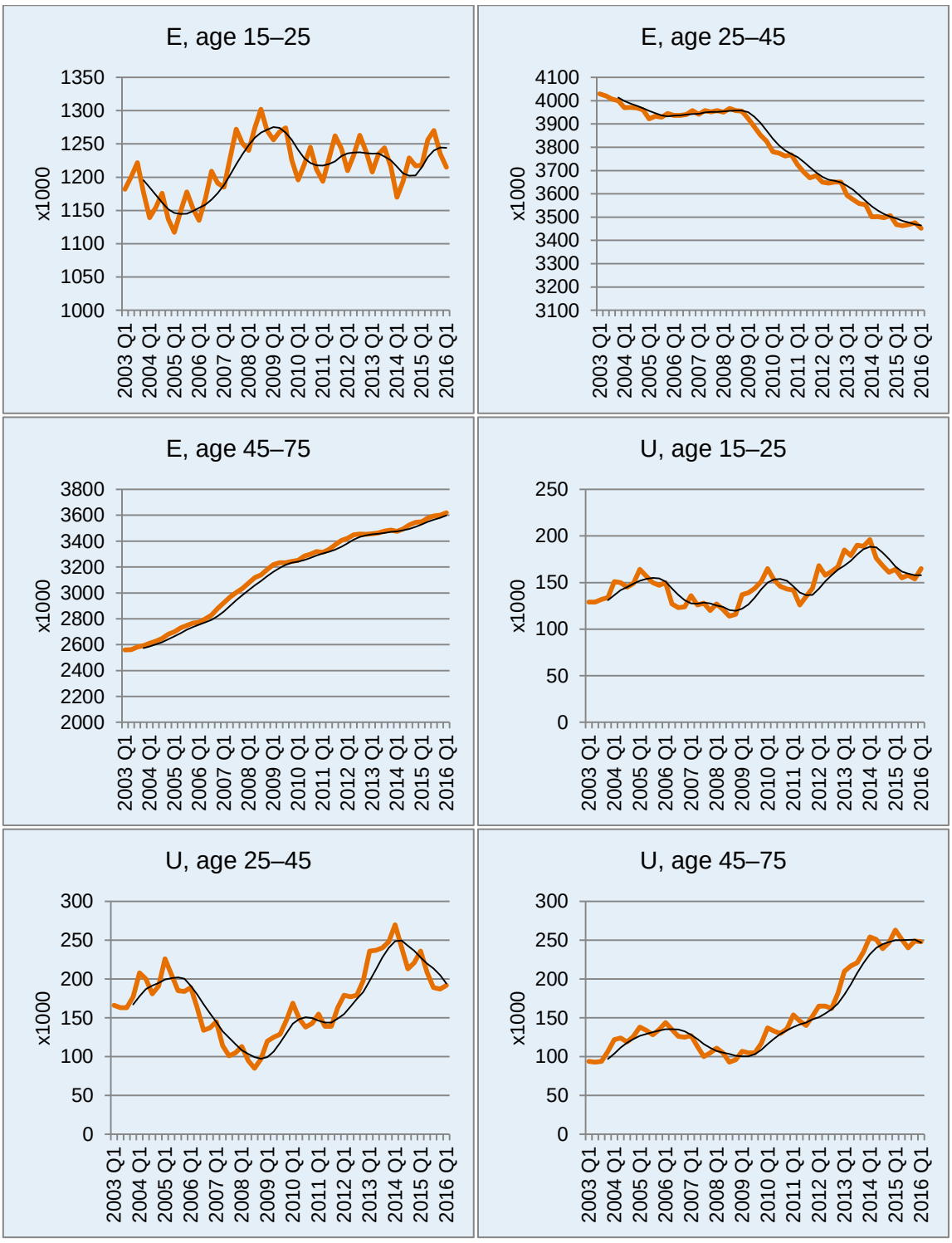
*, ** and *** indicate the significance of the estimate at a 10%, 5% or 1% level. The lag (in quarters) used is shown in parentheses.

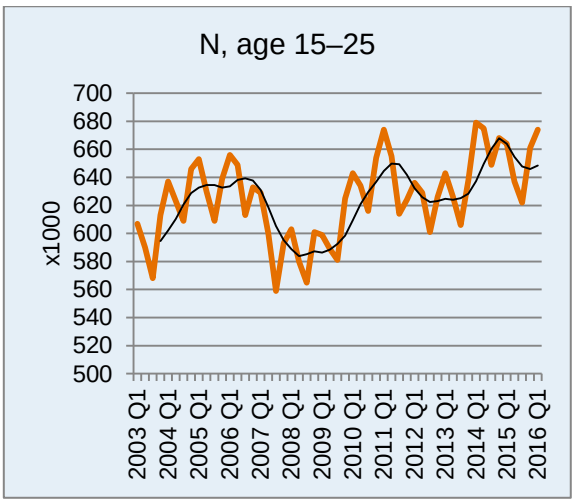
7 Appendix: graphs

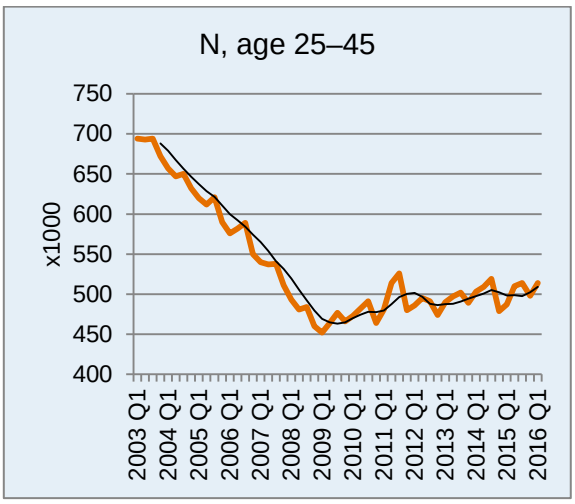
7.1 Data on employment, unemployment and non-participation levels

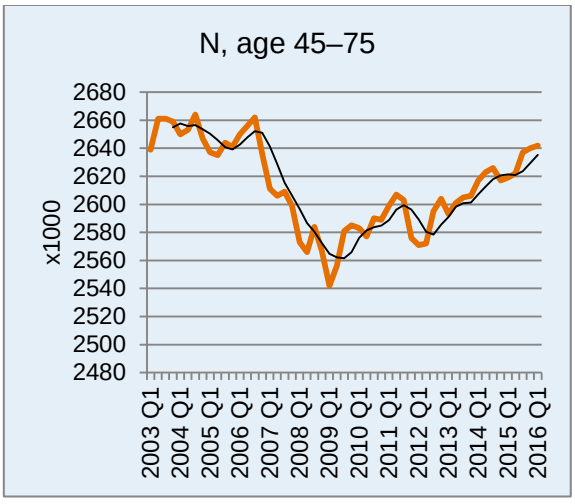
Figure 7.1 **Employment, unemployment and non-participation, by group. Including a four-period moving average.**

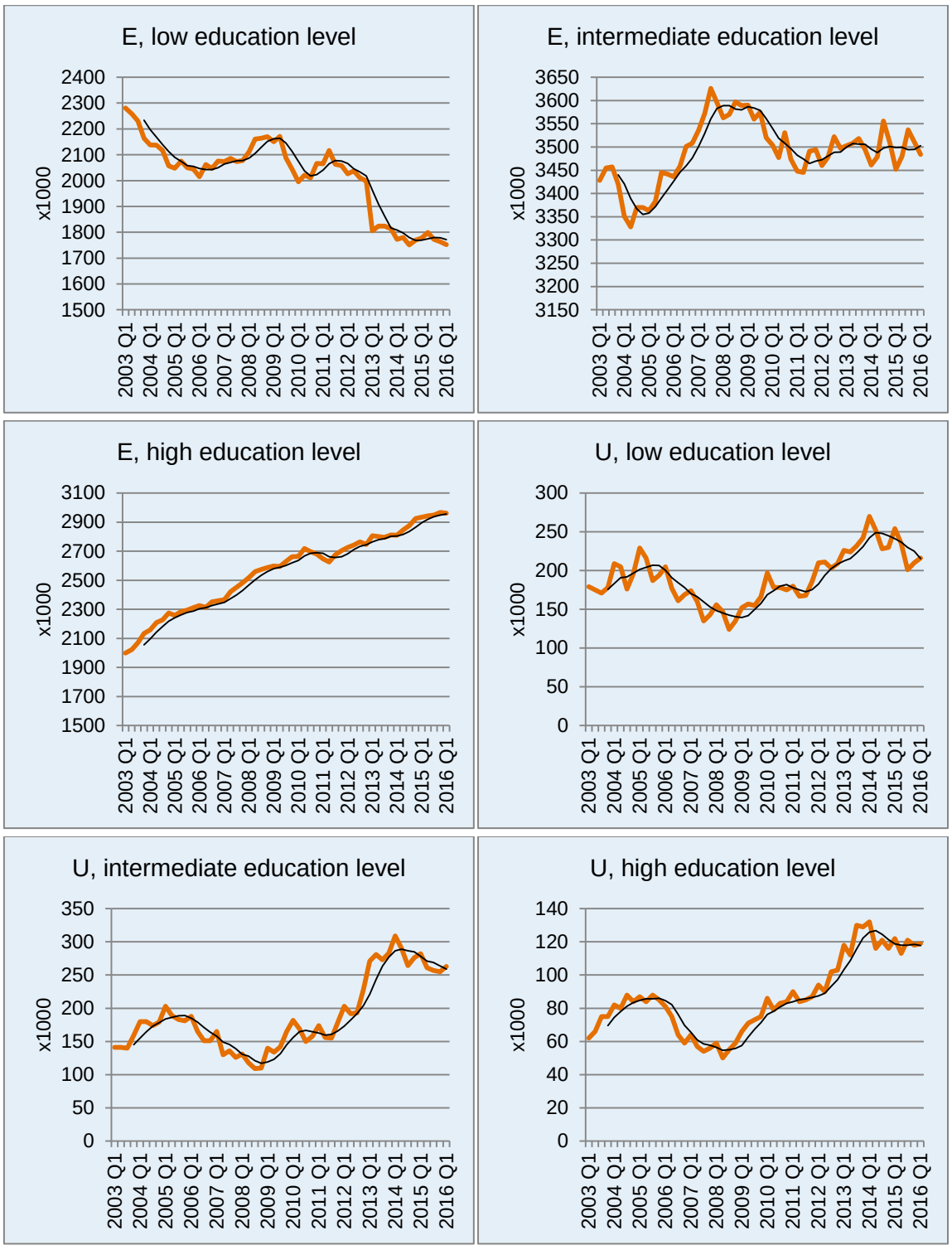

E, men
x1000
4700
4600
4500
4400
4300
4200
4100
E, women
3900
3800
3700
3600
3500
3400
3300
3200
3100
U, men
400
350
300
250
200
150
100
50
0
U, women
N, men
1650
1600
1550
1500
1450
1400
1350
1300
N, women
2500
2400
2300
2200
2100
2000
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1

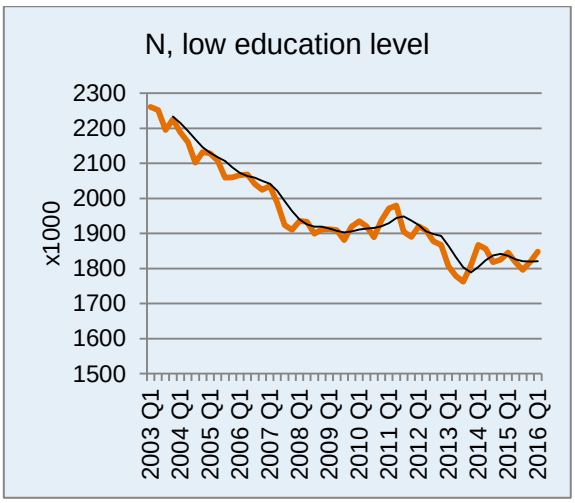

E, age 15–25
x1000
1350
1300
1250
1200
1150
1100
1050
1000
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
E, age 25–45
x1000
4100
4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
E, age 45–75
x1000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
U, age 15–25
x1000
250
200
150
100
50
0
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
U, age 25–45
x1000
300
250
200
150
100
50
0
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
U, age 45–75
x1000
300
250
200
150
100
50
0
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1

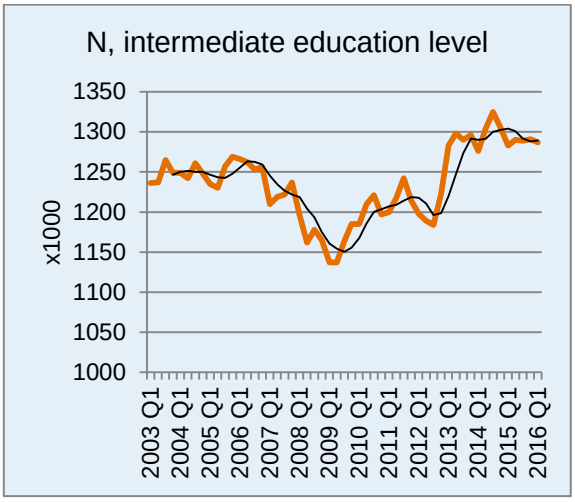

N, age 15–25
x1000
700
680
660
640
620
600
580
560
540
520
500
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1

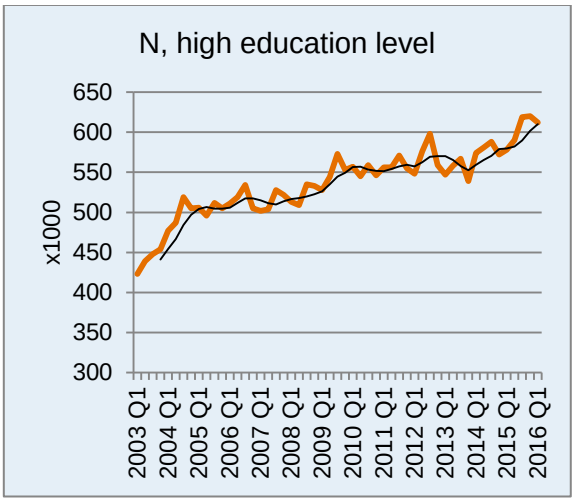

N, age 25–45
x1000
750
700
650
600
550
500
450
400
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1


N, age 45–75
x1000
2680
2660
2640
2620
2600
2580
2560
2540
2520
2500
2480
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1


E, low education level
x1000
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
E, intermediate education level
x1000
3650
3600
3550
3500
3450
3400
3350
3300
3250
3200
3150
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
E, high education level
x1000
3100
2900
2700
2500
2300
2100
1900
1700
1500
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
U, low education level
x1000
300
250
200
150
100
50
0
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
U, intermediate education level
x1000
350
300
250
200
150
100
50
0
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
U, high education level
x1000
140
120
100
80
60
40
20
0
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1

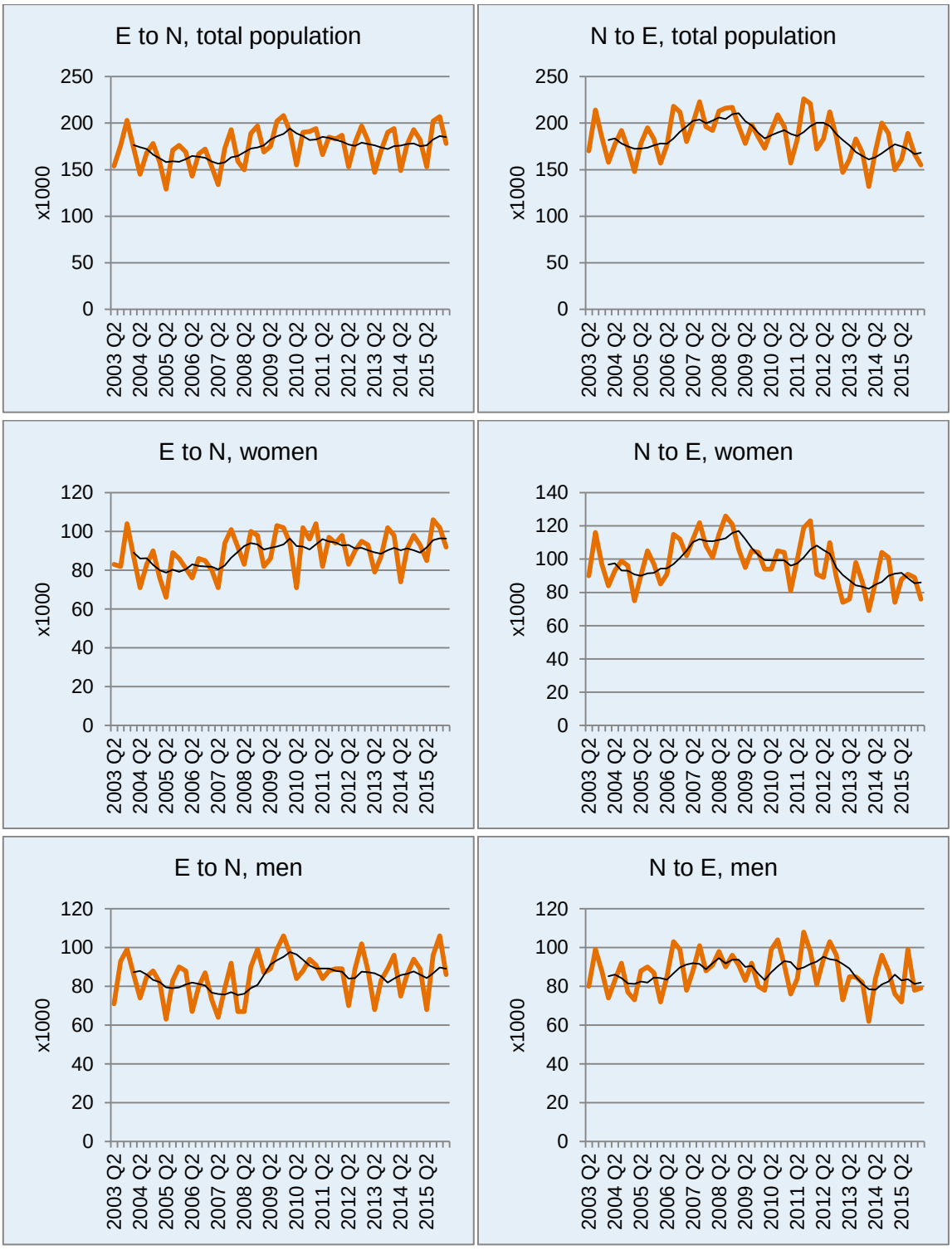

N, low education level
x1000
2300
2200
2100
2000
1900
1800
1700
1600
1500
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1


N, intermediate education level
x1000
1350
1300
1250
1200
1150
1100
1050
1000
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1


N, high education level
x1000
650
600
550
500
450
400
350
300
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1

7.2 Flows by group

Figure 7.2 **Flow charts for the total population, men and women. Including a four-period moving average.**



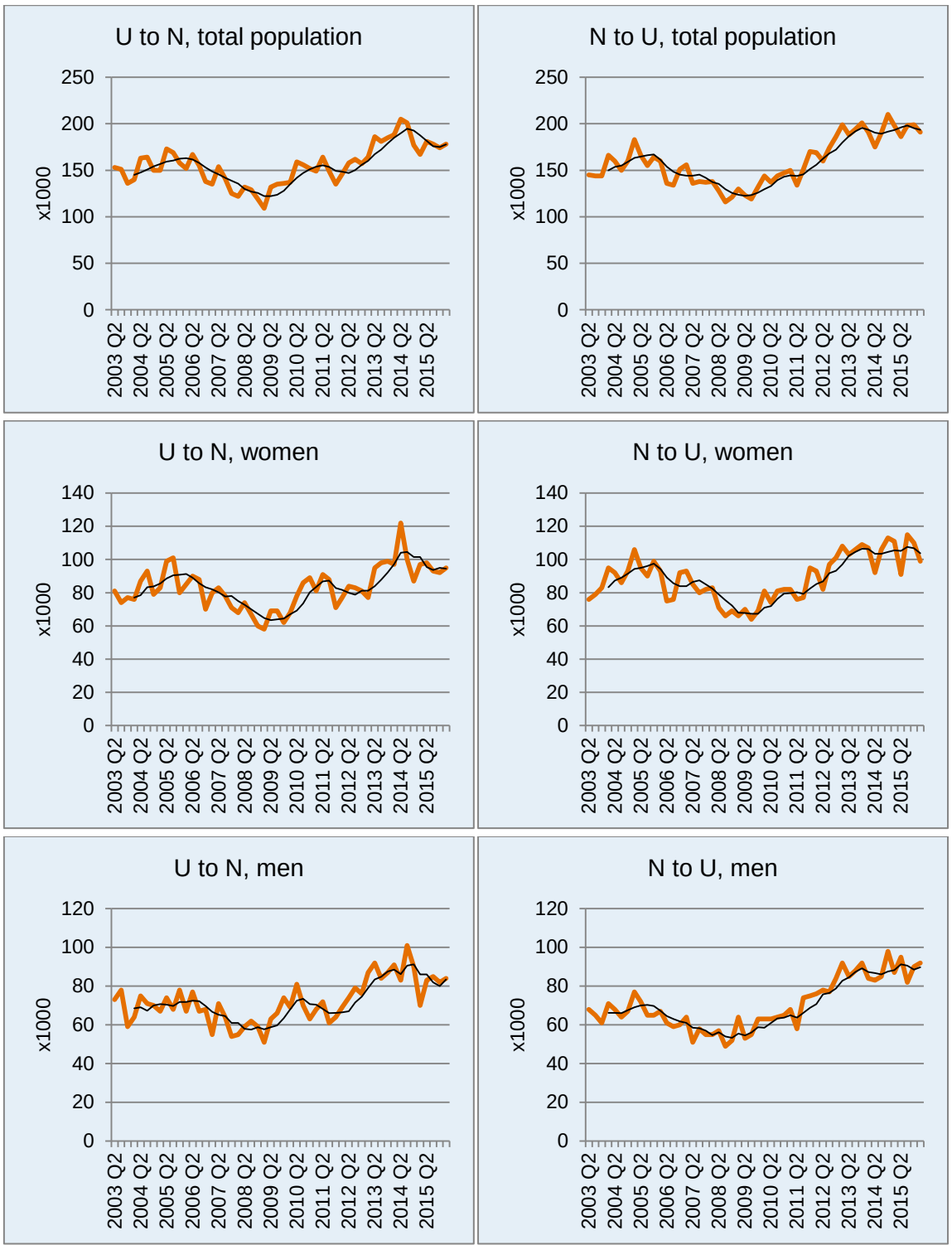
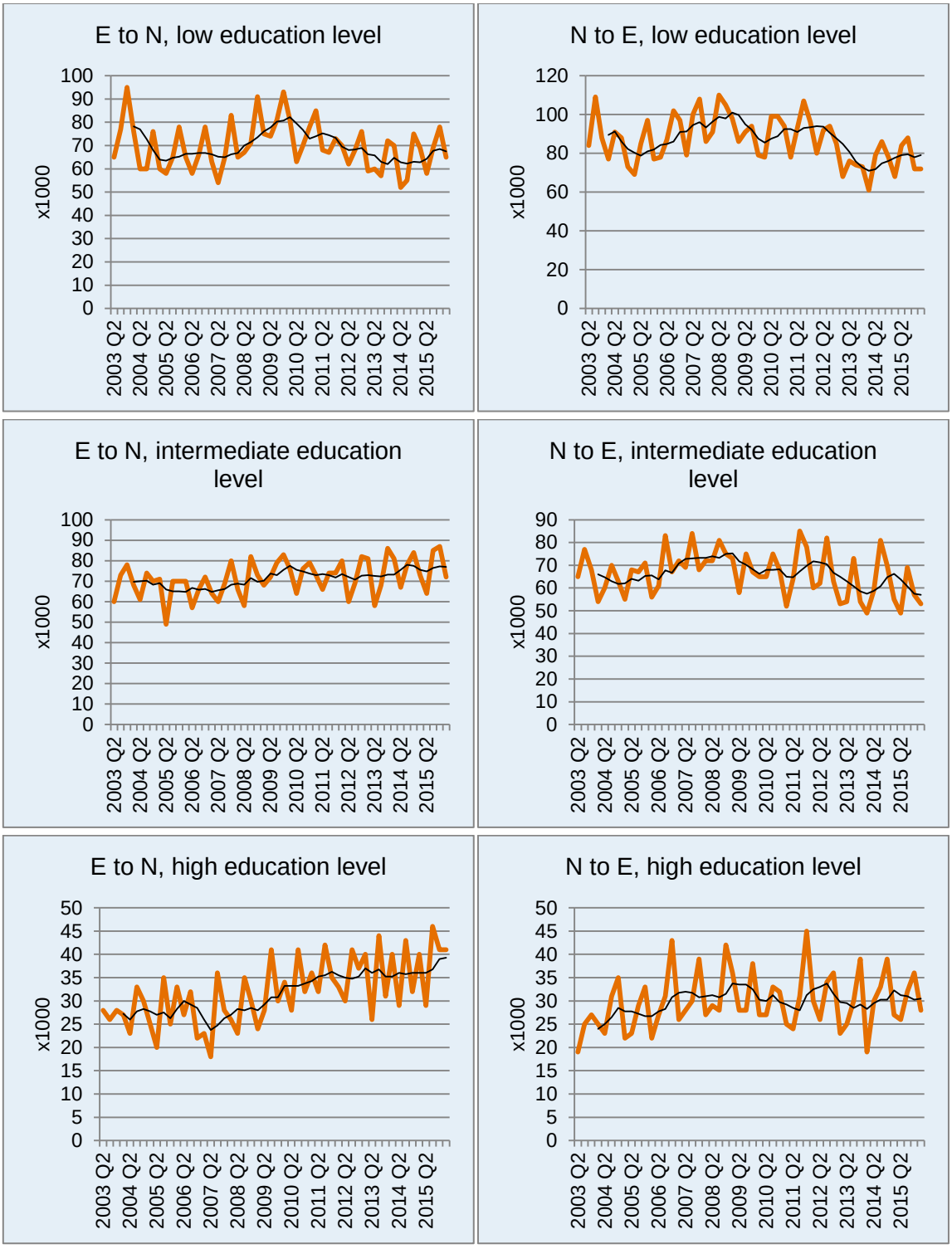
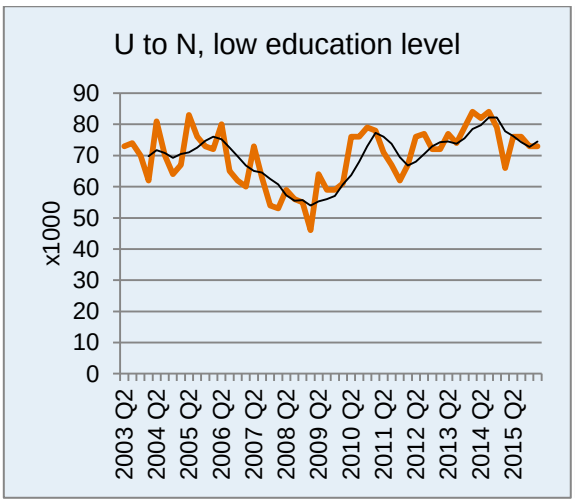
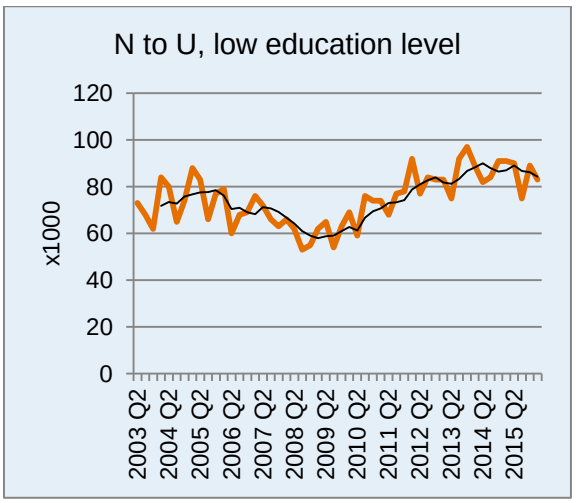
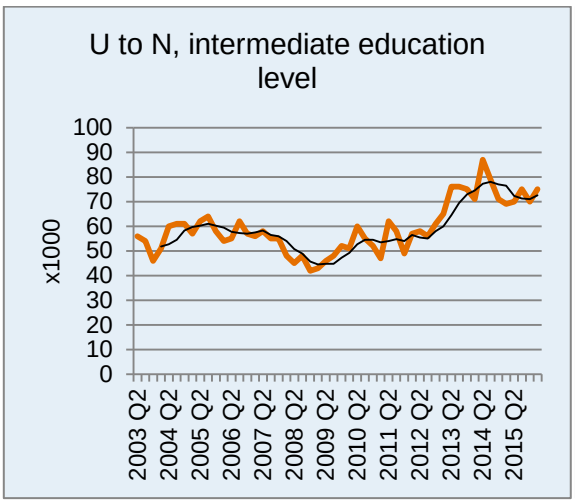

U to N, total population
N to U, total population
U to N, women
N to U, women
U to N, men
N to U, men
x1000
250
200
150
100
50
0
140
120
100
80
60
40
20
2003 Q2
2004 Q2
2005 Q2
2006 Q2
2007 Q2
2008 Q2
2009 Q2
2010 Q2
2011 Q2
2012 Q2
2013 Q2
2014 Q2
2015 Q2

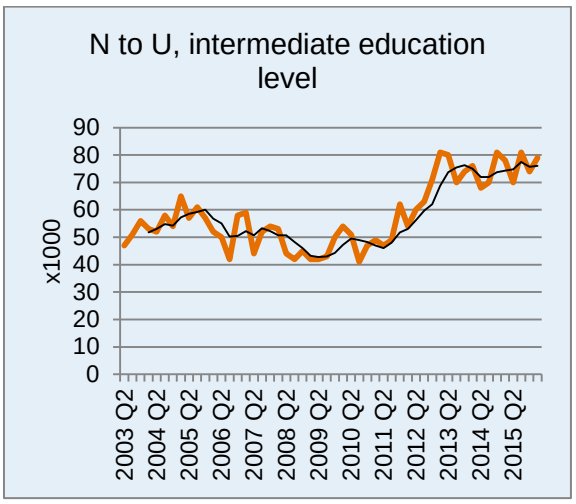
Figure 7.3 Flow charts, by education level. Including a four-period moving average.

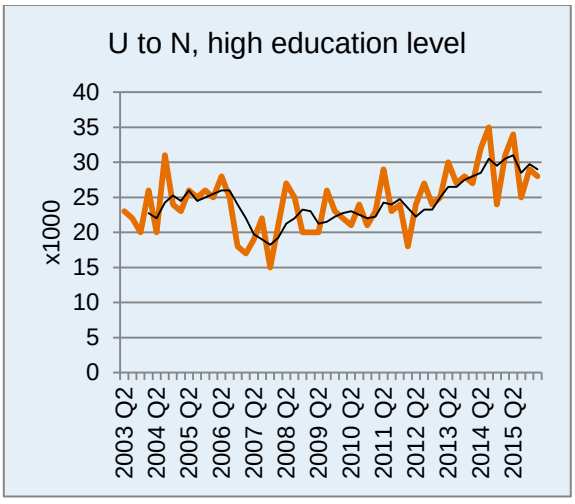



U to N, low education level
x1000
90
80
70
60
50
40
30
20
10
0
2003 Q2
2004 Q2
2005 Q2
2006 Q2
2007 Q2
2008 Q2
2009 Q2
2010 Q2
2011 Q2
2012 Q2
2013 Q2
2014 Q2
2015 Q2


N to U, low education level
x1000
120
100
80
60
40
20
0
2003 Q2
2004 Q2
2005 Q2
2006 Q2
2007 Q2
2008 Q2
2009 Q2
2010 Q2
2011 Q2
2012 Q2
2013 Q2
2014 Q2
2015 Q2


U to N, intermediate education level
x1000
100
90
80
70
60
50
40
30
20
10
0
2003 Q2
2004 Q2
2005 Q2
2006 Q2
2007 Q2
2008 Q2
2009 Q2
2010 Q2
2011 Q2
2012 Q2
2013 Q2
2014 Q2
2015 Q2


N to U, intermediate education level
x1000
90
80
70
60
50
40
30
20
10
0
2003 Q2
2004 Q2
2005 Q2
2006 Q2
2007 Q2
2008 Q2
2009 Q2
2010 Q2
2011 Q2
2012 Q2
2013 Q2
2014 Q2
2015 Q2


U to N, high education level
x1000
40
35
30
25
20
15
10
5
0
2003 Q2
2004 Q2
2005 Q2
2006 Q2
2007 Q2
2008 Q2
2009 Q2
2010 Q2
2011 Q2
2012 Q2
2013 Q2
2014 Q2
2015 Q2

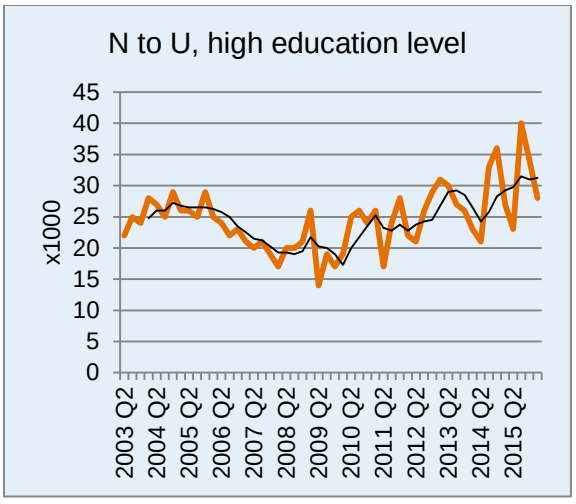
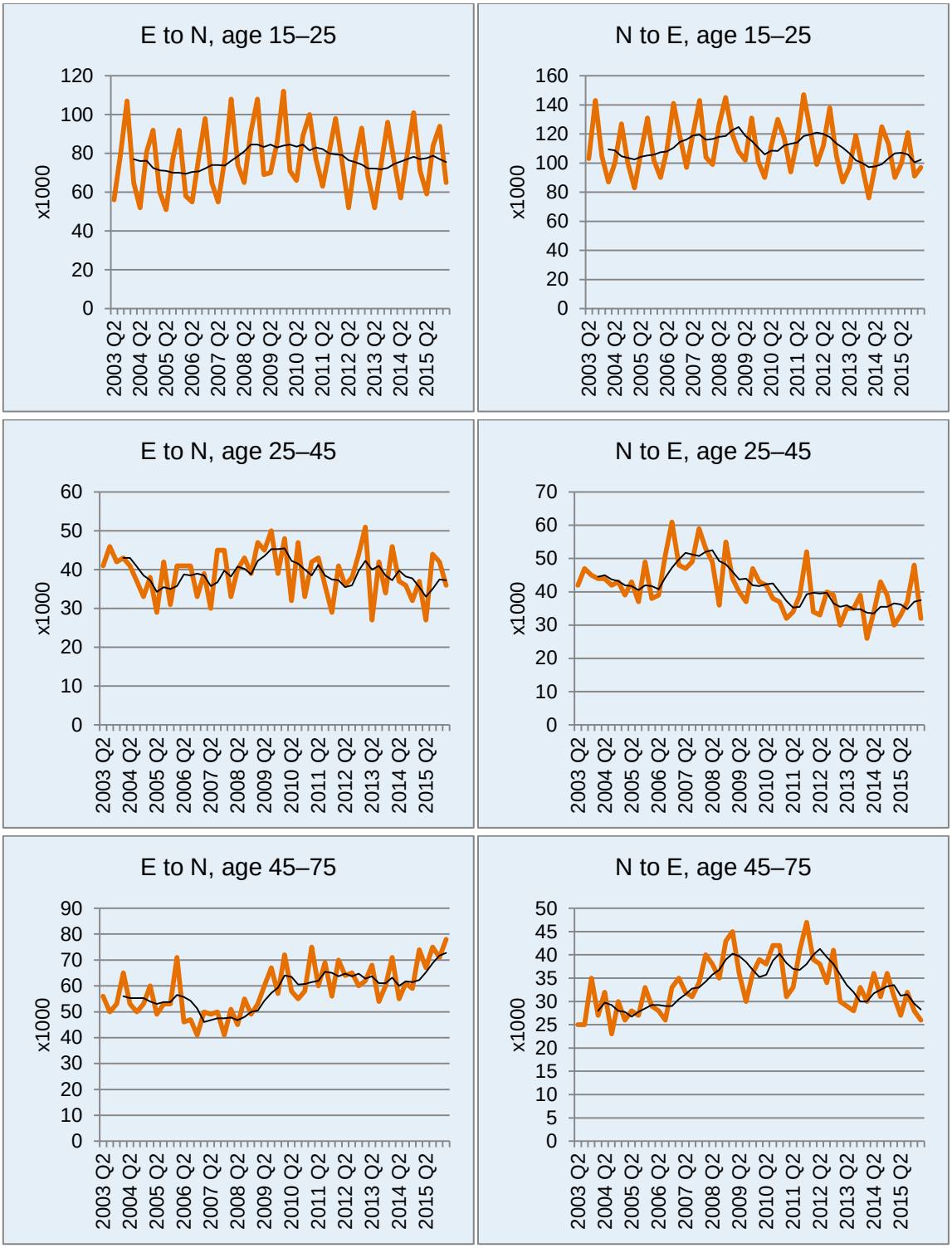
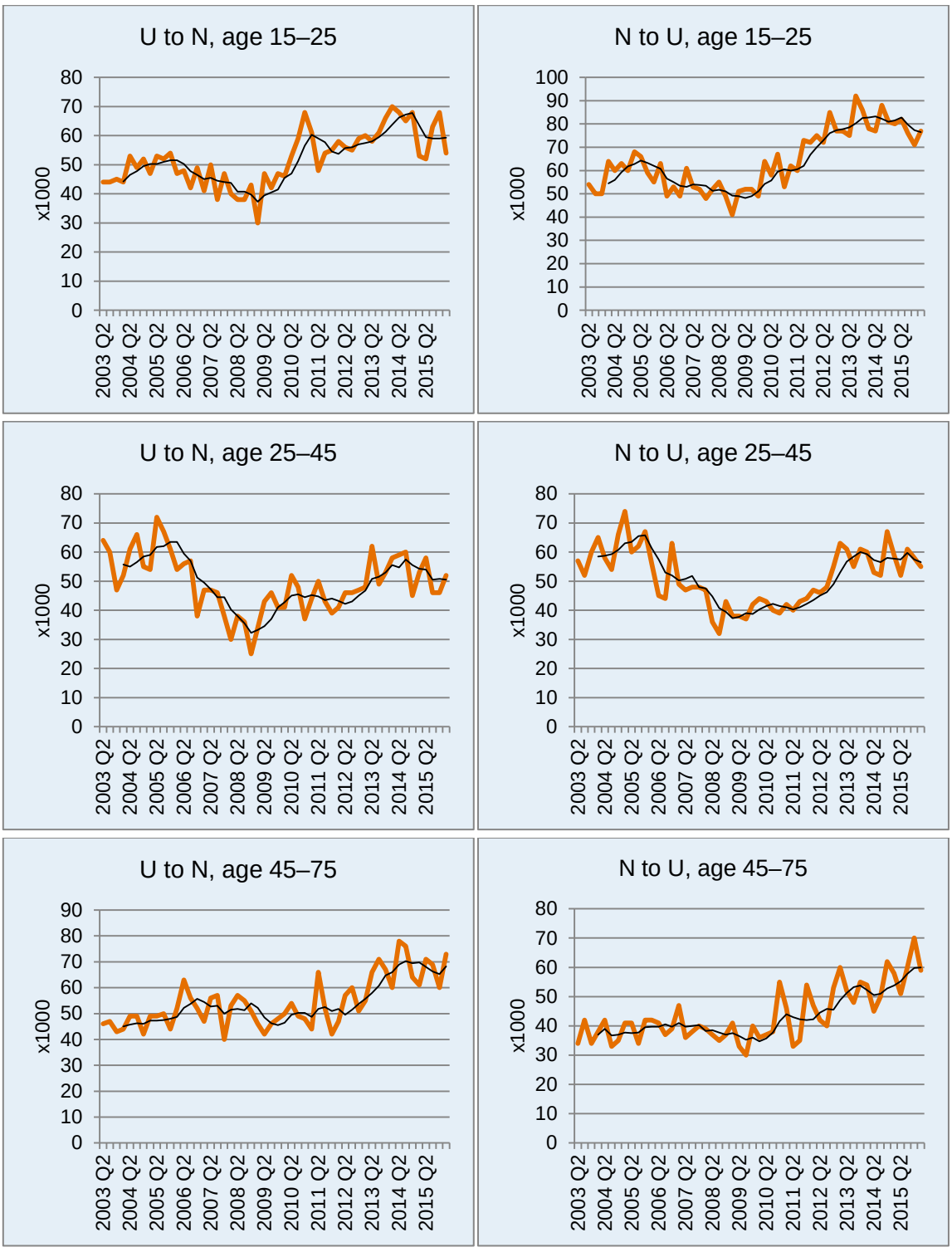

N to U, high education level
x1000
45
40
35
30
25
20
15
10
5
0
2003 Q2
2004 Q2
2005 Q2
2006 Q2
2007 Q2
2008 Q2
2009 Q2
2010 Q2
2011 Q2
2012 Q2
2013 Q2
2014 Q2
2015 Q2

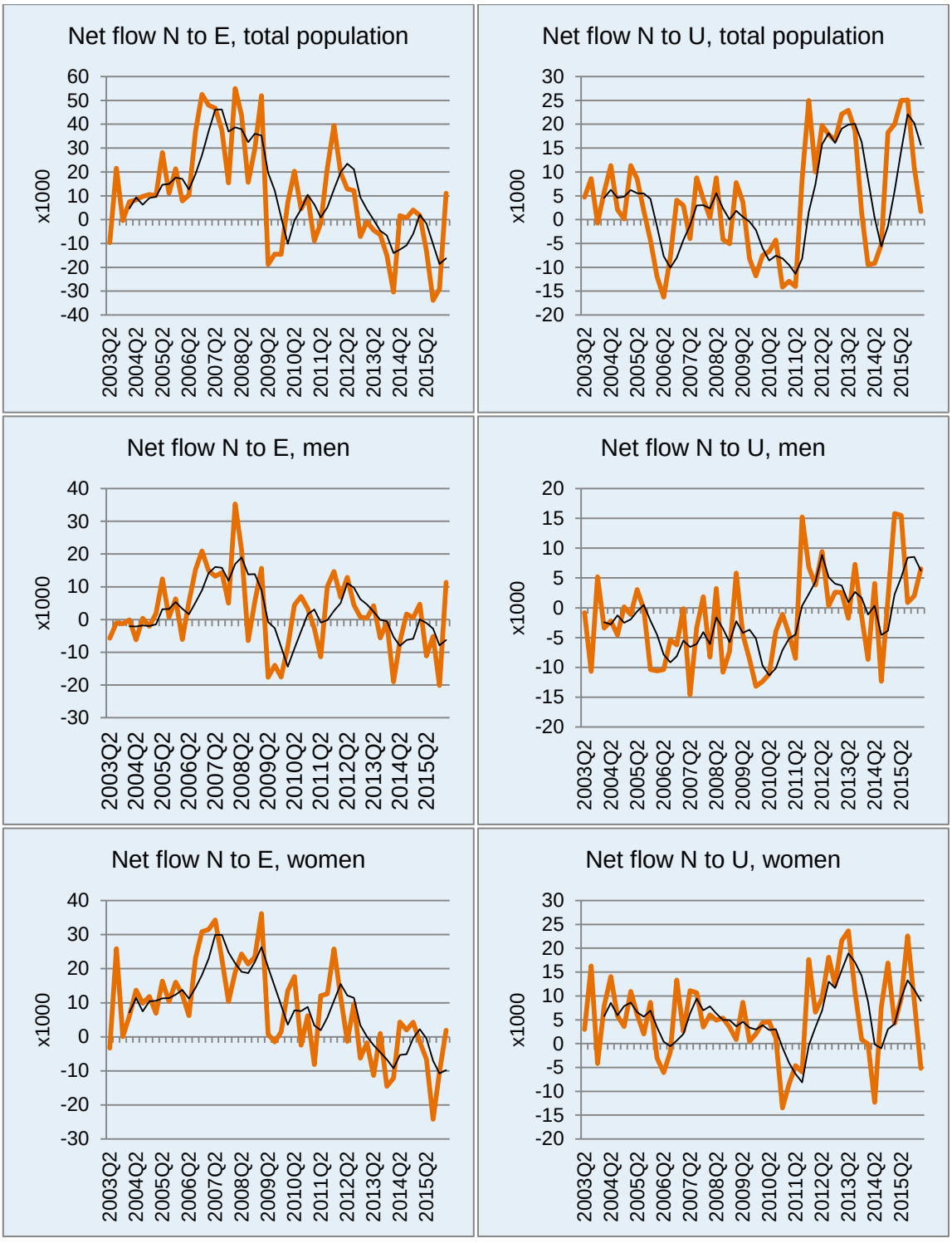
Figure 7.4 Flow charts, by age group. Including a four-period moving average.

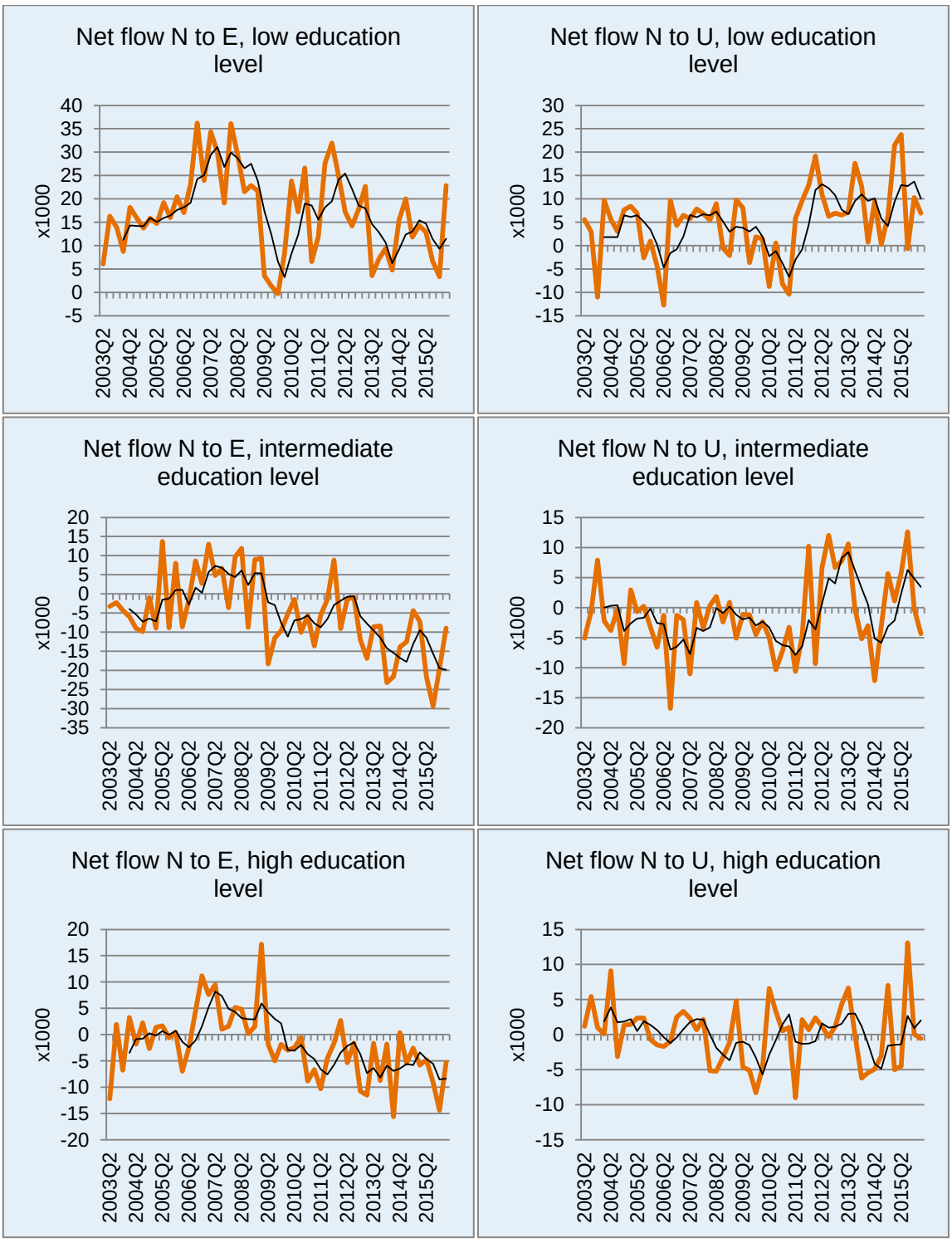


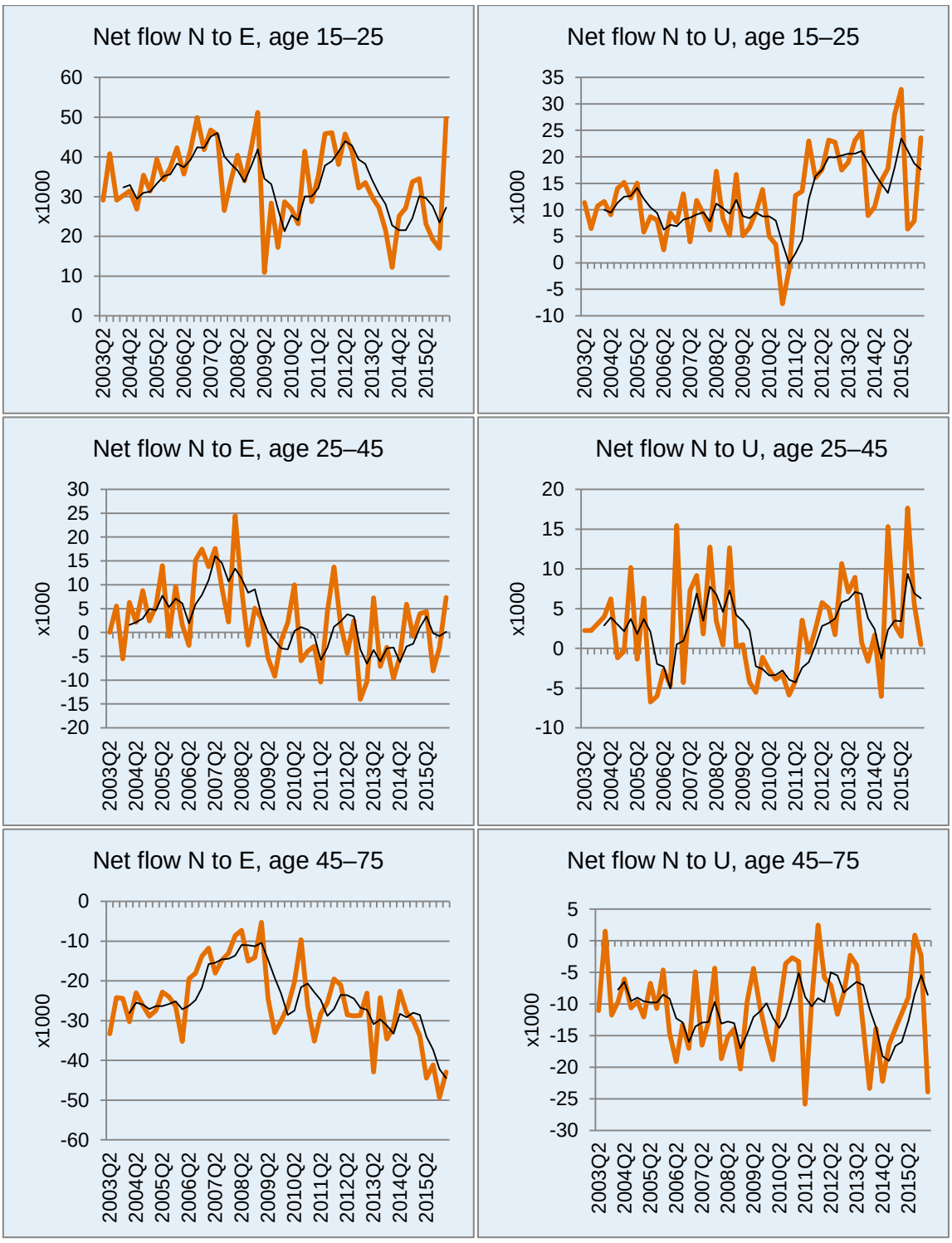

U to N, age 15–25
N to U, age 15–25
U to N, age 25–45
N to U, age 25–45
U to N, age 45–75
N to U, age 45–75
x1000
2003 Q2
2004 Q2
2005 Q2
2006 Q2
2007 Q2
2008 Q2
2009 Q2
2010 Q2
2011 Q2
2012 Q2
2013 Q2
2014 Q2
2015 Q2

7.3 Appendix: net flow graphs

Figure 7.5 **Net flow charts for the total population, men, women, three age groups and three education levels. Including a four-period moving average.**




Net flow N to E, low education level
x1000
40 35 30 25 20 15 10 5 0 -5
2003Q2 2004Q2 2005Q2 2006Q2 2007Q2 2008Q2 2009Q2 2010Q2 2011Q2 2012Q2 2013Q2 2014Q2 2015Q2
Net flow N to U, low education level
x1000
30 25 20 15 10 5 0 -5 -10 -15
2003Q2 2004Q2 2005Q2 2006Q2 2007Q2 2008Q2 2009Q2 2010Q2 2011Q2 2012Q2 2013Q2 2014Q2 2015Q2
Net flow N to E, intermediate education level
x1000
20 15 10 5 0 -5 -10 -15 -20 -25 -30 -35
2003Q2 2004Q2 2005Q2 2006Q2 2007Q2 2008Q2 2009Q2 2010Q2 2011Q2 2012Q2 2013Q2 2014Q2 2015Q2
Net flow N to U, intermediate education level
x1000
15 10 5 0 -5 -10 -15 -20
2003Q2 2004Q2 2005Q2 2006Q2 2007Q2 2008Q2 2009Q2 2010Q2 2011Q2 2012Q2 2013Q2 2014Q2 2015Q2
Net flow N to E, high education level
x1000
20 15 10 5 0 -5 -10 -15 -20
2003Q2 2004Q2 2005Q2 2006Q2 2007Q2 2008Q2 2009Q2 2010Q2 2011Q2 2012Q2 2013Q2 2014Q2 2015Q2
Net flow N to U, high education level
x1000
15 10 5 0 -5 -10 -15
2003Q2 2004Q2 2005Q2 2006Q2 2007Q2 2008Q2 2009Q2 2010Q2 2011Q2 2012Q2 2013Q2 2014Q2 2015Q2


Net flow N to E, age 15–25
x1000
60
50
40
30
20
10
0
2003Q2
2004Q2
2005Q2
2006Q2
2007Q2
2008Q2
2009Q2
2010Q2
2011Q2
2012Q2
2013Q2
2014Q2
2015Q2
Net flow N to U, age 15–25
x1000
35
30
25
20
15
10
5
0
-5
-10
2003Q2
2004Q2
2005Q2
2006Q2
2007Q2
2008Q2
2009Q2
2010Q2
2011Q2
2012Q2
2013Q2
2014Q2
2015Q2
Net flow N to E, age 25–45
x1000
30
25
20
15
10
5
0
-5
-10
-15
-20
2003Q2
2004Q2
2005Q2
2006Q2
2007Q2
2008Q2
2009Q2
2010Q2
2011Q2
2012Q2
2013Q2
2014Q2
2015Q2
Net flow N to U, age 25–45
x1000
20
15
10
5
0
-5
-10
2003Q2
2004Q2
2005Q2
2006Q2
2007Q2
2008Q2
2009Q2
2010Q2
2011Q2
2012Q2
2013Q2
2014Q2
2015Q2
Net flow N to E, age 45–75
x1000
0
-10
-20
-30
-40
-50
-60
2003Q2
2004Q2
2005Q2
2006Q2
2007Q2
2008Q2
2009Q2
2010Q2
2011Q2
2012Q2
2013Q2
2014Q2
2015Q2
Net flow N to U, age 45–75
x1000
5
0
-5
-10
-15
-20
-25
-30
2003Q2
2004Q2
2005Q2
2006Q2
2007Q2
2008Q2
2009Q2
2010Q2
2011Q2
2012Q2
2013Q2
2014Q2
2015Q2

CPB Netherlands Bureau for Economic Policy Analysis

CPB Background Document | March 2017

Labour supply and the business cycle:

Lessons from labour market flows and international forecasting practices

Annette Zeilstra
Karel Boxhoorn