European Institute for Gender Equality

Economic Benefits of Gender Equality in the European Union

Report on the empirical application of the model

Acknowledgments

The present report is part of the work of the European Institute for Gender Equality (EIGE) on the economic benefits of gender equality in the European Union (EU). The study was commissioned by EIGE and carried out by ICF, Cambridge Econometrics and Collegio Carlo Alberto. The project was managed by the gender mainstreaming team of EIGE: Helena Morais Maceira and Barbara Limanowska with the support of Dimitrios Tsoutsias.

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More about the study: http://eige.europa.eu

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Foreword

Gender equality is one of the founding pillars of the European Union and much progress has been made over the years to improve the everyday lives of women and men, especially with the creation of more equal opportunities. EIGE's Gender Equality Index demonstrates a positive trend of development in the domain of employment, reflecting the EU's focus on economic and labour market policy. However, large gender gaps persist when comparing educational attainment, pay and income, labour market activity rates and the provision of unpaid work and distribution of time between women and men.

Lower wages and employment prospects for women also increase their risk of poverty or social exclusion, especially later in life when they are dependent on a pension that relies on previous earnings. When it comes to education, women are largely missing from STEM (Science, Technology, Engineering and Mathematics) fields, which have promising job prospects at present and in the future. In short, women's talents are not being used to the full, which is putting a strain on individuals, employers and the society at large.

The European Institute for Gender Equality has produced sound evidence that confirms improvements to gender equality will generate economic growth for the EU and benefit individuals and society at large. We looked at the economic impacts of reducing gender inequalities in STEM education, labour market activity and pay. We also considered the demographic changes when these gender gaps are reduced and a more equal distribution of unpaid care work is achieved.

Our findings prove that more gender equality boosts economic growth. The evidence confirms that improvements to gender equality would generate more jobs for the EU – up to 10.5 million additional jobs by 2050. Gross Domestic Product (GDP) per capita would also be positively affected and could increase up to nearly 10% by 2050. Another important finding shows that addressing different gender inequalities together is likely to generate more positive impacts, rather than tackling them one by one in isolation.

From a methodological point of view, this study is unique in the EU context. It is the first of its kind to use a robust econometric model (E3ME macroeconomic model) to estimate the macroeconomic benefits of gender equality in a broad range of policy areas.

The study shows that promoting gender equality and mainstreaming the different perspectives of women and men into the policy areas of education, labour market participation and pay, among others is essential not only for reasons of social justice and fairness but it is also essential for smart, sustainable and inclusive growth. Structural changes are necessary to avoid permanent losses in wealth and sluggish growth rates and to put the European economy back on an upward sustainable growth path.

On behalf of the Institute and its team, I would like to thank all the experts, researchers and my colleagues at EIGE who contributed to this publication.

Virginija Langbakk
Director
The European Institute for Gender Equality (EIGE)

Contents

1. Introduction

The European Institute for Gender Equality (EIGE) commissioned ICF, Cambridge Econometrics and Collegio Carlo Alberto to deliver a study on the socio-economic impacts of gender equality improvements on the macroeconomic performance of the EU.

The aim of this study was to assess the wider socio-economic impacts of narrowing gender gaps as a result of the implementation of measures to improve gender equality in Europe. The study focuses on three potential future gender equality improvements:

- More women graduating with degrees in science, technology, engineering and mathematic (STEM graduates);
- More women actively participating in the labour market; and
- Reduced gender pay gaps.

A common theme throughout the three pathways[1] is a shift to a more equal distribution of unpaid care work, which is a necessary precondition for the realisation of gender equality and is likely to lead to an increase in fertility rates[2]. As changes in fertility rates have important macroeconomic consequences, they were also include in the modelling.

This study is unique in the EU context, because it uses a robust econometric model to estimate socio-economic outcomes of improving gender equality in several broad areas including education, labour market participation, wages and work-life balance. There is no previous study that has attempted macro-econometric modelling of such a broad range of improvements to gender equality in the EU.

The outputs of the study include nine (9) publications:

1. Literature review: existing evidence on the social and economic benefits of gender equality and methodological approaches
2. EU and EU Member States overviews
3. **Report on the empirical application of the model**
4. How the evidence was produced: briefing paper on the theoretical framework and model
5. How the evidence was produced: factsheet on the theoretical framework and model
6. Economic impacts of gender equality in the EU policy context: briefing paper
7. Economic impacts of gender equality: briefing paper
8. How gender equality in STEM education leads to economic growth: briefing paper
9. How closing the gender labour market activity and pay gap leads to economic growth: briefing paper

This report summarises the methodological approach, outlines key assumptions that were applied and explains the socio-economic modelling results.

The remainder of this report is divided into five chapters:

- Chapter 2 describes the research that informed our modelling approach;
- Chapter 3 describes the modelling approach, including model interlinkages in the E3ME macroeconomic model, key modelling assumptions and information about the baseline scenario;
- Chapter 4 outlines the gender equality pathways that were modelled;
- Chapter 5 presents and explains the socio-economic modelling results for the gender equality pathways; and
- Chapter 6 summarises the key conclusions that can be drawn from the analysis.

1 The term 'pathway' refers to a certain gender inequality, for which at least a theoretical link to macroeconomic performance has been established in literature. The term 'outcome' refers to potential consequences of gender equality (i.e. change in fertility) that can affect the performance of the economy.

2 For references, see *Annex 4 Methodological report on testing the model* and also publication *Literature review: existing evidence on the social and economic benefits of gender equality and methodological approaches, EIGE, 2017* which includes a review of studies that analyse the economic benefits of gender equality in different policy areas.

2.
Research to inform the modelling approach

The modelling approach used in this study was informed by a broad range of research activities that preceded the modelling itself.

Firstly, there was an extensive literature review undertaken to identify potential socio-economic impacts of gender equality relevant from a macroeconomic modelling perspective. This review was carried out both at EU and at national level, to make sure that all relevant evidence was captured and to reflect the potential diversity of impacts across EU Member States. It covered more than 300 research publications that (at least partially) focused on the social and economic impacts of gender equality.

The results of the literature review were summarised in a working document, which identified nine potential pathways in which improvements in gender equality can affect national economic performance. For each of these pathways, the document detailed potential channels through which changes in gender equality can influence the economy and proposed potential approaches to modelling such impacts. The working document intentionally focused on a very broad range of potential economic impacts of gender equality, even if these were perceived as unlikely to be suitable for macroeconomic modelling. This ensured that no economic impact of gender equality was excluded from modelling without justification based on (the lack of) evidence found during the literature review.

Secondly, this working document was presented to an international forum of independent experts [3](specialised on gender equality and economics) to gather feedback from these experts and refine the modelling approach.

Based on the feedback, the number of pathways/outcomes to be modelled was reduced from nine to five (focusing on economic impacts of gender equality in the areas of education, labour market activity rates[4], wages, distribution of unpaid care work in cases where this affects fertility and their combinations). The reduction in the number of pathways could be attributed mostly to two factors:

- Some pathways through which gender equality could affect the economy were not likely to have a sufficiently large impact to be registered at a macroeconomic scale; and
- There was insufficient evidence/data on economic impacts of gender equality to enable macroeconomic modelling in several pathways.

The experts at the forum also provided some additional comments on the presented modelling approach, which helped to refine the modelling methodology and ensured that all relevant macroeconomic impacts of gender equality were considered during the modelling process.

Separate modelling scenarios were developed for each of the four selected pathways (and their combinations) to allow for empirical testing of the economic impacts of gender equality[5]. This process required detailed analysis of historical data to identify past trends in gender equality, development of suitable approaches to projecting these trends into the future, and a review of additional literature to better understand the likely future impact of the projected trends. For a detailed description of these modelling scenarios and their development see Annex 4 *Methodological report on testing of the model*.

Simultaneously to the development of the modelling scenarios, the model used for macroeconomic modelling was tailored to better capture gender equality aspects, reflecting the comments of the independent experts on our modelling approach. The tailored model was then used to model the scenarios, as described in this report.

3 Martina Bisello (Eurofound), Alessandra Casarico (Bocconi University), David Cuberes (Clark University), Nicola Duell (Economix Research & Consulting), Egle Krinickiene (Mykolas Romeris University), Anna Rita Manca (DG Joint Research Centre), Anna Minasyan (University of Göttingen), Anita Nyberg (University of Stockholm), Ewa Okoń-Horodyńska (Jagiellonian University), Anthony Rafferty (University of Manchester), Giovanni Razzu (University of Reading), Irene Riobóo Lestón (University Rey Juan Carlos), Annalisa Roselli (University of Rome Tor Vergata), Ewa Ruminska-Zimny (Warsaw School of Economics), Marc Teignier (University of Barcelona)

4 The activity rate is the percentage of economically active population in the total population, following the defi nition used by Eurostat (http://ec.europa.eu/eurostat/web/products-datasets/-/tipslm60).

5 See Chapters 3-4 below for more detailed descriptions of the modelling process.

3. Modelling approach

This chapter outlines the methodology for the socio-economic modelling of the gender equality scenarios. It is structured into five sections:

- Section 3.1 provides an overview of how the socio-economic modelling in E3ME fits in to the wider study;
- Section 3.2 provides a summary of the E3ME model;
- Section 3.3 discusses the key economic flows that are represented within the model;
- Section 3.4 discusses the main limitations of the model; and
- Section 3.5 discusses, in detail, the demographic and labour market assumptions in the baseline scenario.

3.1 Overview of methodology

The approach used in this study was based on four key steps:

Step 1: Selecting pathways by which gender equality affects the economy

The first step was to identify the main pathways in which the implementation of gender equality measures can affect macroeconomic performance of the EU. The selection of these pathways was based on an extensive review of literature on the potential social and economic impacts of gender equality. It was then discussed with a forum of independent experts on gender equality and economic modelling to ensure that the selection appropriately reflects available evidence. Drawing on the literature review and expert comments, it was concluded that sufficient evidence of macroeconomic impacts of gender equality was available for pathways focusing on educational attainment, labour market activity rates, the gender pay gap and the effect of a more equal distribution of unpaid care work on fertility.

Step 2: Scenario development

The next step in the socio-economic assessment of gender equality measures involved a detailed analysis to assess the potential effects of gender equality measures across the four selected pathways (educational attainment, activity rates, pay gap and the impact of a more equal distribution of unpaid care work on fertility). The analysis focused on how targeted equality measures across these pathways would affect key macroeconomic indicators. This analysis eventually formed scenario inputs for the E3ME macroeconomic model (see Annex 1 *Methodological report on testing of the model*). They reflect changes to wage rates, labour market activity rates, demographics and potential productive capacity. More information about the scenarios and how they were used to derive the E3ME model inputs is available in Chapter 4.

Step 3: Developing E3ME model inputs

The gender equality pathways were then tailored to form scenario inputs appropriate for the E3ME macroeconomic model (see Section 3.3). Analysis of the potential to close the gender gap across the pathways/outcomes was used to form exogenous adjustments to wage rates, labour market activity rates, demographics and potential productive capacity in the E3ME model. In all cases, we assumed that the gender gap was reduced due to improvements for women rather than a worsening in conditions for men (e.g. to close the education gap there is an increase in women's qualifications rather than a decrease in men's). This assumption reflects that in practice, measures to improve gender equality are likely to be focused on improving outcomes of women rather than worsening outcomes of men.

This does not necessarily mean, however, there are no negative impacts for the current overrepresented position and status of men in society, as we discuss in the results chapter. More information about the scenarios and how they were used to derive the E3ME model inputs is available in Chapter 4.

Step 4: E3ME modelling

The final stage was to simulate each individual scenario in the E3ME model. The estimated effects of gender equality measures on key indicators (labour supply, wage rates, population) in each scenario were input to E3ME to assess the wider socio-economic effects of the measures. The scenarios were input separately to the model and the cumulative effect of combining interventions from different pathways has also been modelled.

3.2 Using E3ME to model gender equality scenarios

E3ME is a macro-econometric model of the global economy that covers each Member State in Europe[6]. It is a well-established model that has been widely used to assess the macroeconomic and labour market impacts of policy scenarios at a European level. E3ME is used in producing CEDEFOP's

6 See www.e3me.com for further information, including the full model manual.

annual skills projections and has recently been applied in studies for DG Justice, to assess the macroeconomic effects of measures to facilitate work-life balance, for DG EAC, to assess possible economic imbalances resulting from educational outcomes, and for DG Employment, to assess the economic feasibility of a European unemployment benefit system.

E3ME includes a detailed representation of the European and global labour market, including econometrically estimated equations for labour market participation, employment and wage rates at sectoral and regional levels. The structure of E3ME is based on the system of national accounts and the model uses an input-output framework to deduce industry interdependencies.

In this way, E3ME provides a consistent framework for the gender equality analysis. It is a demand-driven model based on a post-Keynesian logic and, unlike many other macroeconomic models, E3ME does not make assumptions about economic equilibrium. For example, the model allows for the possibility of labour markets not being in equilibrium and includes involuntary unemployment or economic inactivity. Persistent imbalances, e.g. due to gender inequality, may be a feature of the model's results. Consistent with a non-equilibrium approach, the model also does not assume that economic agents are fully rational and optimise their decisions, or that firms are necessarily profit maximising. There is a growing field of literature that questions whether the assumptions used in equilibrium models provide an adequate representation of complex real-world behaviour[7]. Instead of relying on agent optimisation assumptions, E3ME simulates the actions of economic agents based on empirically-observed behaviours. For example, wages in E3ME are modelled as a function of productivity, wages in other sectors and price movements; wages do not usually find a point that clears the labour market and therefore involuntary unemployment is a standard outcome.

In order to assess improvements in gender equality, the standard E3ME model has been expanded to include additional labour market equations that are disaggregated by sex. Labour supply in the model was already disaggregated by sex and age group so the developments relate to employment demand. A new set of econometric equations was constructed for this purpose.

The model assumes that both women and men apply for each job vacancy that arises, according to their relative shares in the labour market (so more women in the labour market suggests that more women will apply for jobs). The choice of an employer may also depend on the expected differences in wage rates between women and men. The econometric equation describing employment demand thus features the relative labour market shares and wage rates as explanatory variables (ideally any differences in productivity would also be captured but the data do not support this).

Differences between the wage rates of women and men were also incorporated into the model structure. As gender-specific productivity data are not available we have not estimated a set of econometric equations for wage differentials, but the specifications allows us to vary wage differentials in the pathways described in the next chapter.

3.3 Model structure and economic flows

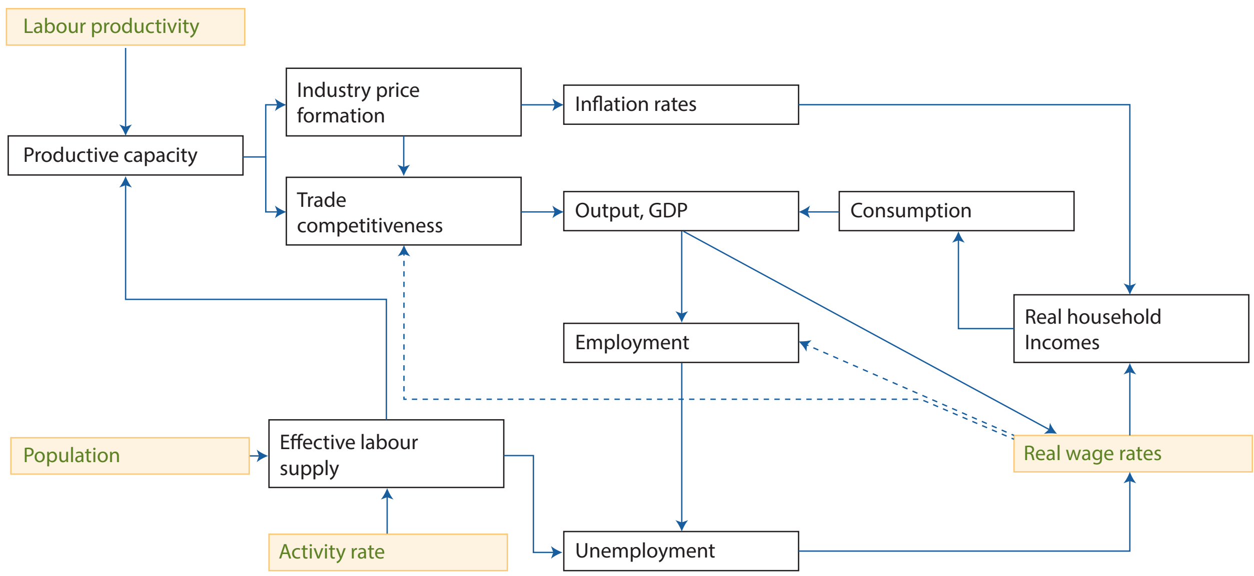
Figure 3.1 shows some of the key linkages within the E3ME model. As a simplified representation, there are still some model linkages that are not shown in the figure. The main paths of causality are:

- Higher activity rates increase labour supply. This has two effects. Firstly, there is likely to be an immediate increase in unemployment. The increase in unemployment reflects an excess supply of labour and, as a result, wages will begin to adjust downwards (and some existing workers may leave the labour market). It will take time for wage rates to adjust and, eventually, for labour demand to respond to the increase in supply and lower wage rates. At macroeconomic level, a larger workforce leads to an increase in potential output, or productive capacity[8]. This increase in potential output may motivate firms to reduce prices in order to boost production levels. Labour is an important input to production in many sectors of the economy. Following an increase in the supply of labour, those sectors that were labour constrained (e.g. due to a high demand and a shortage of skilled workers) could increase output. Furthermore, lower relative wage rates will improve the competitiveness of EU firms and, if firms reduce prices (or improve quality) to reflect the lower

7 For example, see Beinhocker, E (2007) 'The Origin of Wealth: Evolution, Complexity, and the Radical Remaking of Economics'. See also the ever-growing field of behavioural economics, e.g. Kahneman, D (2011), 'Thinking, Fast and Slow'.

8 Potential output, or the potential productive capacity of the economy, refers to the maximum economic output when all resources are fully utilised. Increases in the size of the labour force means that there is a larger pool of workers to draw upon and, therefore, there is the potential to produce more.

Figure 3.1 Key flows and interlinkages in E3ME when modelling labour market scenarios



costs they face[9], this would lead to an increase in demand for goods and services produced within the EU. In the long run, higher rates of growth could lead to higher employment levels, negating the initial increase in unemployment.

- An increase in STEM qualifications will also increase potential capacity in certain industry sectors. This is because educational improvements will lead to a more productive workforce and output per worker will increase. This increase in labour productivity will allow firms in these sectors to increase output and reduce average prices for their output. According to economic theory and historical observation, the likely outcomes following an increase in economic output and lower prices are increases in domestic real incomes and a boost to competitiveness, both of which will lead to higher GDP.

- If fertility rates increase due to a more equal sharing of unpaid care work, then there will be a higher population. In the short run this would lead to higher consumption due to the additional infants (not shown on the diagram) although consumption per capita would be likely to fall. Once the additional people reach working age, then the labour supply could increase. This leads to the same effects as described in the first bullet point above. It is important to note that since in this pathway higher fertility rates are the result of a more equal distribution of unpaid care work, higher fertility does not result in additional time out of the labour market for women.

- Higher wage rates represent a reallocation of resources from businesses to households. The net effects may be either positive or negative, depending on how households spend their additional income, and how companies react. An increase in consumption seems likely but initial benefits will be at least partially cancelled out when companies increase prices in response.

3.4 Limitations of the modelling approach

All modelling approaches represent simplifications of reality and E3ME is no exception. It is important to be aware of the underlying assumptions of the modelling, both in terms of structure and scenario design, when interpreting the results from a modelling exercise.

The key question is how well the model represents reality in the context of the policies that are being tested. E3ME is highly empirical, incorporating econometric estimates to simulate future behaviour. As such, it is subject to limitations related to the 'Lucas Critique' in that the scenarios we consider will include changes in policy as well as potential changes in technology, potentially leading to behaviour that is different from historical estimates.

9 E3ME does not necessarily assume perfectly competitive firms that are price takers. The extent to which firms reduce prices in response to a fall in labour costs is estimated based on empirical data and information on mark-up rates and rates of cost pass-through.

A much more basic limitation in the modelling is the level of detail that is possible. The economic impacts modelled must be evidenced at macroeconomic level, which is not the case for many of the reviewed social and economic impacts of gender equality (for example the evidence of macroeconomic impact of improving gender equality in labour migration patterns is unclear). In addition, when carrying out a whole-economy analysis we must include the linkages between sectors; but this limits the level of detail that can be used to the NACE[10] 2-digit level.

Whilst E3ME includes a detailed treatment of gender in the labour market (with labour supply and employment equations estimated separately for women and men), there are some simplifications in representing interactions in the labour market. For example, E3ME does not represent the labour force by occupation or by skill-level. As such, the model does not take account of potential skill shortages in some sectors of the economy. The effects of an increase in the labour supply on employment and wages does, however, take account of empirically-observed sectoral and regional variation. If firms in a specific sector have historically faced high demand for output and constraints due to a lack of workers, then the E3ME equations would reflect that there will be a larger increase in economic output and employment, and a smaller reduction in wages, following an increase in the labour supply.

The final limitation in the modelling approach relates to the data that are used in the analysis. Input data are clearly important in any modelling approach but especially so for an econometric model where historical data are used to derive parameters as well as the baseline starting point. Most of the E3ME data are sourced from Eurostat (for European countries) which provides consistency across Member States but previous revisions to published data have shown that there is also uncertainty in the information held in the model's historical databases.[11]

10 NACE is the acronym used to designate the various statistical classifications of economic activities developed since 1970 in the European Union.

11 As the E3ME is an economic model based on the national accounting system, it does not capture things that are not included in GDP. Some examples of dimensions that the literature on gender economics has highlighted as important, but are not covered by E3ME, are listed below:
- Not including unpaid household work, which can account for as much as a third to a half of GDP (Miranda, 2011);
- Not including the costs of reproduction of labour, which neglects the importance of unpaid domestic and care work for reproduction of societies (Picchio, 1992);
- Focusing on gender equality as equality in resources rather than equality in opportunities in the well-being domain (Sen, 1992); and
- Treating household as a unique entity and thus neglecting the issues of household bargaining (Agarwal, 1997).

3.5 The E3ME baseline

3.5.1 Importance of the baseline for scenario analysis

An important part of scenario analysis involves forming a credible baseline to reflect how the EU labour market and economy might be expected to develop under current policy and regulation. As results from E3ME scenarios are usually presented as (percentage) difference from the baseline, at first it may appear that the actual levels in the baseline are not important. However, by defining the labour market conditions at Member State level, the choice of baseline can have a large bearing on the socio-economic results for each scenario. For example, if there is excess labour supply and high unemployment in the baseline, then a policy that increases labour demand could lead to a substantial increase in employment levels, but is likely to have a limited impact on wages and prices. However, if an alternative baseline was used, in which the labour market is operating at close to full employment, increases in demand would be likely to have more pronounced inflationary effects.

3.5.2 Formation of the E3ME baseline

It is therefore important to use a robust, credible baseline that does not introduce bias into the scenario results. For this reason, the E3ME baseline is made to be consistent with forecasts used in other analysis and official European Commission publications. The baseline used in this analysis has been made consistent with the latest labour market projections published by CEDEFOP (2016).[12] Demographic trends are consistent with the Eurostat population projections (EUROPOP, 2013)[13] – which it should be noted include changes in population due to migration as well as domestic trends. Other economic projections are made consistent with the 2015 Aging Report (DG EcFin, 2014) and the underlying assumptions in the 'Trends to 2050' publication (DG Energy, 2013).

The baseline includes a gradual recovery from the recession back to trend rates of economic growth. These growth rates are stable thereafter, although affected by changes in demographic development.

12 http://www.cedefop.europa.eu/en/events-and-projects/projects/forecasting-skill-demand-and-supply/data-visualisations

13 http://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-projections-data

3.5.3 Derivation of CEDEFOP's labour market projections

For this study, which involves the comparison of scenarios related to labour market indicators, the baseline labour market projections used in E3ME are particularly important. The baseline has been calibrated to the CEDEFOP 2016 labour market and employment projections. For its employment forecasts, CEDEFOP uses a version of the E3ME model combined with detailed off-model estimates of employment demand and supply. The main results used here are the projections of labour supply, by sex and five-year age band, and the projections for employment, by economic sector. The starting point for the projections is the long-term economic forecast that is provided by DG Ecfin.

The projections are verified at Member State level by a group of national experts and modified to take into account the feedback that these experts provide.

3.5.4 Trends in CEDEFOP's labour market baseline

The CEDEFOP labour market projections, which the E3ME baseline is calibrated to, reflect an increase in the demand for labour in the years up to 2020. At the same time, labour supply is impacted by post-war baby boomers leaving the workforce. It is likely that the jobs that this demographic cohort are leaving behind are very different from the jobs that will be required in the future. CEDEFOP forecasted that an increasing share of jobs will be held in the service sector and that the trend of more high-skill jobs at all levels will continue, while the numbers of many manual or routine jobs will decline. CEDEFOP also forecasted that less jobs will require medium-level qualifications and that there will be a large demand for high-skilled and low-skilled workers. In terms of labour supply, CEDEFOP found that there will be a significant rise in the number of people with high-level qualifications and that more women will pursue high-level qualifications. There is a forecast stabilisation of workers pursuing medium-level qualifications and a decline in the number of workers with low-level qualifications. CEDEFOP also forecast that there is a considerable risk for skill mismatch in Europe in 2020 due to rapid technological progress and possible lags in the education and training process. It is estimated that there will be an increased number of high-skilled workers in low-skilled jobs for some period of time and a fall in the number of low-skilled or low-qualification jobs.[14]

Figure 3.2 and Figure 3.3 show the key trends in the CEDEFOP labour force and sectoral employment projections that are reflected in the E3ME baseline. It is noteworthy that the baseline already includes some closure of the gender activity gap over the period to 2025.

3.5.5 Baseline fertility rates

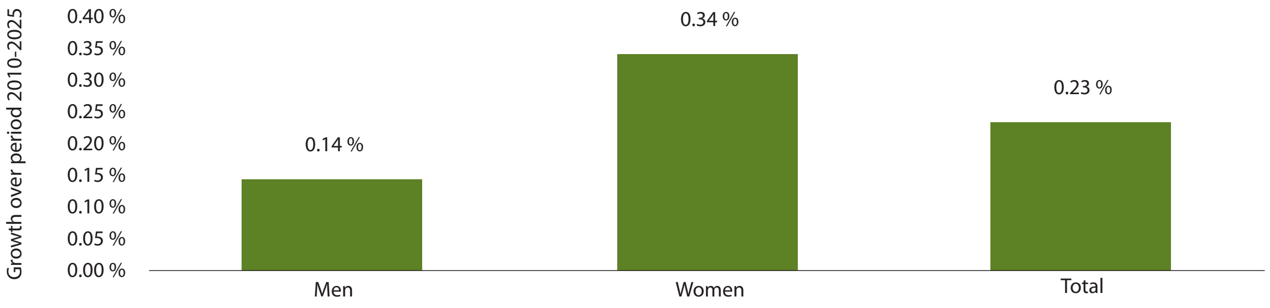
The E3ME baseline demographic assumptions are taken from EUROPOP 2013. As gender equality measures could affect fertility rates (see Section 4.5 for more details), it is particularly important to appreciate the demographic trends and, specifically, the fertility rate trends that are already reflected in the EUROPOP baseline.

The EUROPOP 2013 projection assumes that, in the long term, fertility rates across Member States converge to a level reflective of that currently observed in those Member States where fertility rates are highest. The fertility rate increases in almost all Member States. The exceptions are Ireland, France and Sweden (where fertility rates are already above 1.9 and are expected to fall over the projection period). Overall, in the EU, the fertility rate is projected to rise from 1.59 in 2013 to 1.68 by 2030 and to 1.76 by 2060. In every Member State the fertility rate is assumed to remain below the natural replacement rate of 2.1 over the period to 2060 (DG EcFin, 2014).

Figure 3.4 shows the baseline projections of European fertility rates.

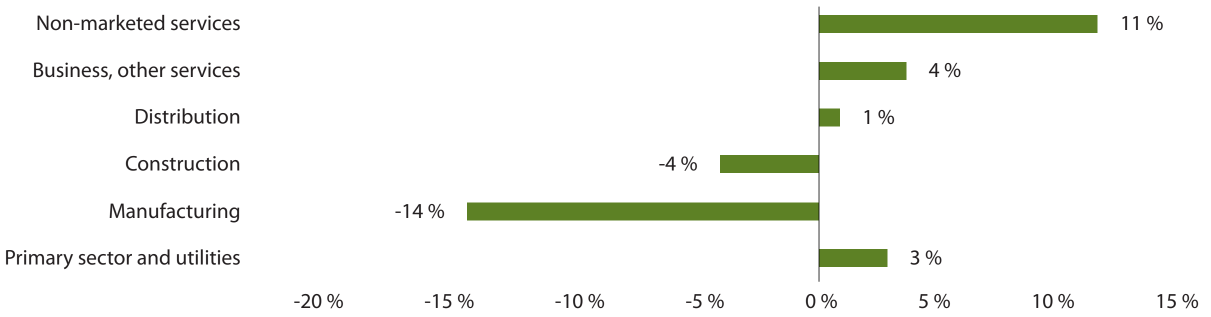
14 Future skills supply and demand in Europe, Forecast 2012. Luxembourg, Publications Office of the European Union.

Figure 3.2 Labour force growth rate CEDEFOP forecast over the whole period 2010 - 2025



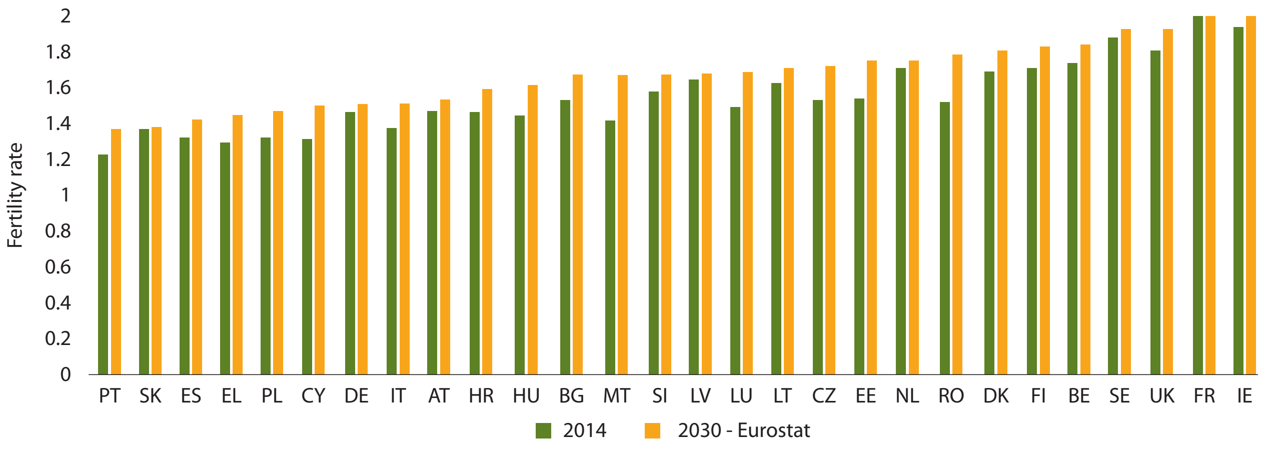
Source: CEDEFOP, 2016[15]

Figure 3.3 Employment growth rate by industry, CEDEFOP forecast over the whole period 2010 - 2025



Source: CEDEFOP, 2016[16]

Figure 3.4 Fertility rates projected by Eurostat in 2030, by Member State



Source: Eurostat population projections

15 http://www.cedefop.europa.eu/en/publications-and-resources/data-visualisations/labour-force?locale=EN&dataSource=SFML&plot=subsetTimeSeries&question=LabourForce&onlyEU=0

16 http://www.cedefop.europa.eu/en/publications-and-resources/data-visualisations/employment-trends?locale=EN&dataSource=SFME&plot=inCountry&question=00.+GrowthRateEmployment&onlyEU=0

4. Scenario descriptions

To explore the impact of advancing gender equality on the labour market and the wider economy, a scenario-based approach was used. In total, ten scenarios in addition to the baseline were modelled. Each scenario describes what would be the socio-economic impact of additional gender equality measures adopted and implemented in comparison to the E3ME baseline.

The scenarios differ in terms of the outcomes they focus on. Separate scenarios were developed for three distinct pathways (equality in STEM education, participation in the labour market and wages) to reflect the fact that the socio-economic impacts of gender equality measures are likely to substantially differ across these areas. We also assess two scenarios that focus on estimating the combined impacts of measures aimed at different outcomes adopted at the same time.

A common theme that underlies the three pathways is that there is a more equal share of unpaid care work between women and men. A more equal share of unpaid work allows, for example, higher rates of female participation in the labour market. A likely further consequence of a more equal share of unpaid care work is increases in fertility rates. We have not included increases in fertility rates in the three pathways because:

- It is difficult to quantify the effects in each of the three pathways individually;
- It makes interpretation of the modelling results more difficult.

However, we have assessed two scenarios in which fertility rates increase, based on possible changes in aggregate trends in the historical data. The combined scenarios also include increases in fertility rates.

The scenarios across all the different pathways differ in the assumed magnitude of improvement in gender equality due to the implementation of gender equality measures. Throughout this report we present two distinct types of scenarios: 'Rapid Progress' scenarios assume a higher, swifter improvement in gender equality; 'Slow Progress' scenarios assume more gradual, slower improvement in gender equality. The approach reflects the relatively sparse evidence on socio-economic impacts of different types of gender equality measures identified in the EU. In the absence of more robust evidence of potential policy impacts, we prefer providing high and low estimates of possible impacts rather than one 'true' estimate.

This section describes the various scenarios that were modelled and, in each case, the key modelling input assumptions. More detailed information about the scenario input assumptions is available in Annex 4 *Methodological report on testing of the model*.

4.1 Introduction

Throughout this report the modelling scenarios are arranged into five groups (four of which are described as 'pathways' that could be stimulated by policy, and one as an 'outcome' that is likely to accompany the other effects), with each pathway describing different types of socio-economic outcomes of gender equality measures. These pathways were selected based on an extensive literature review, which identified the most important improvements in gender equality that were likely to lead to outcomes that could be modelled at macroeconomic level.

Four individual sets of scenarios were modelled, each reflecting different aspects of gender equality improvements:

- Pathway 1: Closing of gender gap in tertiary education (STEM);
- Pathway 2: Increase in labour market activity rates of women;
- Pathway 3: Closing of gender pay gaps;
- Outcome 4: Demographic change (a higher fertility rate as a result of a shift to a more equal distribution of unpaid care work).

There is an additional pathway that considers the combined effects of gender equality measures across all the different areas:

- Pathway 5: Combines Pathways 1-3 and the higher fertility rates.

Pathway 5 assumes that a number of gender equality measures could be adopted simultaneously. We have assumed that there is no direct substitution effect between the measures, meaning that the effects of educational attainment, activity rates, wage rates and a more equal distribution of unpaid care work leading to an increase in fertility rates are additive and the individual effects can be summed together to estimate the overall combined effects of these policy measures. We assume that there is, at most, a very low degree of 'double counting' where the impacts of different scenarios overlap. For Pathways 1 and 2 (and also outcome 4), the scenario design ensures that this is the case by clearly separating the modelling focus of each pathway:

Table 4.1 Summary of modelling scenarios

	Summary	Slow Progress Scenario	Rapid Progress Scenario
Pathway 1: Closing of gender gap in tertiary education	Larger pool of STEM graduates increases potential output in several sectors.	Closure of gender gap in computing by 2-14pp; closure of gender gap in engineering by 4-12pp	Closure of gender gap in computing by 5-14pp; closure of gender gap in engineering by 9-12pp
Pathway 2: Increase in female activity rates	Increase in female labour activity increases the potential output of the economy.	0-13pp reduction in the activity rate gap by 2030	0-20pp reduction in the activity rate gap by 2030
Pathway 3: Closing of gender pay gaps	Changes to female wage rates increase household incomes but also raise employer costs.	0-5pp reduction in the gender pay gap by 2030	0-14pp reduction in the gender pay gap by 2030
Outcome 4: An increase in fertility rates as an effect of a more equal distribution of unpaid care work	Higher population affects expenditure patterns, and labour supply after 2035.	0-5% increase in fertility rate by 2030	0-8% increase in fertility rate by 2030
Pathway 5: Combined impacts	Includes the combined effects of the three pathways above, plus the higher fertility rates.	All the factors listed above	All the factors listed above

- Pathway 1 models effect of change in qualification distribution in the labour force to 2030 (improved quality of labour);
- Pathway 2 models effects of an increase in the overall number of workers up to 2030 (higher quantity or labour).

For Pathway 3, data limitations meant it was not possible to fully isolate the wage differentials that were not due to differences in education levels or activity rates and so some double counting may be possible. However, as the results from Pathway 3 show that closing the gender pay gap has only a small impact on the main macroeconomic indicators, the degree of double counting is minimal (and our sensitivity analysis confirmed this[17]), so it is reasonable to accept Pathway 5 as the combined impact of the different outcomes.

As noted above, for each of the five pathways, two scenarios were modelled - a 'Slow Progress' scenario and a 'Rapid Progress' scenario. These variants reflected the potential variation in difficulty of adopting new gender equality measures across Member States:

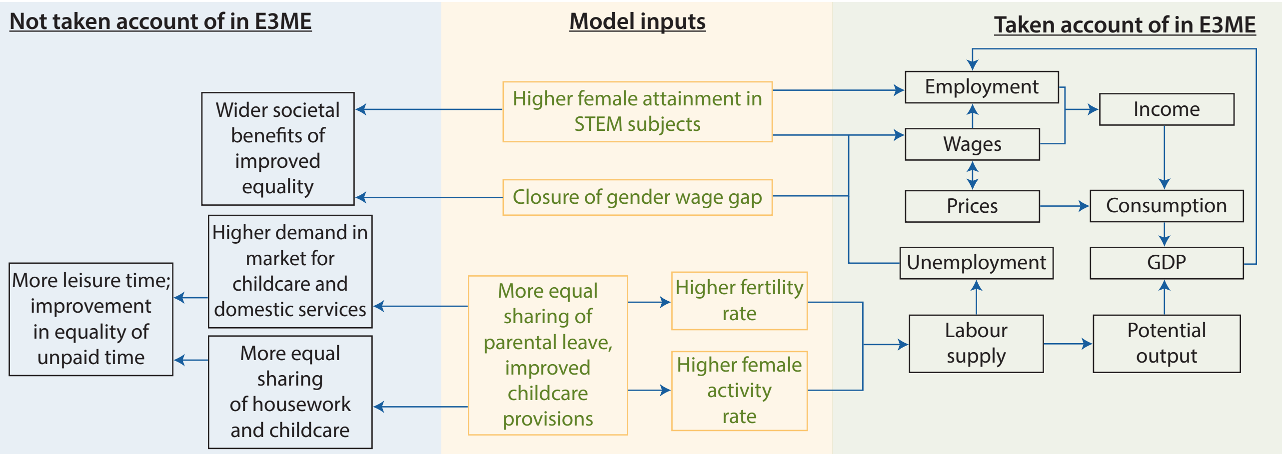
- The 'Slow Progress' scenario reflects a case where there are more difficulties in adopting additional gender equality measures compared to baseline and thus the improvements in gender equality are likely to be more gradual;
- The 'Rapid Progress' scenario reflects a more ambitious case, where the measures to improve gender equality are implemented much sooner.

Each scenario was compared to the baseline to isolate the socio-economic effects of the additional implemented gender equality measures. All the scenarios assume a wider implementation of gender equality measures than that assumed in the baseline. The baseline, which is calibrated to the CEDEFOP projections[18], only reflects expected future labour market trends based on current policy and legislation. It assumes an absence of additional gender equality measures implemented in the future that go beyond what is currently in place.

17 Pathway 5 reflects the combined effects of all other pathways. A sensitivity was tested on Pathway 5, in which we excluded the wage gap assumptions from Pathway 3 and it was shown to have a negligible impact on the overall results for Pathway 5.

18 See Section 3.3 of this report.

Figure 4.1 Coverage and limitations of the modelling



Source: EIGE's study

A summary of the ten scenarios at the EU28 level is provided in the table below. The estimated changes presented in the table have been developed based on analysis of historical data and findings from the literature review carried out during this project (see Chapter 4 for details).

It is important to note in the table above that the scenarios are based on outcomes rather specific policies. Although it is assumed implicitly that the policy framework is put in place to achieve these outcomes, in this exercise we are not assessing individual policies. The aim of the modelling is to assess the impacts of improvements in gender equality rather than to assess in detail how gender equality might be improved.

Figure 4.1 summarises how the scenarios fit into the modelling framework, in particular showing which factors are and are not covered by the E3ME model.

4.2 Closing of gender gap in tertiary education (Pathway 1)

4.2.1 Pathway rationale

In most European countries young women are better educated and have higher enrolment rates to tertiary education than young men. According to Eurostat data in 2015, 28.2% of the EU female population from the age bracket 15 to 64 had a tertiary education degree while the same proportion for males was 24.7%. At the Member State level only two out of 28 countries, namely Austria and Germany, had a lower proportion of women with a tertiary degree than men.

However, important inequalities between boys and girls exist in terms of fields of education chosen. In fact girls are less likely than boys to choose Science, Technology, Engineering, or Mathematics (STEM) as field of study at graduate and post-graduate level, even when they perform at comparable level in maths and science (European Parliament, 2015). In terms of determinants of the gender gap, the literature (OECD, 2011 & Sikora and Pokropek, 2011) often refers to stereotyping in education and training choices and lack of female role models as major problems contributing to the gap.

At an individual level, lagging behind men in STEM studies may translate into lower employment prospects and lower earnings for women once in the labour market, giving origin, in turn, to lower economic independence and development. This is because STEM related sectors have been growing much faster than others and have significantly higher wages (European Parliament, 2015).

At an aggregate level such differences have potentially significant implications for employment, productivity and economic growth. Reducing the gender gap in STEM education areas could help reduce bottlenecks in the labour market, increase employment and the productivity of women and reduce occupational segregation. Ultimately this could foster economic growth via both higher productivity and increased labour market participation (European Commission, 2014). This provides a reasonable justification of including such a pathway in the modelling exercise.

4.2.2 Pathway description and derivation

This pathway estimates the potential change in the gender education gap as a result of future gender equality measures (i.e. removal of stereotypes in education; promotion, awareness raising and career guidance to encourage girls to study in male-dominated fields and boys in female-dominated ones) that could take place in addition to the baseline scenario. The gender education gap is defined as:

$$Gap_{edu} = \left(1 - \frac{Share_W}{Share_M}\right)$$

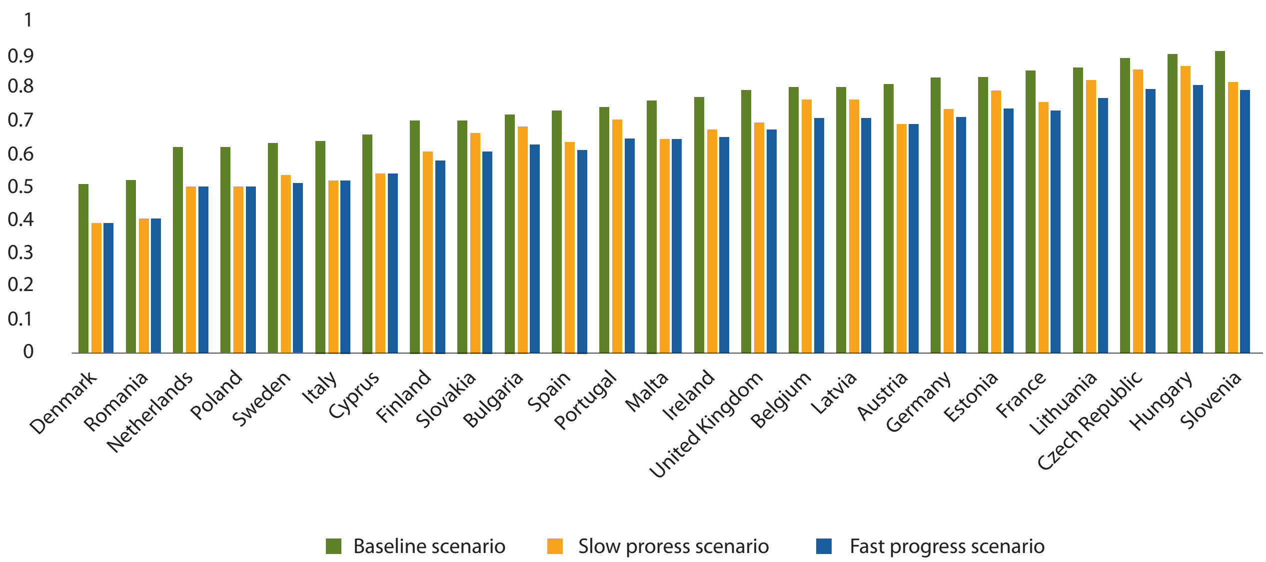
where $Share_w$ stands for the proportion of women graduates in the total number of graduates and $Share_m$ stands for the corresponding proportion of men graduates. Note that if Gap_{edu} equals one the educational field is completely dominated by men; if it is zero there is equal share of men and women; and if it is negative there is more women than men among graduates.

More specifically, the pathway focuses on gender gaps in the fields of computing and engineering. These education fields are marked by low student participation of women compared to men, despite strong employment prospects after finishing studies. Other educational fields (such as humanities and social sciences or business studies) are not considered in this pathway, either because of their low employment prospects or because no evidence of gender inequality in participation was identified.

The estimates about the future potential decrease in gender gaps in education have been prepared for computing and engineering separately. The potential for gender equality measures to close the gender education gap in Member States was estimated based on the historical rate of reduction of the gender gap in education over the period between 2001 and 2013. It was assumed that prior historical trends are an indicator of the potential impact of additional gender equality measures. This is a conservative assumption based on the fact that prior negative historical trends are likely to result from a variety of factors (i.e. cultural attitudes towards gender equality), which can inhibit policy impact.

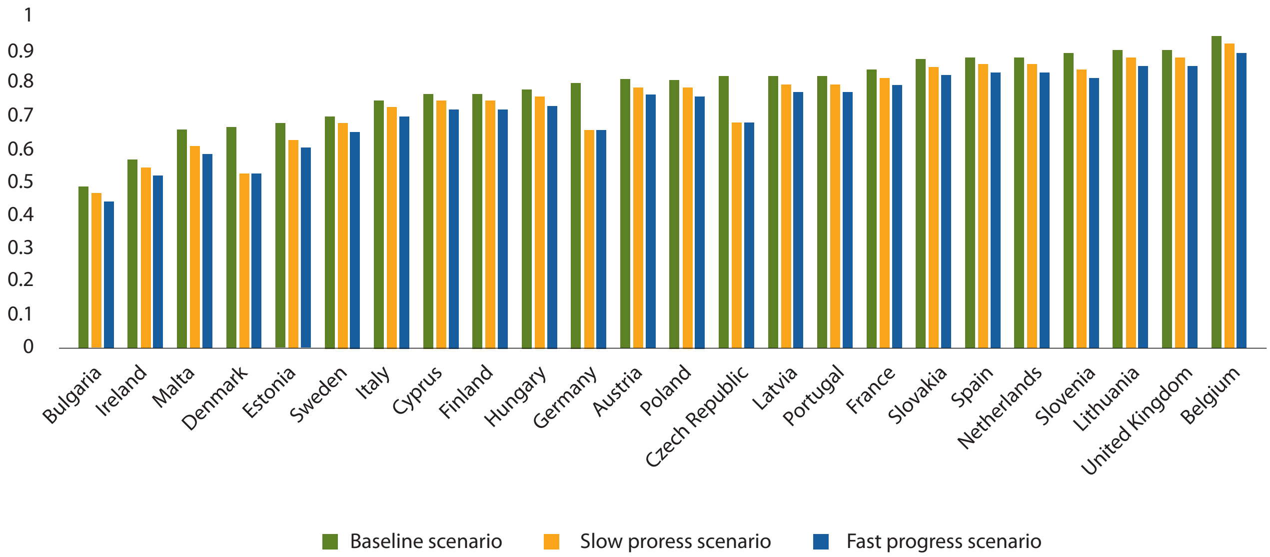
The Slow Progress and Rapid Progress scenario variants differ in terms of the assumed rate of reduction in the tertiary education gender gap for the forecast period 2013-2030 (see Figure 4.2 and Figure 4.3). For example, in Sweden the proportion of men graduating in engineering is estimated to be 63% higher than the proportion of women in 2030 under the baseline scenario. Under the slow progress scenario it is estimated to be 54% higher and under the fast progress scenario it is 52% higher.

Figure 4.2 Gender gap in engineering graduates under each scenario in 2030



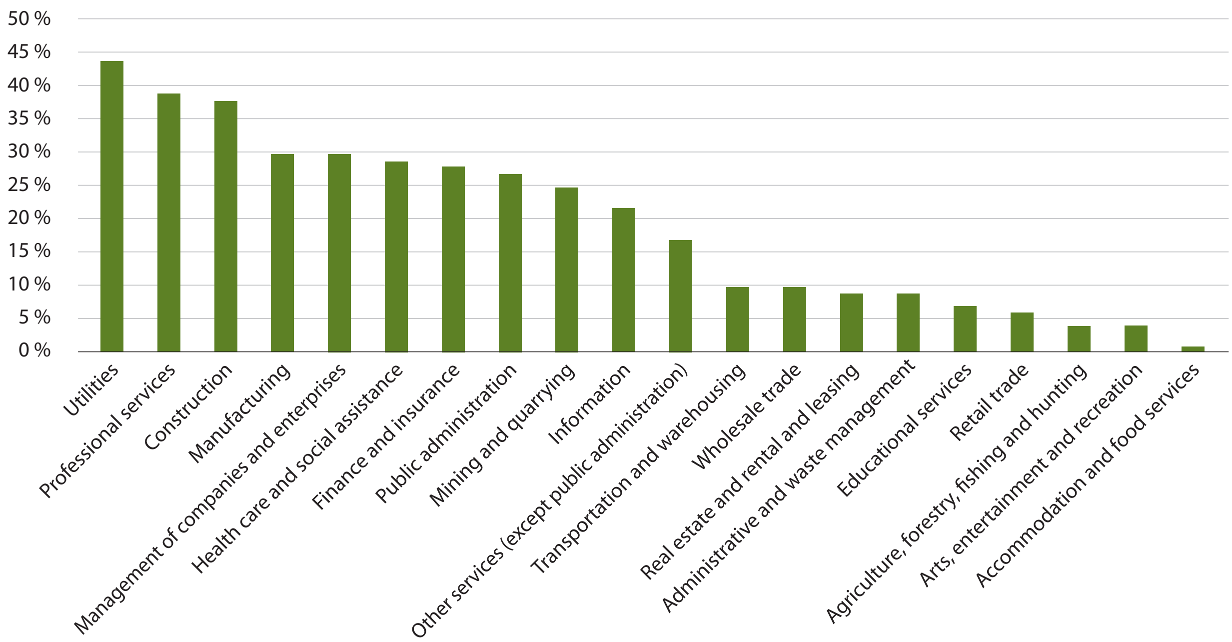
Notes: Insufficient data for Luxembourg, Croatia, Romania and Greece.

Figure 4.3 Gender gap in computing graduates under each scenario in 2030



Notes: Insufficient data for Luxembourg, Croatia, Romania and Greece.

Figure 4.4 Percentage of jobs occupied by STEM graduates at a sectoral level



*Source: Rothwell, J. 2013. 'The Hidden STEM Economy', based on Brookings analysis of O*NET and OES, US data, 2011*

4.2.3 E3ME modelling methodology

Although E3ME includes a basic measure of educational attainment, it does not include detail by subject area. To model this scenario in E3ME we therefore used information on the total share of STEM graduates by sector to estimate the extent to which an increase in STEM graduates would boost potential productive capacity. We assumed that the number of male graduates did not change relative to the baseline scenario, and that the closure of the education gap was met wholly by an increase in the number of women graduating in STEM subjects. Figure 4.4 shows the share of jobs at a sectoral level that are occupied by STEM graduates[19]. We used these shares to estimate the impact of an increase in STEM graduates on potential output at a sectoral level. This methodology reflects that the increase in potential productive capacity will be largest in those sectors that employ a relatively high share of STEM graduates.

4.3 Increase in labour market activity rates of women (Pathway 2)

4.3.1 Pathway rationale

Although gender inequalities spread in different domains, it is probably in labour market participation that differences between women and men are most marked. Women are likely to undertake much more unpaid work, including caring obligations for children and elderly relatives, than men. Therefore they participate less in the labour market and/or are forced to pursue a lower career profile. As a consequence, despite the recent noticeable increase across Europe in activity rates of women, the average EU gender gap in activity rates is still 15%, and the differences at national level are sometimes much larger.

Starting from the W*omenomics* theory proposed by Matsui et al. (1999), several studies have assessed that increasing participation of women in the labour market is likely to increase GDP and counterbalance the negative effects of ageing populations in developed countries. According to research led by the OECD (2008), narrowing the gap between employment rates of men and women has accounted for half of the increase in Europe's overall employment rate and a quarter of annual economic growth since 1995.

The importance of increasing women's labour market participation for GDP growth is assessed by different international simulation studies. For instance Daly (2007), Löfström (2009) and Aguirre et al. (2012) show that increasing gender balance in labour market participation and employment would significantly increase GDP in the Eurozone. Similar results are also confirmed at national level (Casarico and Profeta 2007; Matsui et al. 1999, 2005, 2010, 2014; Bryant et al. 2004; Klasen 1999; Klasen and Lamanna 2009; Mitra et al. 2015; Esteve-Volart 2009; Cuberes and Teignier 2012 and 2016; Lako and Diouf 2009). These studies generally agree on the positive macroeconomic impact of increasing the labour market activity of women.

4.3.2 Pathway description and derivation

Pathway 2 focuses on the potential future increases in labour market activity rates of women due to the implementation of additional gender equality measures (compared to the baseline) and the extent to which the gender gap in activity rates could be closed. The gender equality measures that can positively influence women's activity rates include the following:

- Childcare and other care provision / funding;
- Changes in paternity, maternity, parental and filial leave pay and conditions;
- Promotion and support of part time and flexible working arrangements;
- Promotion of female entrepreneurship;
- Promotion of gender-neutral recruitment;
- Improved healthcare for women.

The gender gap in the activity rates of men and women is defined as follows:

$$Gap_{Part} = \left(1 - \frac{Act\_rate_W}{Act\_rate_M}\right)$$

where Act_rate_w stands for activity rate of women aged 20 to 64 and Act_rate_m stands for the activity rate of men from the same age group, based on Eurostat labour force survey data. Note that if Gap_{Part} equals one only men are active in the labour market; if it is zero there is equal share of men and women; and if it is negative there is more women than men in the labour force.

Estimates of the potential closure of gender gaps in activity rates as a result of additional gender equality measures were prepared for two groups based on Member State performance:

- The best performing Member State (Sweden) and Member States with similarly low gender gaps in activity rates (Finland, Lithuania);
- The remainder of the Member States that have a worse performance in terms of gender gaps - the other 25 Member States.

It was assumed that additional gender equality measures would be implemented in the 25 Member States that were not classified as 'best-performing' and that such additional

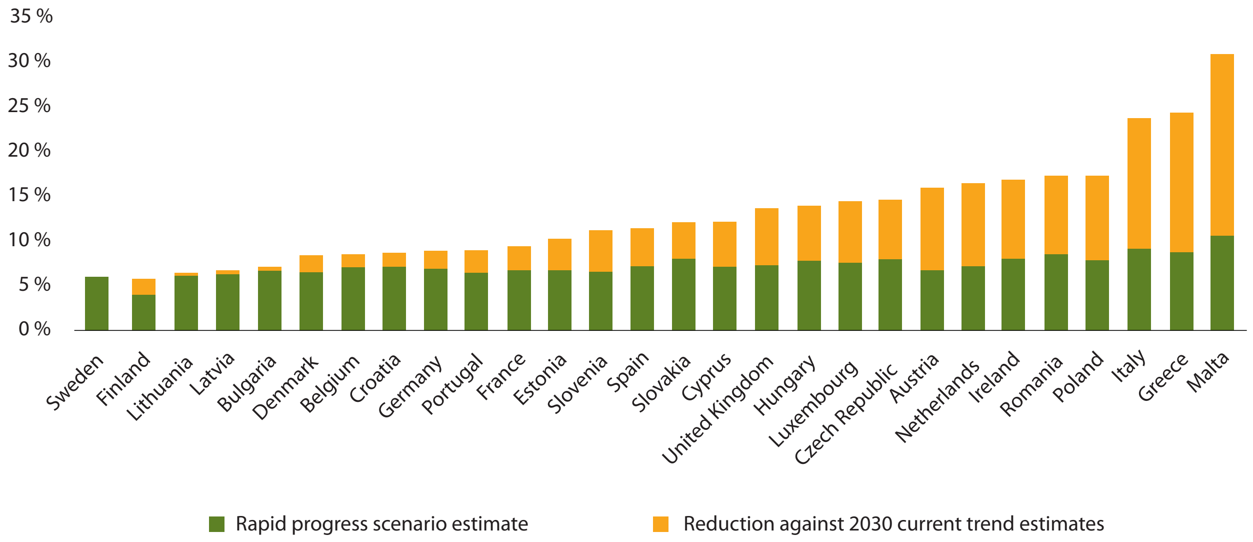
19 US data for the share of STEM graduates by sector was used as a proxy due to insufficient data at European level. The data are taken from Rothwell, J. 2013. 'The Hidden STEM Economy'.

gender equality measures would have at least some positive effect on the activity rates of women. These assumptions reflect the fact that most Member States still have sizeable gender gaps in activity rates.

It was assumed that countries with higher gender gaps in activity rates reduce the gaps faster than countries with lower gender equality gaps. This assumption is based on analysis of historical data, which showed that there has recently been a relatively strong process of convergence in gender gaps in activity rates across Member States. Since 2000, countries with higher gender gaps in activity rates generally reduced their gaps much faster than countries with lower gaps.

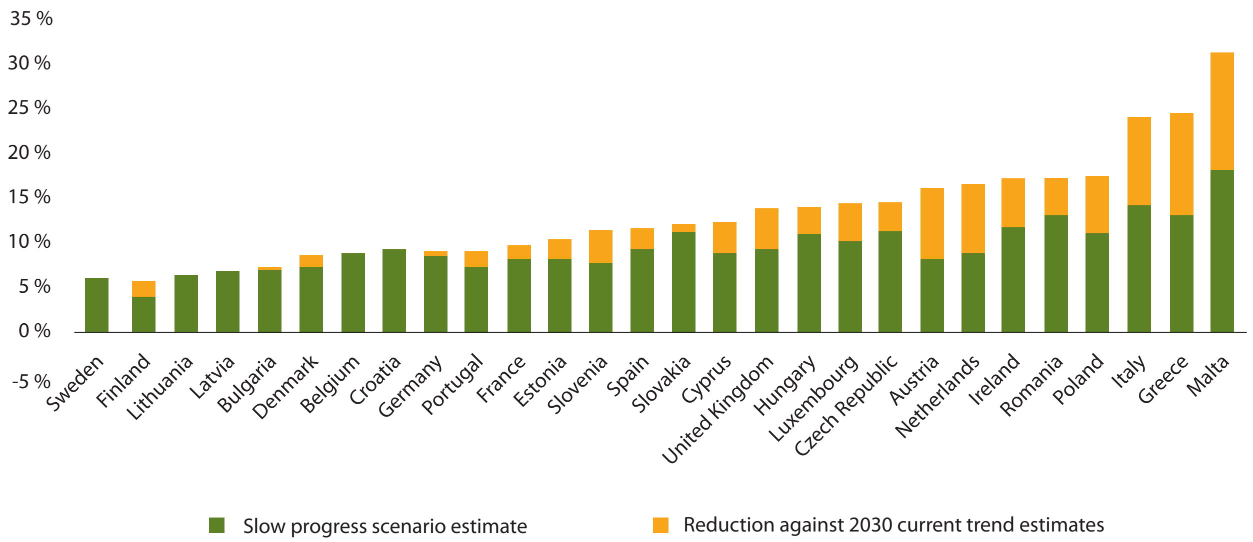
Two scenario variants were constructed, a 'Rapid Progress' and a 'Slow Progress' scenario, each assuming a different rate of implementation of additional gender equality measures, relative to a baseline estimate based on an extrapolation of current trends.

Figure 4.5 Estimated decrease in activity rate gender gaps in Rapid Progress scenario against current trend estimates



Source: Study calculations, Eurostat data for 2014, Eurostat population projections, Cedefop labour force projections
Notes: Gender gaps are defined as: 1- activity rate of women/ activity rate of men.

Figure 4.6 Estimated decrease in activity rate gender gaps in Slow Progress scenario against current trend estimates



Source: Study calculations, Eurostat data for 2014, Eurostat population projections, Cedefop labour force projections
Notes: Gender gaps are defined as: 1- activity rate of women/ activity rate of men.

4.3.3 E3ME modelling methodology

To convert the analysis on gender gaps in activity rates into E3ME scenario inputs, we assumed that there was no direct change to labour market activity rates of men relative to the baseline scenario and so the closure of the gender gap in activity was achieved wholly through an increase in the activity rates of women.[20] This reflects that in practice, policy measures to increase gender equality are likely to focus on improvement of situation of women rather than worsening the situation of men.

The inputs to the scenario focus on the potential change in activity rates by 2030. We interpolated activity rates of women in this pathway over 2015-2030 so that there is gradual (but not complete) convergence up to 2030. We assumed that there would be no further convergence between activity rates of women and men over the period 2030-2050.

4.4 Closing of the gender pay gap (Pathway 3)

4.4.1 Pathway rationale

Despite legislation aimed at securing equal pay for women and men – "Equal pay for equal work" is one of the European Union's founding principles - the gender pay gap has persisted into the twenty-first century. In 2014, gross hourly earnings by women were on average 16.1% below those of men in the European Union, with high variability across Member States.

The gender pay gap is likely to result from a variety of factors such as demographic characteristics, sectoral and occupational segregation, levels of human capital, personal preferences, family related issues, wage bargaining differences between women and men and/or employer discrimination.

Equal pay legislation, technological changes[21], and evolving social norms contribute, among other factors, to reducing the gender pay gap (Olivetti and Petrongolo 2016). However, gender differences in pay still persist in all EU28 Member States. Different authors (Bertrand et al. 2014; Goldin and Katz 2002 among others) have shown that one of the main drivers of the gender pay gap is women's dominant role in the provision of child care and home production in general and the consequent work-life balance considerations. Further explanations of the persisting gender pay gap come from the psychological and experimental literature. According to these findings women are more risk-averse than men (Cro-son and Gneezy, 2009), less likely to opt for performance pay (Niederle and Vesterlund, 2007) and less likely to negotiate for their wages (Babcock et al. 2003, Rigdon, 2013).

The literature on the economic benefits of reducing the gender pay gap is more limited than the one on the gender gap in labour market participation, however some studies identify the positive impact of reducing gender pay gaps on GDP and income per-capita (Schober and Winter-Ebmer 2009, Tzannatos 1999 and Cavalcanti and Tavres 2008), on savings and investments (Seguino and Floro 2003, Rossi and Sierminska 2015, Ward et al. 2010, World Bank 2012), and on women's confidence and responsibility at work (Booth 2003, Fernandez 2013).

4.4.2 Pathway description and derivation

This pathway reflects the potential for gender equality measures to close the gender pay gap.[22] It estimates the potential closure of the gender pay gap as a result of tar-geted gender equality measures (additional to that expect-ed in the baseline from an extrapolation of current trends). The measures that are considered to have potential to close gender pay gap include:

- Legal provisions regarding equal pay and working conditions;
- Equal pay and working condition policies such as requesting employers to provide statistics on pay disaggregated by sex;
- Removing sectoral and occupational segregation;
- Reducing the number of career breaks among women;
- Promoting progression of women into senior positions.

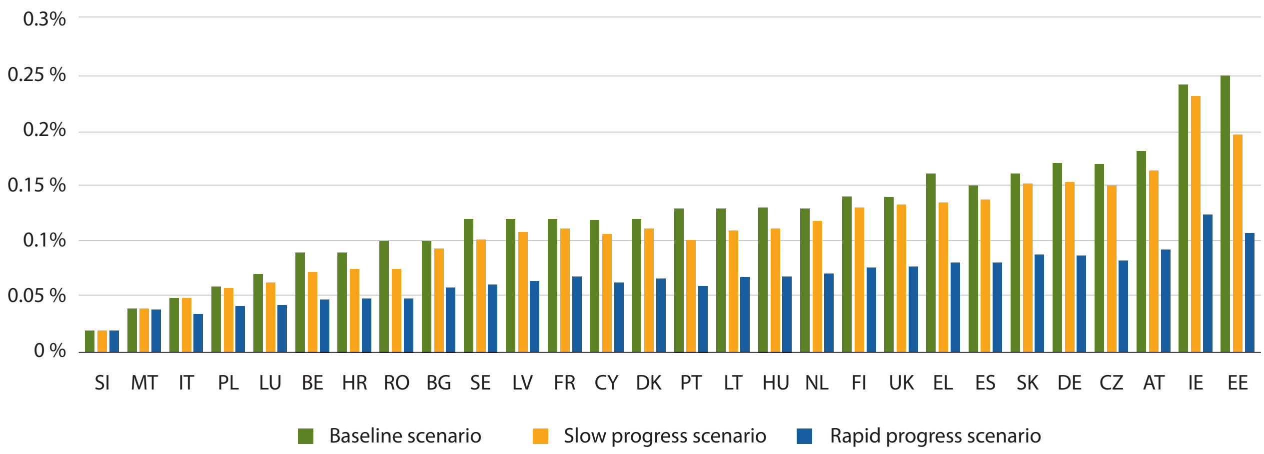
In these estimates, we assume that additional gender equality measures can be implemented compared to current trend estimates (except in the best performing Member States, which have already a very low degree of

20 Although we did not directly change male activity rates directly in our scenario inputs, endogenous responses within the model are entirely possible. For example, if a higher supply of women into the labour force forces down wage rates then it could lead to existing workers (both men and women) reducing participation.

21 Technological progress in the workplace has raised the value of non-manual skills relative to manual ones, thereby raising female relative wages (Black and Spitz-Oener 2010).

22 Defined according to the Eurostat methodology (http://ec.europa.eu/eurostat/statistics-explained/index.php/Gender_pay_gap_statistics) as 'the difference between the average gross hourly earnings of men and women expressed as a percentage of the average gross hourly earnings of men.'

Figure 4.7 Gender pay gap in the baseline, slow progress and rapid progress scenarios in 2030



Source: Study calculations, Eurostat population projections, Cedefop labour force projections

Notes: Gender gaps are defined as: 1- average gross hourly earnings of women/ average gross hourly earnings of men. Note that if pay gap is positive men earn more than women; if it is zero there is equal share of men and women; and if it is negative women earn more than men. The maximum positive value of pay gap is one, but there is no negative limit to its value.

inequality). Furthermore we assume that such additional gender equality measures will have at least some positive effect on female hourly earnings. These assumptions reflect the fact that most Member States (except the best performing ones) still have sizeable gender pay gaps.

Similarly to the pathway focused on female activity rates (see Section 4.3), gender pay gaps are assumed to converge across countries, reflecting the convergence trend identified in historical data.

As shown in Figure 4.7, the 'Rapid Progress' and 'Slow Progress' scenario variants for this pathway each assume a different rate of implementing additional gender equality measures. In the 'Slow Progress' scenario, the gender pay gap is slightly smaller than in the baseline. In the 'Rapid Progress' scenario, the gender pay gap is substantially lower than in the baseline.

4.4.3 E3ME modelling methodology

To model this scenario in E3ME, we have made an exogenous adjustment to wage rates for women. We have assumed that wage rates for men did not directly change relative to the baseline scenario but that the wage rates for women have increased so that the wage gap closes to the values implied in Figure 4.7 above.

Importantly, we also assume that the change in relative wage rates between men and women does not lead to additional hiring of men at the expense of women.

4.5 More equal distribution of unpaid care work leading to higher fertility rates (Outcome 4)

4.5.1 Overall rationale

Fertility rates and gender equality in distribution of unpaid care work are historically strongly linked. However, in the past, traditional family arrangements were correlated with higher numbers of children. During the first demographic transition to smaller families women became much more equal with men but at the same time women were burdened by the stress of combining paid and unpaid household and care work, and thus tended to have less children (child care burden being among the factors that might have contributed to the new tendency). In recent years fertility rates have increased particularly in the most developed societies with a high degree of gender equality, reflecting, among other factors, the positive effect of a more equal distribution of unpaid care work on the propensity to have children. Due to the potential negative consequences of demographic change for economic growth in Europe (Bloom et al. 2010), facilitating the materialisation of fertility intentions and, consequently, rising fertility rates have increasingly been perceived as an important policy goal.

A more equal distribution of unpaid care work can be the result of men being more involved in the social reproduction activities and thus increasing their share of care work, or the result of an increase in social infrastructures reducing the time women devote to unpaid care work. In both cases, the changes contribute to a decrease in unpaid care work that would generally be taken by women. Current literature attributes the recent increase in fertility rates in Europe to the development of a more equal distribution between women and men of unpaid family work (Neyer et al. 2013, Mills 2010). Moreover many studies provide evidence that greater gender equality in unpaid care work tends to lead to increases in fertility intentions (Begall and Mills 2011, Vignoli et al. 2012, Mills et al. 2008, Esping-Andersen et al. 2007). Additionally, other studies show how specific institutional factors (like childcare subsidies, taxation policies and other forms of family support), structural factors (e.g. labour market rigidities or high uncertainty in the markets), socio-cultural factors (such as attitudes toward working mothers and the perception of the gender roles), and the role of the partner's characteristics can interact in the relationship between gender equality and fertility (Matysiak and Vignoli 2008).

As outlined in the introduction to this chapter, it is important to note that higher fertility rates are not an intended outcome of the gender equality measures. They are, however, a likely outcome of the policies that would need to be introduced to bring about the outcomes in Pathways 1-3. As changes in fertility rates can have substantial macroeconomic impacts (as we show), it is important to include them in the modelling. Aside from difficulties in quantification, we do not include changes in fertility rates in the scenarios linked to Pathways 1-3 because it would make interpretation of the scenario results much more difficult. We therefore consider the effects of higher fertility rates separately and in the combined scenarios that comprise Pathway 5.

4.5.2 Scenario description and derivation

The gender equality measures to promote a more equal distribution of unpaid care work and that could potentially facilitate the materialisation of fertility intentions and, consequently, improve fertility rates include:

- Childcare and other care provision / funding;
- Changes in paternity, maternity, parental and filial leave pay and conditions;
- Promotion and support of part time and flexible working arrangements;
- Changes in work-life balance conditions, including pre and after school care services.

Starting from Eurostat projections in their main fertility scenario, assumptions about potential further increase in fertility rates due to improved gender equality were developed. The development of fertility rates is only considered up until 2030 and fertility rates are assumed to stay constant over 2030-2050.

Two scenarios were produced, assuming additional improvements in gender equality compared to Eurostat projections:

- Rapid Progress scenario – assume a larger increase in fertility due to implementing a high number of additional gender equality measures;
- Slow Progress scenario – assume a smaller increase in fertility due to implementing a lower number of additional gender equality measures.

The potential increases in the fertility rate were prepared for three groups based on Member State clustering[23]. It was assumed that countries with lower gender equality had greater scope to increase fertility rates than countries with high gender equality. In countries with higher levels of gender equality countries, improvements in gender equality are likely to be smaller.

Figure 4.8 and Figure 4.9 show the fertility rate assumptions in the 'Rapid Progress' and 'Slow Progress' scenario compared to the E3ME baseline in 2030 (and the 2014 values).

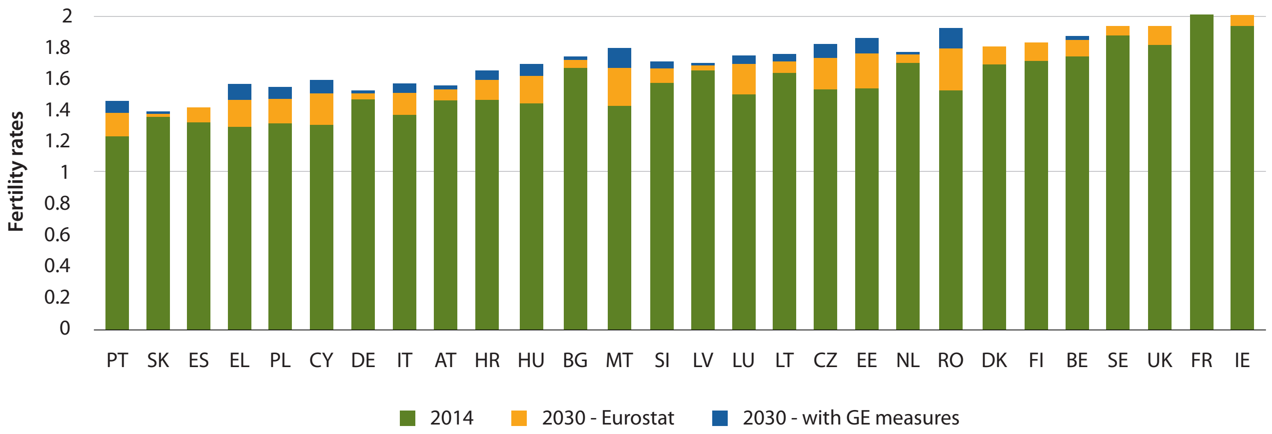
4.5.3 E3ME modelling methodology

Population projections by age band are an input assumption to the E3ME model. For Outcome 4, the fertility rates implied by the Rapid Progress and Slow Progress scenarios were used to estimate the number of new-borns per annum, making sure there is no double counting since average fertility rates are applied to the lifetime of a woman. We assumed that the new-born boy/girl ratio is 50:50 and then allocated new-borns each year to population projections by age group (e.g. a new-born in 2015 will be 25 years old in 2040.

This new set of population projections was used as an input to the model for the Rapid Progress and Slow Progress scenarios.

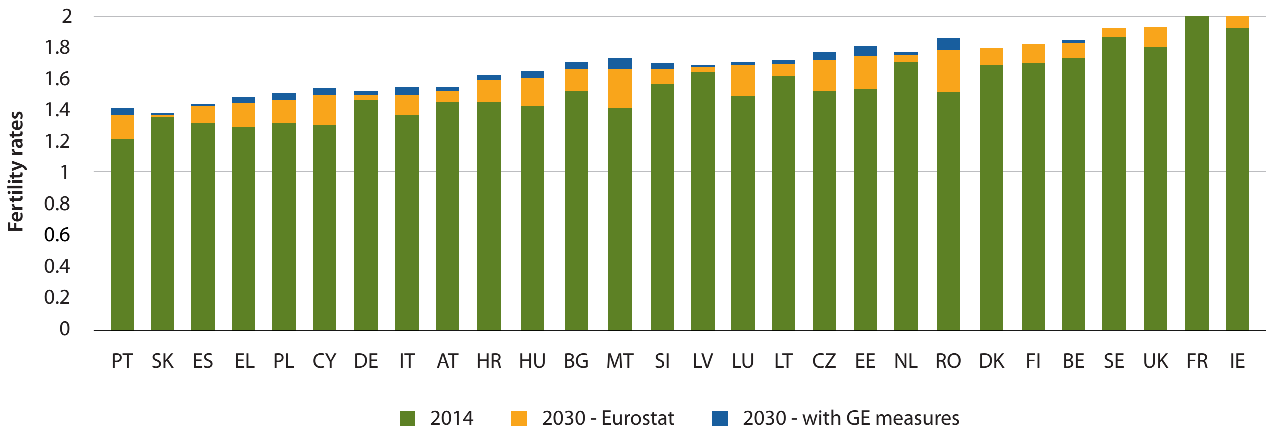
23 The clustering was based on current levels of gender equality, as measured by the Gender Equality Index published by EIGE. More precisely we used the Gender Equality Index scores in the work, money and time domains to divide the countries into three groups with roughly the same number of Member States.

Figure 4.8 Increase in fertility rates in the Rapid Progress scenario



Source: Study calculations, Eurostat population projections, Cedefop labour force projections

Figure 4.9 Increase in fertility rates in the Slow Progress scenario



Source: Study calculations, Eurostat population projections, Cedefop labour force projections

5.
Socio-economic impacts of increased gender equality in different policy areas

This chapter describes the results from the socio-economic modelling of the gender equality scenarios. Section 5.1 outlines the theory to describe the labour market effects following an increase in labour supply (which is a key driver of the socio-economic impacts in the scenarios included under Pathways 1, 2 and 3). Section 5.2 provides a more detailed explanation of the scenario-specific effects and presents the key results from each scenario.

5.1 Economic impact of an increase in labour supply

In Pathways 1 and 2, and in Outcome 4, a similar pattern emerges from the results. These results all represent instances where there is an increase in the supply of labour:

- In Pathway 1, there is an increase in the supply of high-skilled labour, due to a higher number of females graduating with degrees in STEM subjects;
- In Pathway 2, there is an increase in the female labour supply, due to an increase in female activity rates in the labour market;
- In Outcome 4, there is an increase in the fertility rate, which eventually leads to an increase in the labour supply after a 20-year lag, when the new-borns reach working age.

In all of these cases, the increase in labour supply leads to an immediate increase in the potential productive capacity of the economy; more people are willing and able to work and so there is the *potential* for higher levels of production and economic output. Subsequent to the increase in labour supply, in regions with low unemployment rates, existing vacancies will be filled and there may be an increase in employment, if the demand for labour is not already satisfied by existing supply. However, in regions with higher levels of unemployment and where there are fewer skill shortages, there is initially no reason that the demand for labour would increase. As a result, there would be an initial excess supply of labour, leading to an increase in unemployment relative to the baseline scenario; although there would be an increase in the number of people willing and able to work, this would not initially be matched by an increase in the number of jobs to be filled.

Eventually, excess labour supply and higher unemployment rates (relative to the baseline) will lead to a gradual downwards adjustment in wage rates. Empirical data show that wages are 'sticky'; it takes employers time to react and update wage offers in response to a change in labour market conditions. This is due to a combination of factors, such as imperfect information, lags in wage and price setting by firms, employee protection measures and collective agreements. However, in the medium to long term, the excess supply gradually reduces workers' bargaining power and employers will begin to lower wage offers (relative to the baseline scenario) as the labour market becomes more competitive.

There are two potential upshots[24] of the lower market wage rates:

- for firms, the relative cost of employing more people will fall and so, over time, firms will begin to increase their demand for labour;
- for individuals, the lower wages will make employment a less attractive option and, consequently, some may decide to no longer actively participate in the labour market, as the market wage rate falls below their reservation wage.

The basic relationships are shown in Figure 5.1. There is an initial increase in unemployment (note that in the figure initial unemployment is set to zero for ease of interpretation) but, over time, wage rates fall leading to an increase in employment (from E_0 to E_1) and a fall in labour participation (from LS_1 to LS_2).

The size of the effects of an increase in the labour supply on employment and wages reflects the empirically-observed sectoral and regional variation. Firms in sectors with high demand for output and constraints due to a lack of workers will generally increase economic output and employment more and reduce wages less after an increase in the labour supply.

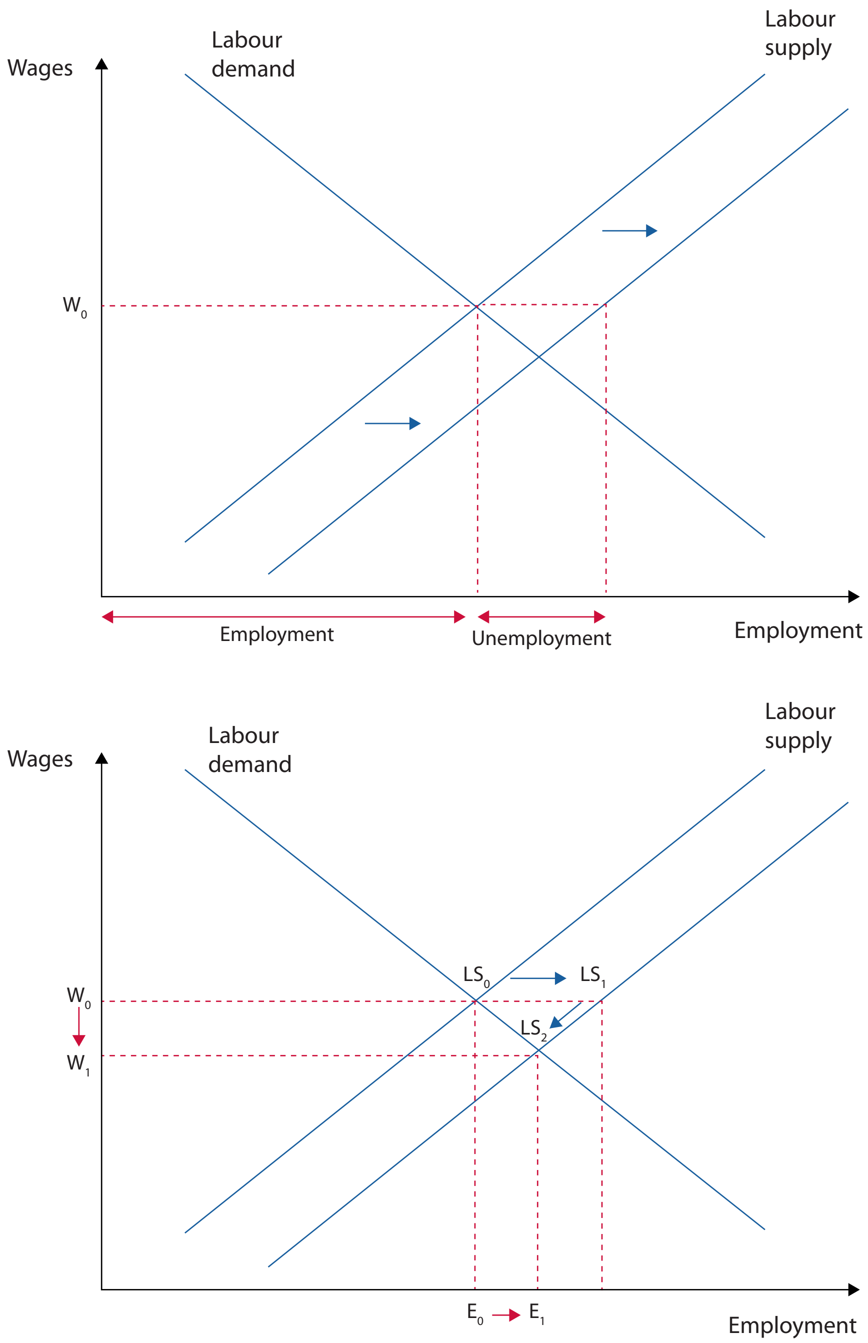
5.2 Economic results

This section presents the economic and labour market results for the EU28. Principal results include:

- A positive effect of gender equality measures on GDP per capita. GDP per capita is estimated to increase by 6-10% relative to the baseline by 2050 when all gender measures covered by this study are adopted simultaneously (Pathway 5).

24 It is important to note that there are other interactions that are also modelled and will affect the extent of these impacts. For example, there is sectoral variation in the ease at which other inputs to production could be substituted by labour. The unemployment rate is also an important factor in the wage equations and in the activity equations (as it reflects the tightness of the labour market).

Figure 5.1 Impact of an increase in labour supply



- An overall positive effect of gender equality measures on employment. The overall employment rate is estimated to increase by up to four percentage points compared to the baseline by 2050 in Pathway 5.
- A strong positive effect of gender equality measures on female employment. By 2050, the female employment rate is estimated to increase by up to five percentage points compared to the baseline in Pathway 5.
- There are likely to be some relatively mild costs of gender equality measures as well. These relate mostly to decreases in male employment and increases in overall unemployment due to the increased labour force participation of women, plus some competitiveness effects between Member States.

In all cases, the results are presented relative to the E3ME baseline.

5.2.1 GDP per capita

GDP per capita increases in Pathways 1-2 and is broadly unchanged in the other single-impact scenarios. The impacts on GDP per capita are largest in the activity rate scenarios (Pathway 2), where sizeable increases in female activity lead to increases in overall labour supply and potential productive capacity. Under this pathway, GDP per capita increases by around 1-2% in 2030 and by 3-6% in 2050 (up to €540bn increase in GDP by 2030 and €2,840bn increase in GDP by 2050).

Increases in GDP per capita are also observed in Pathway 1, which considers closure of the education gap. A more educated workforce is expected to be more productive, boosting the potential productive capacity of the economy and leading to an increase in GDP.

The impacts of higher fertility rates on GDP per capita are negative initially, as a higher dependency ratio leads to a fall in consumption per capita (despite an overall increase in consumption and GDP). In the long term (after 2040), there is an increase in the size of the labour force as the new-borns reach working age. At this point, growth in GDP per capita increases rapidly relative to the baseline. By 2050, GDP per capita is approximately the same in this scenario as in the E3ME baseline.

In the pathway that considers improvements to wage equality (number 3), GDP effects are much lower, with a 0-0.2% increase in GDP per capita over the 2030-2050 period. This is at least partly because the pathway has opposing macroeconomic impacts. Although higher female wages lead to an increase in real household incomes and expenditure, it also increases costs faced by firms. In the long run firms increase prices in order to restore their profit margins, which reduce real incomes and puts downwards pressure on output and GDP from around 2040 onwards.

As outlined in the previous chapter, we also modelled the socio-economic effects in cases where various different gender equality measures are combined. The combination of Pathways 1-3 and the higher fertility rates reflect the fact

Figure 5.2 Effect of individual gender equality pathways on GDP per capita

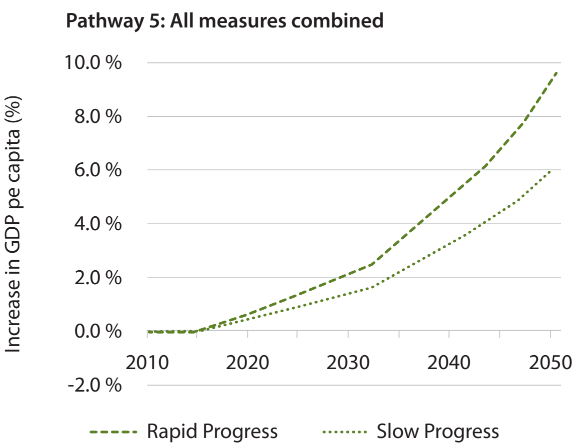
Source: Study calculations

that improving gender equality in one domain could have spill-over effects in the other domains (i.e. more educated women are more likely to participate to the labour market and women who participate in the labour market in countries that have good work-life balance policies are more likely to have more children). This is Pathway 5.

The model results show that there are some limited interaction effects between the various measures and some additional GDP benefits. Pathway 5 reflects a case where women are a) more educated and b) more active in the labour market, as well as the pay gap being closed. Furthermore, the pathway includes an increase in fertility rates, so, as well as a more educated and more economically active existing workforce, the size of the potential workforce increases. These interaction and spill-over effects explain why the GDP results are slightly more positive when Pathways 1-4 are combined, compared to simply adding the different results. By 2030, GDP per capita increases by up to 2% and, by 2050, GDP per capita increases by up to 10% relative to the baseline.

This is a relatively large impact when compared to the E3ME model results from implementation of other labour market policies. For example, E3ME modelling for a study titled: 'Education outcomes and macroeconomic imbalances' for DG EAC in 2016, showed that full convergence in educational attainment across EU Member States over a 20-year period would lead to a 2.2% increase in EU GDP by 2050, compared to a scenario where each EU Member State retains its current distribution of educational attainment.

Figure 5.3 Effect of combined gender equality pathways on GDP per capita



Source: Study calculations

5.2.2 Total Labour Force

The total labour force increases across all gender equality pathways modelled. The largest increase in the labour force is unsurprisingly in Pathway 2 (increased activity rates), where the labour force increases by 6-10 million in 2030 and by 7-12 million in 2050, reflecting the large increase in the number of women actively participating in the labour market. In Outcome 4 (higher fertility rates as a result of more equal distribution of unpaid care work), there is minimal change in the labour force by 2030 but, by 2050, there is a large increase in the working age population and thus an increase in the total labour force, which increases by up to 8 million people, relative to the baseline. The education equality and wage equality pathways (numbers 1 and 3) both show a small increase in the total labour force.

In Pathway 5, the size of the EU labour force could increase by 23 million by 2050. This reflects a large increase in the working age population as well as an increase in women's activity rates and additional supply-side effects due to increases in female education and wage rates.

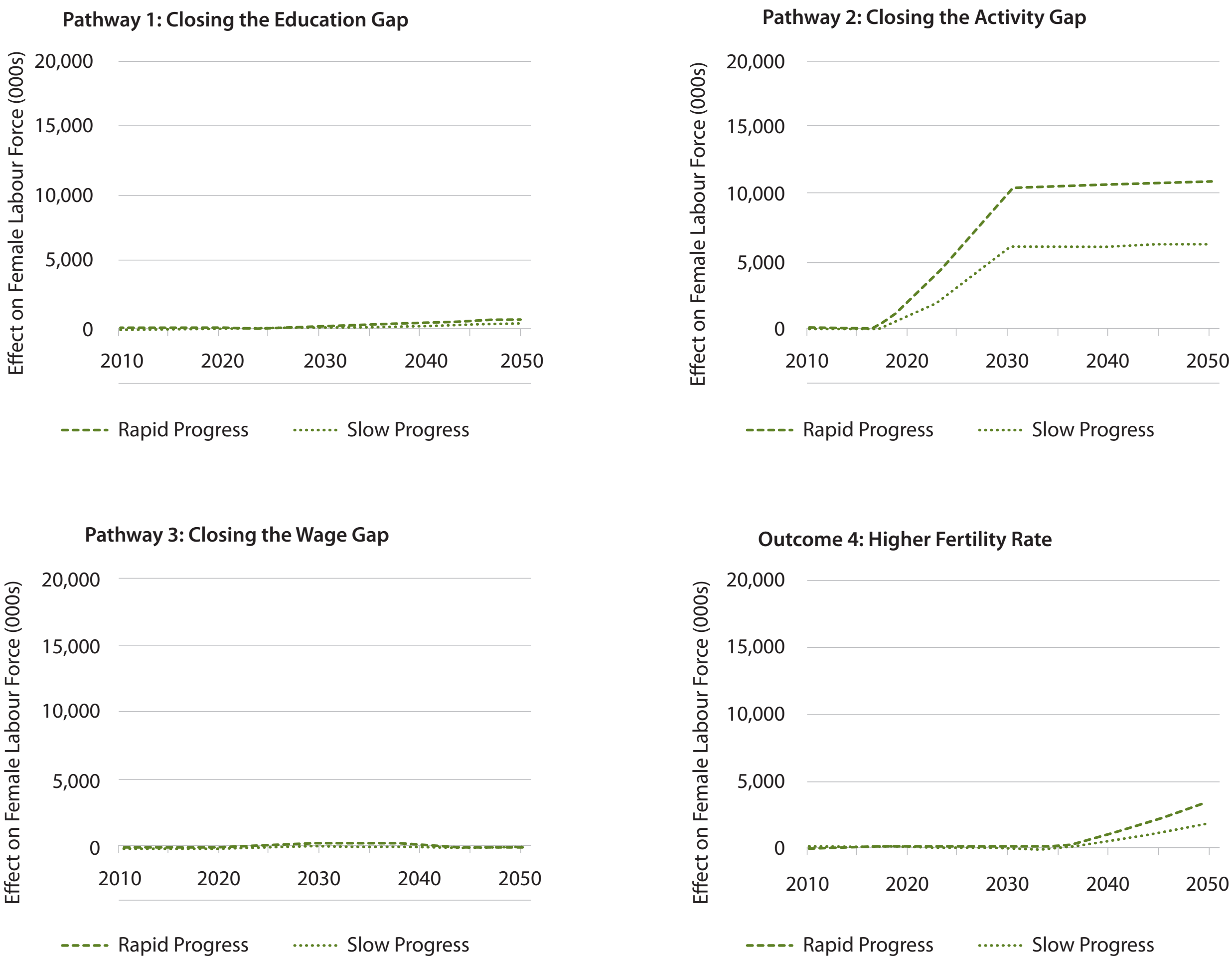
5.2.3 Women in the Labour Force

The number of women in the labour force increases in all the different scenarios that were assessed. The increase in the female labour force is most prominent in Pathway 2, in which activity rates[25] of women are directly targeted. Under this pathway, the number of women in the labour force could increase by more than 10 million by 2030. The size of the female labour force relative to the baseline increases further over the period to 2050, although not as part of the scenario design (in the scenarios it is assumed that female participation rates increase up to 2030); this explains the levelling off of the curve in the charts below. However, after 2030, the higher activity rates of women are maintained and there is further economic growth which leads to a small additional increase in the number of women in the working-age population. Eurofound (2016) describes the positive linkages between female labour market participation and economic growth rates further.

In the scenarios that consider higher fertility rates, the number of women in the labour force remains relatively stable until the mid-2030s, as the additional individuals that enter the population are too young to work. From the mid-2030s onwards, these children reach working age and the number of women in the labour force begins to grow. By 2050, the female labour force is expected to be up to 4 million

25 The activity rate is the percentage of economically active population in the total population, following the definition used by Eurostat (http://ec.europa.eu/eurostat/web/products-datasets/-/tipslm60).

Figure 5.4 Effects of each individual pathway on the female labour force



Source: Study calculations

women larger, when compared to the E3ME baseline in the same year.

There is a small increase in the number of women in the labour force following closure of the education gap (Pathway 1), due to an increase in economic output. However, in Pathway 3, which assumes closure of the wage gap, there is limited impact on activity rates of women. The higher real wage rates initially makes the labour market more attractive to working-age women. Over time, however, the increase in the labour supply puts downwards pressure on wages and participation.

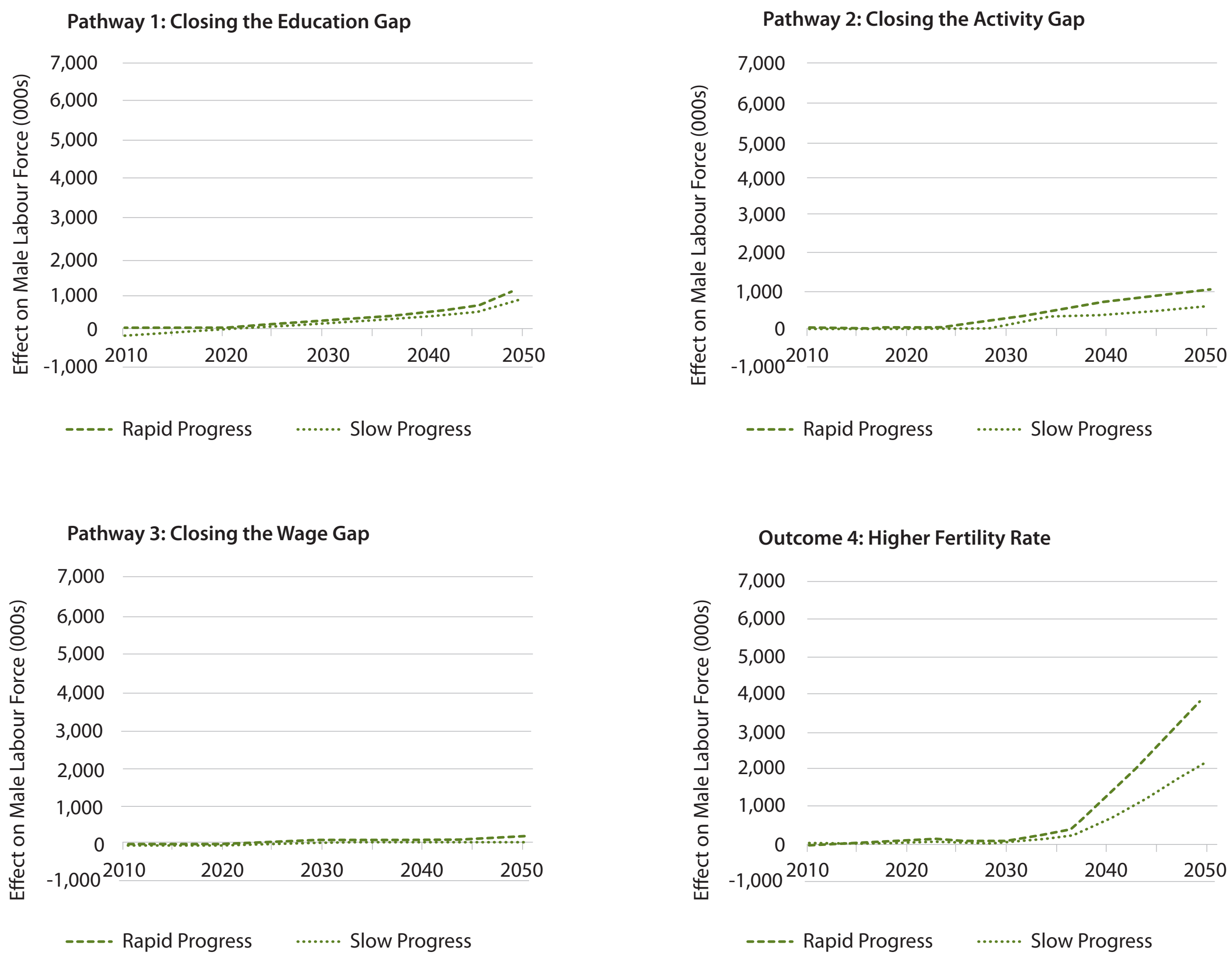
5.2.4 Men in the Labour Force

The number of men in the labour force is not directly affected by the gender equality measures identified in the modelling scenarios. However, in some of the scenarios there are secondary effects from increases in wage rates that can encourage both men and women to participate actively in the labour market, so it is not always only the number of women in the labour force that increases.

In the scenarios that assume a closure of the education gap (Pathway 1), the number of men active in the labour market increases by up to 900,000 by 2050 following an increase in productivity, wage rates and economic output.

In Pathway 2, with higher activity rates of women, the number of men in the labour force does not change by much in the short term but increases in the longer term. Although GDP grows in this pathway over the entire projection period, up to 2030 most of the labour market benefits accrue to the additional women in the workforce. After the activity rate of women stops increasing in 2030 (which was the assumption used in this pathway), the benefits of higher production levels attract more men into the labour market as well. The message from this is that higher rates of participation in the labour market amongst women will only

Figure 5.5 Effects of each individual pathway on the male labour force



Note: The scale has been adjusted compared to the previous figure; the impacts are smaller here than for the female labour force.
Source: Study calculations

benefit women initially but, in the longer run, there could be benefits for both men and women.

Higher fertility rates have no immediate impact on the male labour force, as the higher birth rate leads to an initial increase in children that are too young to work. After a 20-year lag, the number of men in the labour force begins to increase and, by 2050, an increase of up to 4 million of men in the labour force is observed. This is broadly equivalent to the effects observed for the number of women in the labour force under this pathway, as we assume that the increase in fertility rates correspond to an equal increase in the number of boys and girls.

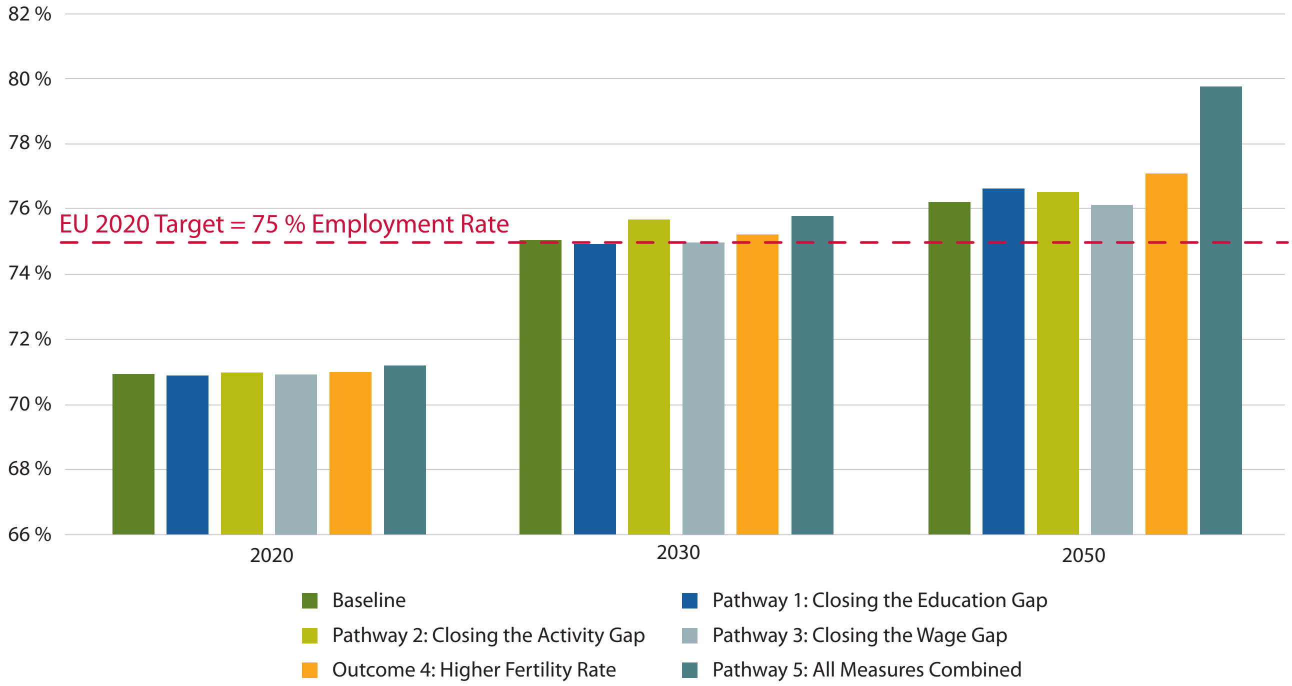
In Pathway 3 there is a very small increase in the number of men actively participating in the labour market following the small increase in GDP growth.

5.2.5 Total employment

In the E3ME model, employment is measured as a headcount, although there are also measures of average working hours in the model. We do not assume that there is any change in the structure of employment, in terms of part/full time jobs, but it is possible that there would be an increase in the share of part-time work in the scenarios (in which case the size of the impact on headcount employment would increase).

Employment results follow similar patterns as GDP but are smaller in magnitude (usually around half the size of impact in percentage terms). The lower relative employment impacts are due to labour productivity improvements as GDP increases, i.e. some of the additional value is captured through higher wage rates or firms' profit margins rather than increases in the number of people employed.

Figure 5.6 EU28 Overall employment rate in Rapid Progress scenarios (percentage of population aged 20-64 in employment)



Source: Study calculations

Total employment falls slightly in Pathway 3 (wage gap), but increases in 2050 under all the other pathways modelled. In Pathway 1, which reduces the education gap, total employment in the EU28 in 2050 increases by up to 1.2 million people; in Pathway 2, which increases female participation rates, employment increases by up to 6 million; in Outcome 4, employment increases by up to 2.5 million; and, under Pathway 5, total employment in the EU28 increases by up to 10.5 million.

5.2.6 Employment rates and Europe 2020 targets

In light of the European Commission's Europe 2020 employment targets, the employment rate is also an important indicator for comparison of the gender equality pathways.

The European Commission's Europe 2020 strategy includes a target for 75% of the population aged 20-64 to be in employment by 2020. This is an ambitious target, particularly following the 2009 global economic downturn and the subsequent federal debt crisis in Europe which led to long-term structural unemployment in a number of EU countries. By 2010, the EU employment rate was 68.6%, more than 6 percentage points lower than the 2020 target. The EU employment rate has improved slightly since then, reaching 70.2% in 2015, but is still almost five percentage points lower than the target rate for 2020. The current employment rate for women is much lower, at 63.8%. Our baseline, which is based on CEDEFOP projections, reflects conditions where the average employment rate for the whole working age population will increase to 71.0% by 2020 and the employment rate for women will increase to 65.5% by 2020.

Most of the gender equality pathways that were modelled for this study reflect a marginal improvement on the baseline employment rate by 2020. In Pathway 5, which combines improvements in female education, wages, activity rates and an increase in the fertility rate, the employment rate reaches 71.2% in 2020.

Although the EU still falls short of the meeting the Europe 2020 targets under the modelled gender equality pathways, these pathways are intended to reflect long-term gender equality measures. As such, in the long run, there is a considerable improvement in both the overall and the female employment rate. In 2030, the results for Pathway 5 show that the female employment rate reaches 72.6%. By 2050 there is parity in the employment rate for women and men under Pathway 5, as the employment rate reaches almost 80%.

5.2.7 Employment by gender

Figure 5.7 shows the impact of the gender equality pathways on total employment of men and women (in absolute terms) in the rapid progress scenarios.

Pathways 1 and 2 show large increases in employment of women but some of this increase comes at the expense of men, meaning that there is a displacement effect. This displacement effect starts off being quite large[26], but it falls quickly over time. By 2050 it lies in the range of 20% (Pathway 2) to 40% (Pathway 1), roughly meaning that for every man displaced from employment there are between two and five additional women in employment. Of most importance, there is still an increase in total employment across Europe.

In Pathway 1, women become relatively more productive due to higher rates of STEM qualifications and there is an increase in the potential output of the economy. As a result, demand for labour increases and, by 2050, we see an additional 1.8 million women in employment. Some of these women displace men in the labour market, as they become relatively more productive and more competitive in the labour market due to their higher qualification levels. As noted above, this pathway has the largest displacement effect.

Pathway 2 assume a relatively large increase in the share of women active in the labour force. In some countries, the gap between the share of women in the labour force relative to the share of men in the labour force falls by up to 20 percentage points in the Rapid Progress scenario by 2030. Participation rates do not increase by much after 2030, which causes growth in employment to slow, but the lagged effects mean employment of women increases further up to 2050. Because women now make up a larger share of the pool of people available for work, we see a large increase in the number of women employed which, by 2050, increases by 4 million under the Slow Progress scenario and by 7 million under Rapid Progress. The displacement effects arise in Pathway 2 because there are more women willing and able to take jobs compared to the baseline. The reduction in male employment takes place gradually because the labour supply of women increases gradually and because women will only have an opportunity to displace jobs previously occupied by men after those men leave their job e.g. during periods of cyclical and frictional unemployment. However, once the share of women in the labour force stops increasing after 2030, male employment levels start to return towards baseline values.

26 Partly this initial high displacement effect relates to a general increase in productivity; if workers become more productive then fewer are needed to meet the given demand for a product. See additional discussion on this issue in Annex 5.

The pathway that assumes an increase in women's wages (number 3) has a minimal impact on employment levels for women. While the higher wages rates incentivise more women to enter the labour market, leading to an increase in the productive capacity of the economy, the higher labour costs also drive firms to reduce their demand for labour relative to other inputs to production. Male employment rates are also largely unchanged.

On its own, an increase in fertility rates could be expected to reduce employment levels amongst women (e.g. due to maternity leave and childcare) but it is important to note that the scenarios describe a much broader set of changes that allow women to increase labour market activities. Overall, therefore, an increase in fertility rates leads to an initial increase in consumption, leading to an increase in demand for goods and services, and an increase in employment. Over the 2040-2050 period, the pace of increase in employment is more rapid, as more men and women reach working age and enter the labour market, leading to an increase in potential productive capacity of the economy, an increase in real incomes and, through the multiplier effect, additional increases in economic output and employment. By 2050, there are an additional 2.5 million people in employment under the rapid progress scenario.

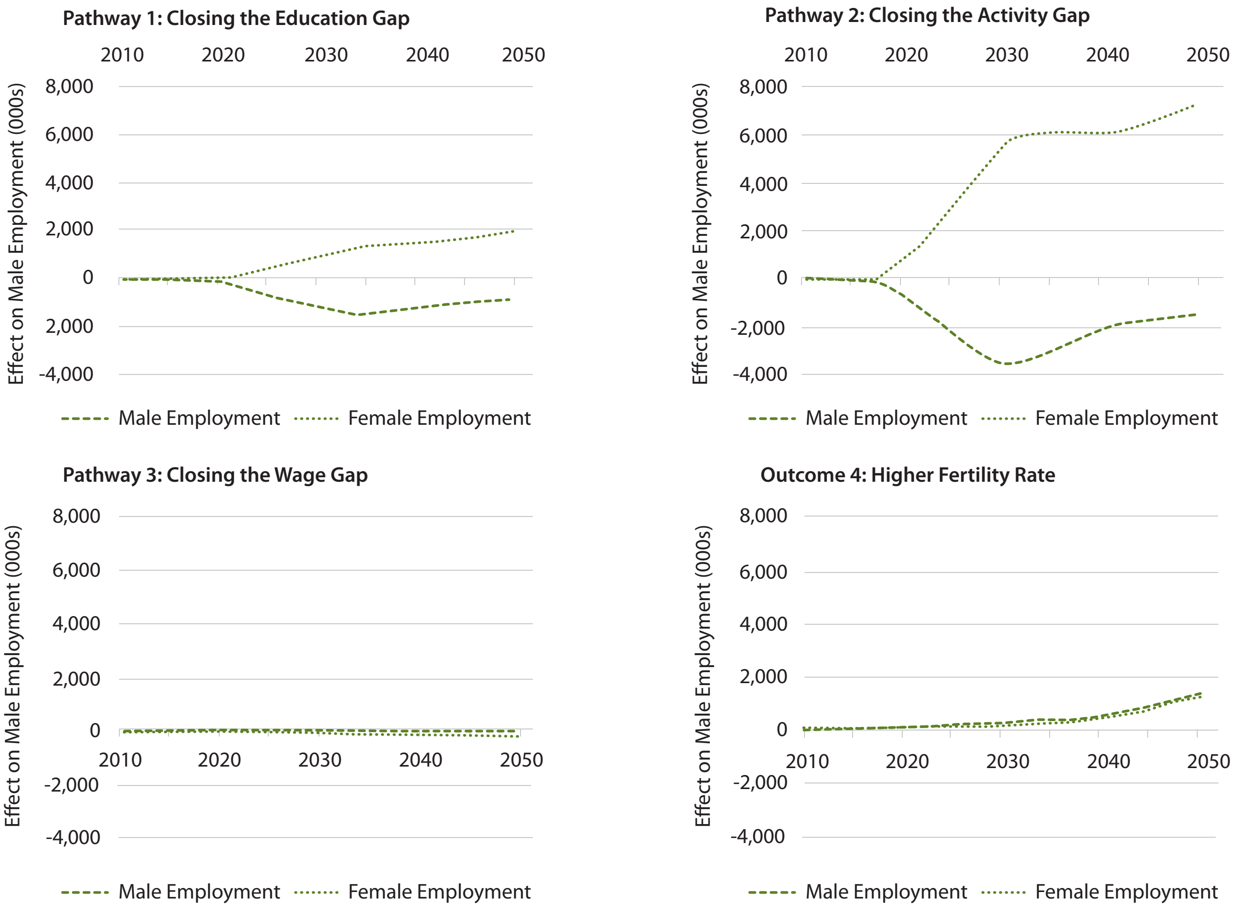
In Pathway 5, employment of women increases by up to 3 million people in 2030 and by up to 7.5 million people by 2050. The profile of the increase in female employment follows that of Pathway 2 (the activity gap) which shows the largest impacts; there is quite a rapid increase in the number of women employed in Europe up to 2030, with a slowing of the rate of increase thereafter, but some further increase towards 2050 due to the additional population. Under Pathway 5, female employment rates are expected to converge with male ones by 2050, pushing towards 80%, compared to a female employment rate of 74.1% in the baseline (see Figure 5.8).

In the combined pathway, it should be noted that it is not just employment levels for women that improve. Due to higher education rates and the wage gap closing, the jobs will be better paid than in the baseline case. Overall there is some increase in both the quantity and the quality of labour.

5.2.8 Unemployment

There is some increase in unemployment rates in the gender equality pathways because the increase in the labour supply is initially greater that the increase in labour demand. This increase is likely to be unavoidable for gender equality policies that try to improve labour market participation of women. The reason is that it takes time for the market to

Figure 5.7 Effect of rapid progress scenarios on employment of men and women



Source: Study calculations

adjust to the new labour supply; it is highly unlikely that all of the additional labour force will be absorbed immediately by firms.

In most cases the increase in unemployment is mild by 2030, generally less than 0.3 percentage points. The exception is the case of reducing the gender gap in activity rates (Pathway 2), where the unemployment rate at EU level increases by up to 3.5 percentage points in the Rapid Progress scenario and by two percentage points in the Slow Progress scenario. However, in the long term labour demand begins to catch up with the increase in labour supply and unemployment starts to fall back towards baseline levels.

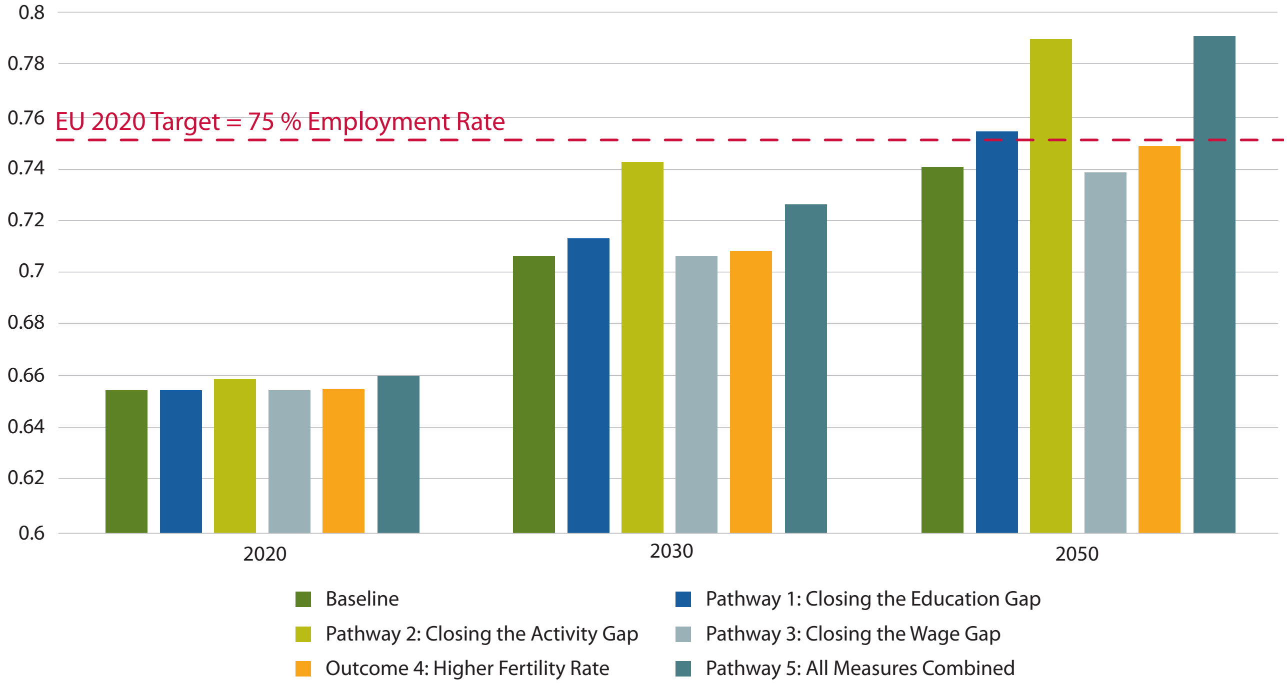
It should also be noted that most of the newly unemployed people are likely to have been previously inactive on the labour market. Thus the increase in unemployment can be interpreted as a cost of integrating women in the labour market, where for some women it will take longer to find employment than for others. As described in previous sections, there is not a net loss of jobs overall in the European economy.

With higher fertility rates, the unemployment rate initially falls very slightly (relative to the baseline), as there is an increase in consumption relative to the working age population, leading to an increase in economic output and employment. This increase in demand for labour is enough to outweigh a small increase in the labour supply. Over 2040-2050, the additional children born under this pathway reach working age and enter the labour force, leading to an initial increase in unemployment. However, it is expected that in the long run (beyond 2050), as real income and consumption rise, there will be further increase in economic output and a further increase in labour demand that will initiate a gradual decline in the unemployment rate.

5.2.9 Gender wage gap

Figure 5.10 shows impacts on the gender wage gap under the various pathways modelled. Two of the pathways result in a closure of the wage gap by 2050. In Pathway 1

Figure 5.8 EU28 Employment rate of women in Rapid Progress scenarios (% of population aged 20-64 in employment)



Source: Study calculations

there is an increase in the number of women graduating in STEM subjects and, because of their higher educational attainment and choice of career in higher-wage sectors under this pathway, women experience a gradual increase in average earnings, reaching parity with wages for men by 2050. In Pathway 3, the gender equality measures are specifically targeted to eliminate the gender wage gap. By 2030 the gender wage gap (ratio of female to male earnings) is reduced to 0.9 and, by 2050, the gender wage gap is eliminated under this pathway. Pathway 5 combines the measures included in all other pathways and so, by 2050, average wages for women are slightly higher than average wages for men.

In Pathway 2 (which assumes an increase in female activity rates) and Outcome 4 (which leads to an increase in fertility rate), there is no effect on the gender wage gap. In both cases, the increase in labour supply and resulting higher unemployment affects wages for men and women in a similar way. The wage gap effects in these scenarios are therefore not shown in Figure 5.10.

5.2.10 Other macroeconomic indicators

Results for other key macroeconomic indicators in 2030 and 2050 are presented in Table 5.1 and Table 5.2 at the end of this chapter.

Consumer spending

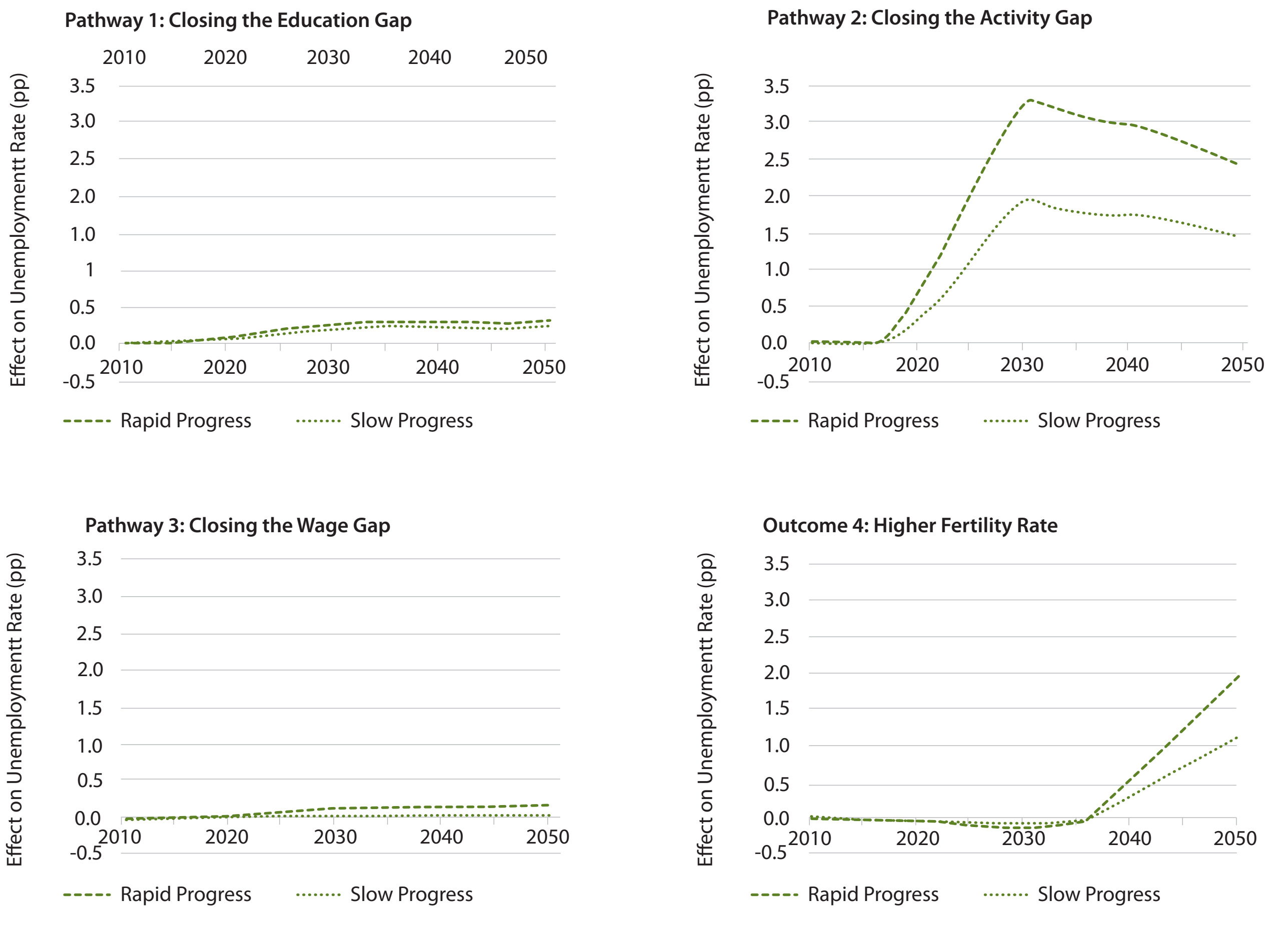
Consumer spending accounts for a very large part of the GDP impacts and, in the pathways which stimulate an increase in the labour force, consumer spending increases by 2-4% by 2050. Consumer spending increases due to an increase in employment and the resulting increase in real household incomes.

Consumer prices and competitiveness

Consumer prices in the activity rate and education pathways are lower than in the baseline due to an increase in the potential productive capacity (supply) of the economy. For example, the increase in the supply of labour puts downward pressure on wages. In the long run, these cost reductions are passed on in the final prices of goods and services. Thus, prices of consumer goods fall and firms see a reduction in the price of intermediate goods and services, which boosts their international competitiveness.

In Pathway 3, which assumes closure of the wage gap, the relatively small exogenous increase in women's wages leads to an increase in the labour supply and, eventually this puts downwards pressure on wages overall so that, by 2030, price effects are negligible.

Figure 5.9 Effect of gender equality pathways on unemployment rate (results presented as pp difference from baseline)



Source: Study calculations

Figure 5.10 Impact of Pathway 1, Pathway 3 and Pathway 5 on the gender wage gap

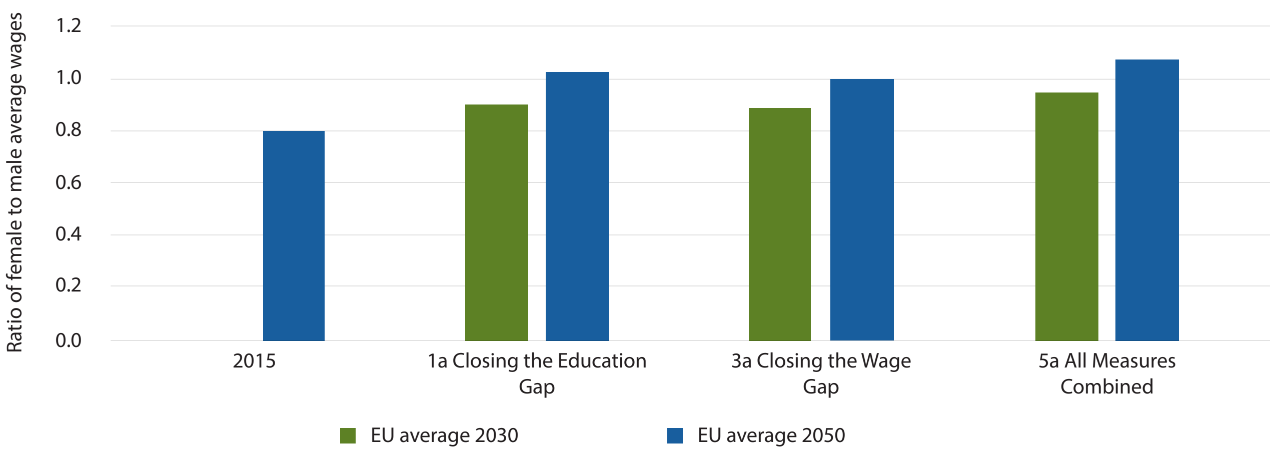
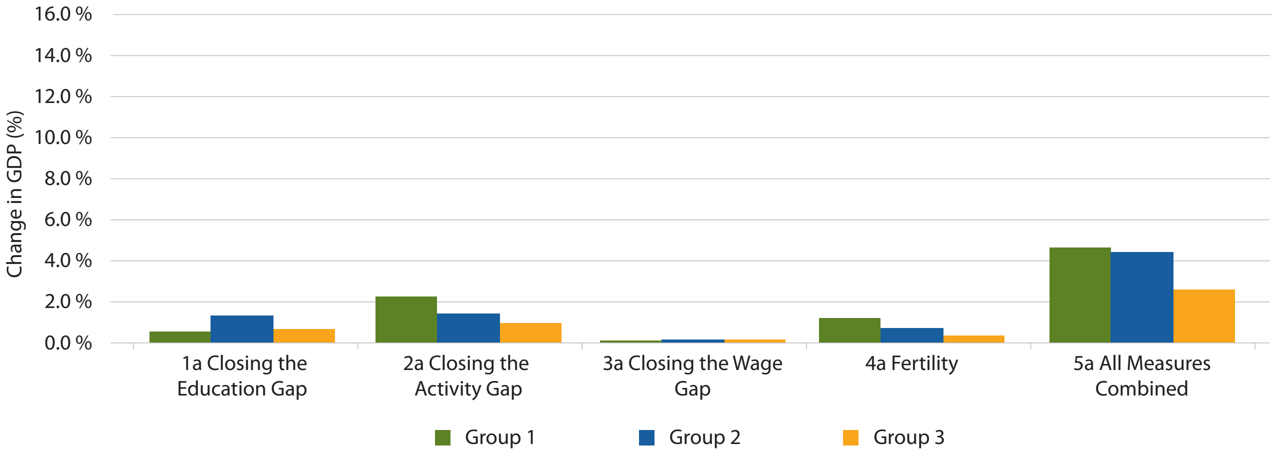


Figure 5.11 Impact on GDP in the Rapid Progress scenarios in 2030



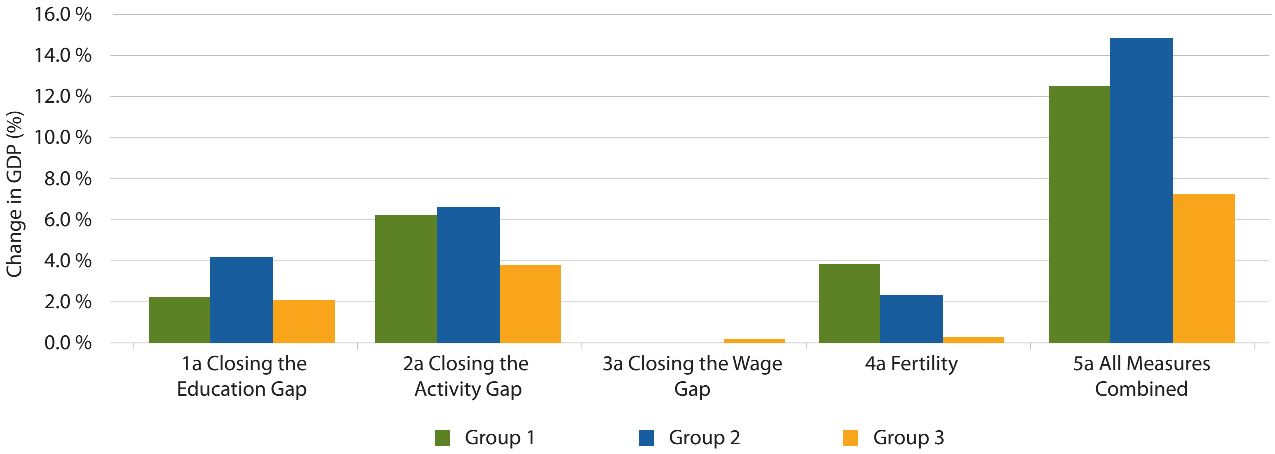
Source: Study calculations

Note(s) Group 1 includes: SK, HR, IT, CZ, PL, LT, EL, BG, PT, BE;

Group 2 includes: ES, HU, MT, FR, RO, EE, DE, LV, LU;

Group 3 includes: SI, IE, AT, NL, UK, FI, CY, DK, SE.

Figure 5.12 Impact on GDP in 2050



Source: Study calculations

Note(s) Group 1 includes: SK, HR, IT, CZ, PL, LT, EL, BG, PT, BE;

Group 2 includes: ES, HU, MT, FR, RO, EE, DE, LV, LU;

Group 3 includes: SI, IE, AT, NL, UK, FI, CY, DK, SE.

The general reduction in consumer prices has two main impacts: it leads to an increase in household real income (and consequently the increase in consumption described above) and it drives an improvement to international competitiveness (leading to an improvement in the trade balance).

Trade balance

Following an increase in the potential productive capacity of the economy and lower prices, the EU produces more goods and services domestically and also becomes more competitive in international markets. As a result, there is an increase in exports and a reduction in imports across all scenarios.

Investment

The impacts on investment demand usually follow the aggregate trends for GDP in the long term. Companies invest in the expectation of future profits, so higher rates of GDP growth lead to additional investment. This is consistent with the modelling results, which show that, by 2050, there is an increase in investment across all scenarios.

5.2.11 Results by Member State

Figure 5.11 and Figure 5.12 show the GDP impacts for the outcome pathways for different clusters of Member States in 2030 and in 2050. The Member States have been grouped according to their current level of gender equality in the area of work.[27] Group 1 comprises the Member States in which measured outcomes for women and men are most unequal while Group 3 comprises Member States with the highest levels of gender equality. For presentational reasons, only the rapid progress scenarios are shown, but the pattern of impacts is similar (but smaller in magnitude) for the slower progress scenarios.

The pattern in the results is one that is very positive overall, with increases in GDP of over 4% in the combined pathways for Group 1 and Group 2 in 2030. GDP gains are typically largest in Member States that are most unequal in the baseline, as greater policy effort is required for them to achieve gender equality. The results also show that larger impacts are typically observed in countries that are lagging at present and so make up the most ground in the scenarios that were modelled.

By 2050 the positive impacts are bigger for all country groups. Again, Groups 1 and 2 see the largest increases in GDP, although this time Group 2 has slightly higher positive impacts due to the long-run benefits of a more highly educated workforce[28].

5.2.12 Results by Sector

Figure 5.13 shows the impacts on Gross Value Added (GVA) in each of the main sectors of the EU economy in 2050. There are positive results in all sectors and the results show that there is quite a similar impact on most of the sectors by 2050, although three sectors stand out as being differentiated (one higher and two lower).

The differences between results across sectors can be explained by the pattern of changes in the components of demand in the scenarios. In general, it is household consumption that increases the most, which explains the larger positive impacts seen for accommodation and food services. The two sectors that see smaller impacts are those that are least reliant on higher levels of consumption; construction output is highly dependent on levels of investment, while output of government services depends on levels of public expenditure.

There is a bit more variation in the sectoral results for employment. As well as depending on the results for output, employment impacts are affected by developments in wage rates and employment levels, and some sectors are much more sensitive to changes in production volume than in others. Figure 5.14 shows that, again, there are no negative results, but this time there are some sectors that are not impacted by much.

The chart is in absolute number of people employed compared to the baseline, so the sectors that are larger employers (e.g. business services, government services) tend to show larger overall impacts. As well as construction, the sectors in which employment does not change by much are energy (small employment level that is inelastic to output), transport and storage and communications (both small employers in the economy). The patterns of employment across the different scenarios are broadly familiar with the results for output.

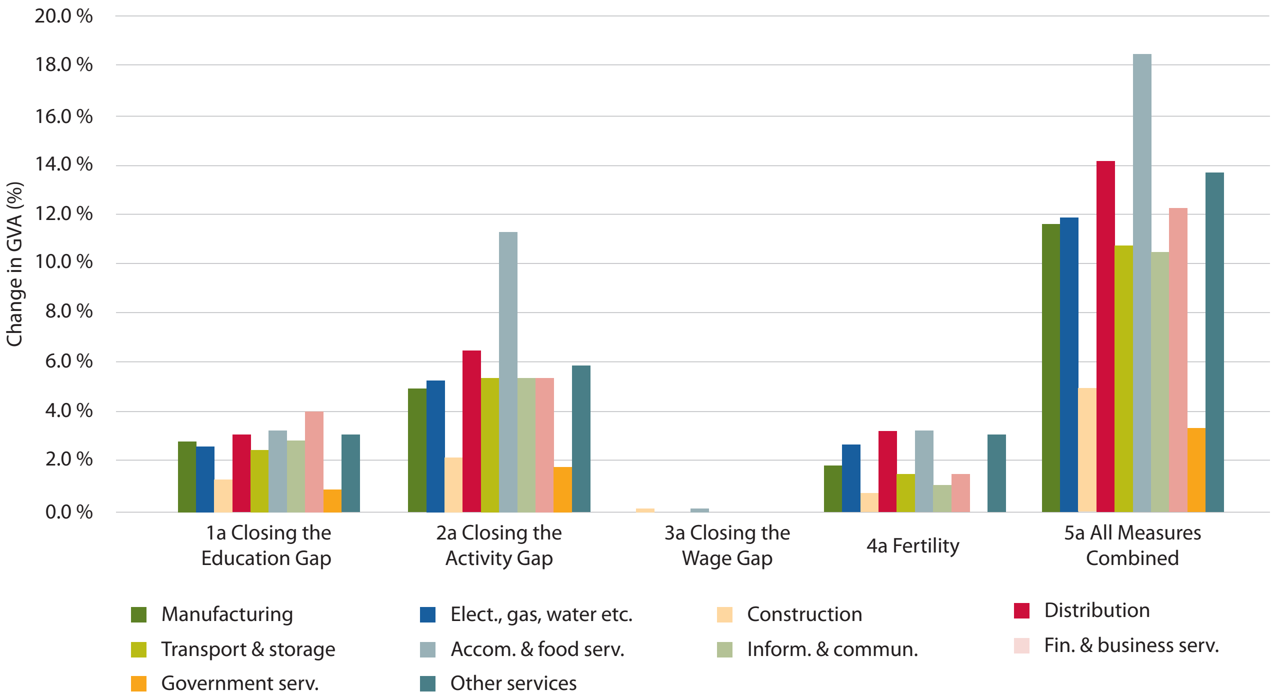
5.2.13 Estimating the value of unpaid work

National accounts provide statistics on production, income formation and income expenditure for different sectors of the economy. They provide the standardised accounting framework that is used for the calculation of GDP. Whilst households are a sector defined within the national accounts, it is only household consumption and wages and salaries from formal employment that are accounted for and measured within the national accounting framework. The value of unpaid home production (time spent on activities such as child care, housing services, cooking and cleaning) is not included within the national accounts, even though these activities create value and contribute to the well-being of individuals, their families and societies. This section of the report estimates the value of unpaid household work in monetary terms and considers the likely effects of gender equality measures on time spent by women and men on unpaid household activities.

27 The clustering was based on current levels of gender equality, as measured by the Gender Equality Index published by EIGE. More precisely we used the Gender Equality Index scores in the work domain to divide the countries into three groups with roughly the same number of Member States.

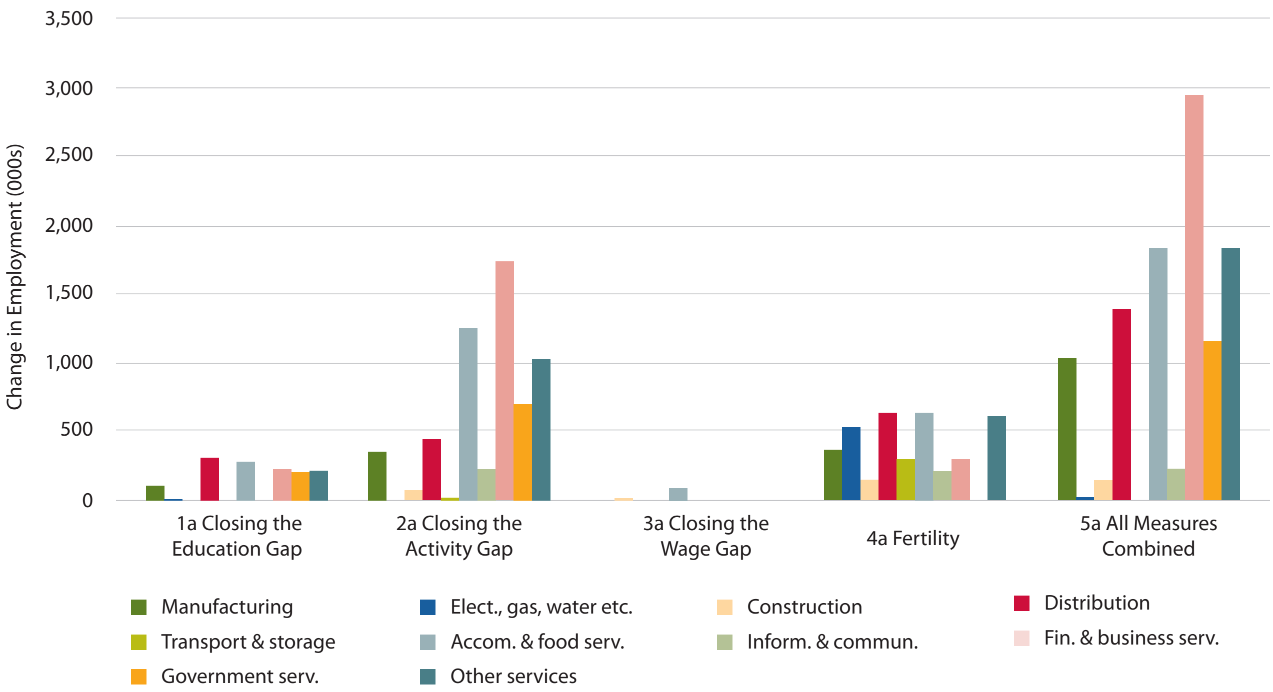
28 The countries in Group 1 are the most unequal in terms of participation rates, but some countries in Group 2 are more unequal in terms of qualifications.

Figure 5.13 Impact on GVA by Sector in 2050



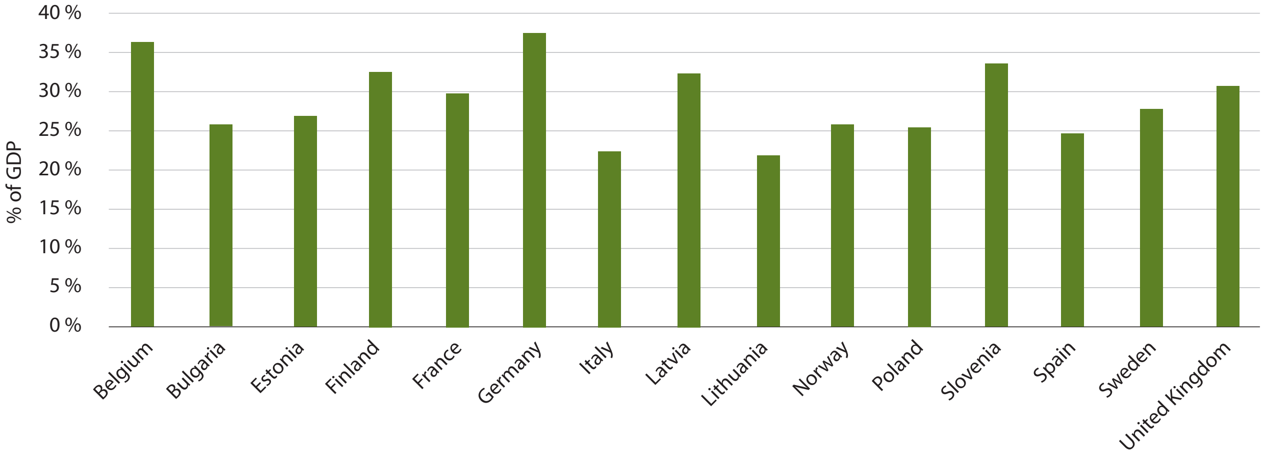
Source: Study calculations

Figure 5.14 Impact on Employment by Sector in 2050



Source: Study calculations

Figure 5.15 Estimated contribution to unpaid household activities (presented as a percentage of GDP in 2015)



Source: Study calculations

There are a variety of methods for valuation of non-paid labour inputs. Eurostat recommends using a replacement cost based on the wages of a generalist worker or housekeeper as the most appropriate basis for valuing household labour[29]. There are many limitations of this approach, as it is likely that a family member puts more time and emotional effort into looking after their home and caring for their family than a paid housekeeper and, as such, their work is likely to be of higher quality and should be valued at a higher rate. However, it is difficult to put a monetary value on this higher quality of work. For simplicity, data on the mean hourly wage rate for people employed in 'Other Services'[30] is used as a measure of the value of unpaid household work, although it is likely that this underestimates the true value. This is multiplied by data on hours spent on household production activities from the Harmonised European Time Use Survey[31] to estimate the value of unpaid household work by women and men across several EU Member States and for the EU as a whole.

The chart below shows the estimated value of women and men's contribution to unpaid household work for a selection of EU Member States, relative to 2015 GDP in each country.

In the pathways where there are considerable increases in female participation in formal employment, we estimate the reduction in the value of time spent on unpaid household activities. This opportunity cost of formal employment is estimated based on the assumption that every unemployed female worker spends approximately twice as much time each week on household production activities[32].

Figure 5.16 presents results showing EU28 GDP impacts in the rapid progress pathways and the estimated scale of the welfare lost in these pathways due to less time spent on household activities, such as childcare, cooking, cleaning and DIY (due to an increase in time spent in formal employment).

The welfare calculations suggest <0.1% downwards adjustment to the estimated GDP impacts for the education gap pathway and a 0.2-0.4% downwards adjustment to the estimated GDP impacts for the activity rate gap pathway. The scale of this adjustment to take account of the value of unpaid work is therefore not sufficient to detract from the substantial GDP and welfare improvements that emerge from the macroeconomic modelling results.

The estimated welfare adjustment for the GDP impacts in Pathway 3 are negligible, as the employment impacts were found to be low. For the fertility rates scenario, the increase in employment followed a (lagged) increase in the working age population, which meant that there was an increase in employment coupled with an increase in the number of

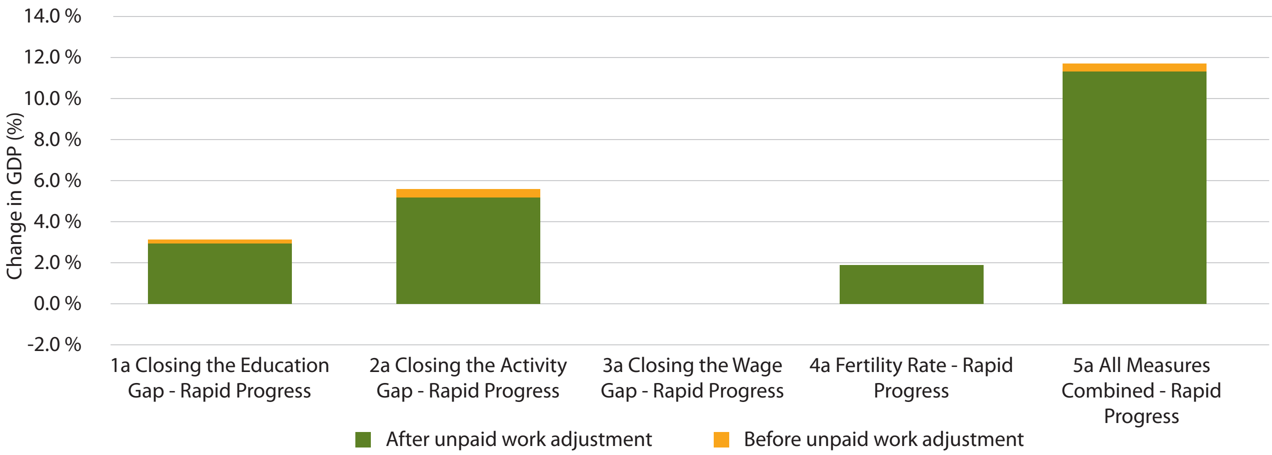
29 Eurostat 2003 European Commission (Ed.): Household Production and Consumption: Proposal for a Methodology of Household Satellite Accounts. Luxembourg, 2003.

30 'Other Services' refers to Nace Rev. 2 Section S activities. These include: activities of membership organisations; Repair of computers and personal and household goods; and Other personal service activities.

31 Harmonised European Time Use Survey, available at: https://www.h5.scb.se/tus/tus/StatMeanMact2.html

32 Assuming women have 10 hours per day to spend on paid work or other household activities, women that are not in formal work will have 10*7=70 hours per week to spend on these activities. If the average woman in employment works for 7 hours per day, 5 days per week, they will spend 35 hours per week in work and would have 70-35=35 hours per week left to spend on other household activities and chores.

Figure 5.16 Impact on GDP before and after adjusting to take account of loss of welfare from women spending less time on household and childcare activities



Source: Study calculations

women and men not in work. Employment rates improved slightly, but not enough to expect a large-scale welfare adjustment to take account of the lost value of unpaid household work.

There are considerable gender inequalities in the time spent on unpaid household activities, with women spending a disproportionate amount of time on activates such as cooking, cleaning and childcare, compared to men. In all the countries we assessed, the estimated value of women's contribution to the household is over 50% and, in some cases, more than double, the contribution by men.

Data from the European Time Use Survey shows that, across this group of 15 EU Member States men spend, on average, 2.3 hours per day on unpaid household activities, compared to an average 3.8 hours per day for women. This creates unequal opportunities as it limits the time that women can spend participating in paid employment.

Outcome 4 and Pathway 2 focus directly on eliminating this unequal distribution of unpaid work. In the pathways that reflect an improvement in educational attainment and activity rates for women, the model results show an increase in employment of women. In Pathway 5, which considered the impacts of a combination of gender equality measures, female and male employment rates converge in the long run, in both cases reaching a 79% employment rate by 2050. It is therefore highly likely that, under this pathway, unpaid household activities will be more equally distributed among women and men, as the time spent in paid employment will be split more equally. Furthermore, the overall increase in the employment rate for the population as a whole suggests that people will have less spare time to spend on unpaid household activities. It is therefore highly likely that some of these activities will be replaced by formal paid employment, creating more jobs in the service sector for cleaners, childminders, gardeners, dog-walkers and similar activities, thus further contributing to economic activity and GDP.

5.2.14 Robustness and sensitivity of results

E3ME is a macro-econometric model, which consists of various econometric equations. Each of the econometric equations in the model is estimated using a data set of annual time series that date back to 1970; the results from the estimation include standard measures of fit and tests for significance. However, instead of using standard t-tests to justify inclusion of explanatory variables in the model based on their statistical significance, the Akaike Information Criterion (AIC) is used to select the equation specification that best fits and explains the historical data. In some cases, for example where data series are short or incomplete, shrinkage estimation is used or an alternative, simpler model specification is applied[33].

It is possible to assess formally the robustness of each individual econometric equation in the model, for example by constructing confidence intervals. It is also possible to

33 A simpler model specification might, for example, assume that consumption grows in line with real incomes, or that employment in a particular sector grows in line with gross output in that sector after an adjustment to take account of a fixed labour productivity expectation.

test how well the equations explain the historical data.[34] However, there is no equivalent method for estimating robustness or explanatory power of the modelling system as a whole – i.e. how well the equations fit together.

Our discussion of robustness therefore focuses on risks and uncertainty on a more qualitative basis. There are many sources of both in the modelling, including:

- The accuracy of the data that are used;
- Definition of the baseline;
- Econometric estimates of the model parameters;
- Inputs to the scenarios.

The accuracy of the data is important in determining overall outcomes but is unlikely to bias results one way or the other. As the data used in the E3ME model are based primarily on Eurostat figures, there is not much scope for improvement or additional testing.

Regarding the baseline, there are many factors that might affect the magnitude of results (e.g. future rates of population growth) without changing the overall messages from the study; and, again, as the baseline has been derived from official projections, there is no reason to suspect upward or downward bias. A key uncertainty here relates to future economic development on both the supply and demand sides of the economy. Our baseline projections assume continued recovery from the recession but also quite strong productivity growth so that there are not labour shortages across Europe. However, if slower productivity growth was combined with ageing populations then there could be capacity constraints within European labour markets, which some of the scenarios described in this report could help to alleviate. Our assumptions here could therefore be viewed as quite conservative in nature.

The parameter coefficients that are estimated in the model are an important part of the overall assessment, as they effectively determine the differences between the baseline results and the scenario results. The econometric methods used to estimate these coefficients ensures that the values are not biased. Some of the key parameter sets are:

- How wage rates respond to a larger labour force;
- How employment responds to changes in wage rates;
- How prices respond to changes in production capacity.

In theory, it would be possible to adjust these parameter values (e.g. by one standard deviation) and test the scenarios again. In practice this is a very resource-intensive exercise and it assumes that the sensitivity of these parameters does not change over time. It is therefore useful to consider the linkages more qualitatively.

In most cases the direction of the effects can be taken as given, either from economic theory or through intuitive reasoning (e.g. in any given sector employment is unlikely to decrease in response to lower wage rates). Following through the logic presented in Figure 3.1, the impacts should on this basis be positive, both in the short and long runs. The magnitude of the impacts is more uncertain but it is reasonable to assume from this analysis that they would be substantial.

Finally, there is considerable uncertainty about the likely scale of the changes implemented in each pathway. To account for this we have included both the rapid progress and slow progress cases in each of the pathways. The results from these different scenarios show that the benefits will increase in line with the measures to increase gender equality, i.e. the more effort that is made to improve gender equality the larger the benefits are likely to be.

34 The R^2 value is a measure of how well the estimated equation explains variation in the data. Most of the econometric equations that are used for European Member states have high explanatory power. For example, the average adjusted R^2 value for the consumption equations (by European Member States) is over 92% in the long-term. The equations in E3ME use time-series data, where R^2 values are typically high (90% or higher) as they pick-up trends in the historical data. Adjusted R^2 is used to adjust for the number of parameters in the model, as the R^2 value increases with the number of parameters included.

Table 5.1 Macroeconomic impacts of the gender equality pathways in 2030

	1. Closing the Education Gap		2. Closing the Activity Gap		3. Closing the Wage Gap		4. Increase in Fertility Rate		5. All Measures Combined	
	Rapid progress	Slow progress	Rapid progress	Slow progress	Rapid progress	Slow progress	Rapid progress	Slow progress	Rapid progress	Slow progress
GDP	0,9%	0,7%	1,5%	0,8%	0,1%	0,0%	0,7%	0,4%	3,8%	2,4%
Consumption	0,8%	0,6%	1,8%	1,0%	0,1%	0,0%	1,2%	0,7%	4,2%	2,4%
Investment	0,5%	0,4%	-0,3%	-0,3%	0,1%	0,0%	0,2%	0,1%	0,6%	0,3%
Exports	0,5%	0,4%	0,5%	0,3%	0,0%	0,0%	0,0%	0,0%	1,0%	0,7%
Imports	-1,2%	-1,0%	-0,8%	-0,5%	0,0%	0,0%	0,7%	0,4%	-1,3%	-1,1%
Consumer price index	-1,7%	-1,3%	-4,0%	-2,4%	0,1%	0,0%	0,1%	0,1%	-5,6%	-3,7%
Labour force	0,1%	0,1%	4,5%	2,6%	0,1%	0,0%	0,1%	0,1%	4,3%	2,5%
Total employment	-0,1%	-0,1%	0,9%	0,5%	-0,1%	0,0%	0,2%	0,1%	1,1%	0,6%
Male employment	-1,0%	-0,9%	-2,9%	-1,8%	-0,1%	0,0%	0,4%	0,2%	-0,5%	-0,3%
Female employment	0,9%	0,7%	5,0%	3,0%	-0,1%	0,0%	0,1%	0,1%	2,8%	1,7%

Source: Study calculations

Table 5.2 Macroeconomic impacts of the gender equality pathways in 2050

	1. Closing the Education Gap		2. Closing the Activity Gap		3. Closing the Wage Gap		4. Increase in Fertility Rate		5. All Measures Combined	
	Rapid progress	Slow progress	Rapid progress	Slow progress	Rapid progress	Slow progress	Rapid progress	Slow progress	Rapid progress	Slow progress
GDP	3,0%	2,2%	5,5%	3,2%	0,0%	0,0%	1,9%	0,7%	11,6%	7,2%
Consumption	2,3%	1,7%	4,5%	2,6%	0,0%	0,0%	1,7%	0,7%	9,2%	5,7%
Investment	1,9%	1,4%	3,0%	1,8%	0,0%	0,0%	0,8%	0,2%	7,3%	4,3%
Exports	0,7%	0,6%	1,2%	0,7%	0,0%	0,0%	0,3%	0,1%	2,3%	1,6%
Imports	-1,2%	-1,0%	-0,1%	0,1%	0,0%	0,0%	0,4%	0,2%	-0,4%	-0,7%
Consumer price index	-2,7%	-2,0%	-5,4%	-3,3%	0,1%	0,0%	-0,9%	-0,3%	-9,0%	-6,1%
Labour force	0,7%	0,6%	5,1%	3,0%	0,1%	0,0%	3,3%	1,8%	9,7%	5,6%
Total employment	0,5%	0,4%	2,6%	1,5%	-0,1%	0,0%	1,2%	0,6%	4,6%	2,8%
Male employment	-0,7%	-0,6%	-1,2%	-0,7%	0,0%	0,1%	0,4%	0,2%	2,5%	1,6%
Female employment	1,8%	1,5%	6,7%	3,9%	-0,2%	-0,1%	1,9%	1,0%	6,9%	4,1%

Source: Study calculations

6. Conclusions

Gender equality and equal opportunities in the labour market have improved over recent decades as a result of legislative, social and cultural changes towards women in the labour force. However, there are still large persistent gender gaps between women and men when comparing their educational attainment, wage rates, labour market activity rates and provision of unpaid care work and distribution of time.

The E3ME modelling results show that encouraging more active participation of women in the labour market and increasing their attainment in STEM (Science, Technology, Engineering and Mathematics) education would have a largely positive effect on GDP per capita and employment of women. The positive impacts are due to an increase in productivity (under the higher education pathway) and an improvement to the potential productive capacity of the economy (under the higher education and higher activity pathways).

Closing the gender pay gap is a measure that is likely to encourage more women to participate in the labour market and it forms one of the pathways that was modelled. The results show a small positive effect on GDP per capita following an increase in women's wages, but there may be a small negative impact on employment under this pathway, as higher labour costs cause firms to substitute labour for other inputs to production.

The pathways show some labour market displacement effects and, in some scenarios, employment rates of men fall. However, these displacement effects fall over time and we still see a net increase in the size of the labour force and employment levels in almost all scenarios when considering the total population.

The scenarios with higher fertility rates show an initial reduction in GDP per capita, following an increase in the number of children (who are not able to contribute to the productive economy) but, in the long run, when these children reach working age, there is an eventual increase in GDP, labour supply and employment. Even though higher fertility rates are not the aim of gender equality policies, they must still therefore be considered in a macroeconomic assessment.

We also modelled the socio-economic effects of a case where all the gender equality measures are combined and fertility rates also increase as a result of a more equal distribution of unpaid care work between women and men. The combination of pathways reflects the fact that improving gender equality in one domain has spill-over effects in other domains, which could lead to concurrent improvement in women's education, improvement in labour market activity rates of women, increase in women's wages and increase in fertility rates. Under this combined pathway, GDP and employment effects were greatest, due to interaction effects between the various gender equality measures.

Under the combined pathway, GDP per capita increases by up to nearly 10% by 2050, and there could be an additional 10.5 million jobs in the EU (70% of which are filled by women).

Annex 1
Detailed scenario inputs

Table 1 Pathway 1 assumptions: estimates of the decrease in gender gap in education by Member State (computing)

Member State	Gender gap in education in 2030 under current trends (%)	Estimated reduction under Fast Progress Scenario (p.p)	Estimated reduction under Slow Progress Scenario (p.p)
Denmark	67%	14.1	14.1
Germany	80%	14.1	14.1
Czech Republic	82%	14.1	14.1
Malta	66%	7.5	4.8
Estonia	68%	7.5	4.8
Slovenia	89%	7.5	4.8
Bulgaria	49%	4.8	2.2
Ireland	57%	4.8	2.2
Spain	88%	4.8	2.2
Italy	75%	4.8	2.2
Cyprus	77%	4.8	2.2
Latvia	82%	4.8	2.2
Lithuania	90%	4.8	2.2
Hungary	78%	4.8	2.2
Netherlands	88%	4.8	2.2
Austria	81%	4.8	2.2
Poland	81%	4.8	2.2
Portugal	82%	4.8	2.2
Slovakia	87%	4.8	2.2
Finland	77%	4.8	2.2
Sweden	70%	4.8	2.2
United Kingdom	90%	4.8	2.2
Belgium	94%	4.8	2.2
France	84%	4.8	2.2

Source: Eurostat data, study calculations

Table 2 Pathway 1 assumptions: estimates of the decrease in gender gap in education by Member State (engineering)

Member State	Gender gap in education in 2030 under current trends (%)	Estimated reduction under Fast Progress Scenario (p.p)	Estimated reduction under Slow Progress Scenario (p.p)
Cyprus	66%	11.9	11.9
Romania	52%	11.9	11.9
Malta	76%	11.9	11.9
Austria	81%	11.9	11.9
Italy	64%	11.9	11.9
Denmark	51%	11.9	11.9
Netherlands	62%	11.9	11.9
Poland	62%	11.9	11.9
Germany	83%	11.9	9.4
Finland	70%	11.9	9.4
Sweden	63%	11.9	9.4
United Kingdom	79%	11.9	9.4
Slovenia	91%	11.9	9.4
France	85%	11.9	9.4
Ireland	77%	11.9	9.4
Spain	73%	11.9	9.4
Belgium	80%	9.4	3.7
Bulgaria	72%	9.4	3.7
Czech Republic	89%	9.4	3.7
Estonia	83%	9.4	3.7
Latvia	80%	9.4	3.7
Lithuania	86%	9.4w	3.7
Hungary	90%	9.4	3.7
Portugal	74%	9.4	3.7
Slovakia	70%	9.4	3.7

Source: Eurostat data, study calculations

Table 3 Pathway 2 assumptions: decrease in gender gap in activity rates by Member State (unadjusted for baseline trends)

Member State	Gender gap in activity rates in 2030 based on current trends (%)	Gender gaps in activity rates by 2030 (%)	
		Slow progress scenario	Rapid progress scenario
Sweden	6%	6% (as current trend)	6% (as current trend)
Finland	6%	4% (as in 2014)	4% (as in 2014)
Lithuania	6%	6% (as current trend)	6% (as current trend)
Latvia	7%	7%	6%
Bulgaria	7%	7%[35]	7%
Denmark	8%	7%	6%
Belgium	9%	9%	7%
Croatia	9%	9%	7%
Germany	9%	8%	7%
Portugal	9%	7%	6%
France	10%	8%	7%
Estonia	10%	8%	7%
Slovenia	11%	8%	7%
Spain	11%	9%	7%
Slovakia	12%	11%	8%
Cyprus	12%	9%	7%
United Kingdom	14%	9%	7%
Hungary	14%	11%	8%
Luxembourg	14%	10%	8%
Czech Republic	15%	11%	8%
Austria	16%	8%	7%
Netherlands	16%	9%	7%
Ireland	17%	12%	8%
Romania	17%	13%	9%
Poland	17%	11%	8%
Italy	24%	14%	9%
Greece	24%	13%	9%
Malta	31%	18%	11%

Source: Study calculations, Eurostat data for 2014, Eurostat population projections, Cedefop labour force projections

35 Assumed the same as current trend in 2030, because Bulgaria is projected to strongly reduce its gender gap in activity rates by 2030 under current trends. Thus, catching up with Sweden in the slow progress scenario does not yield a sensible value.

Table 4 Pathway 3 assumptions: estimates of the decrease in gender pay gap by Member State (unadjusted for baseline trends)

Member State	Gender pay gap by 2030 (%)[36] under current trends	Reduction in gender pay gaps by 2030 (p.p.)	
		Slow progress scenario	Rapid progress scenario
SI	2%	0.0	0.0
MT	4%	0.0	0.1
IT	5%	0.1	1.4
PL	6%	0.2	1.8
LU	7%	0.7	2.7
BE	9%	1.8	4.3
HR	9%	1.5	4.0
RO	10%	2.5	5.0
BG	10%	0.6	4.2
PT	13%	2.9	7.0
SE	12%	1.8	5.9
LT	13%	2.0	6.2
HU	13%	1.8	6.1
LV	12%	1.2	5.5
FR	12%	0.8	5.1
CY	12%	1.3	5.7
DK	12%	0.8	5.3
NL	13%	1.2	5.9
FI	14%	1.0	6.3
UK	14%	0.8	6.2
EL	16%	2.5	8.0
ES	15%	1.3	6.9
SK	16%	0.9	7.2
DE	17%	1.7	8.2
CZ	17%	2.0	8.7
AT	18%	1.7	8.7
EE	25%	5.4	14.3
IE	24%	0.9	11.7

Source: Eurostat data, study calculations

36 Data are not available from Eurostat on hourly pay gap in Greece and Ireland. The pay gap was therefore estimated in the E3ME model.

Table 5 Outcome 4 assumptions: change in fertility rate

Member State	Fertility rates expected in 2030 in baseline (Eurostat –Main scenario projections)	Fertility rates expected by 2030 in	
		Slow progress scenario	Rapid progress scenario
Austria	1.53	1.54	1.55
Belgium	1.84	1.85	1.87
Bulgaria	1.67	1.71	1.74
Cyprus	1.50	1.56	1.60
Czech Republic	1.72	1.78	1.82
Germany	1.51	1.51	1.52
Denmark	1.81	1.81	1.81
Estonia	1.75	1.81	1.86
Greece	1.45	1.50	1.53
Spain	1.42	1.45	1.47
Finland	1.83	1.83	1.83
France	2.00	2.00	2.00
Croatia	1.59	1.63	1.66
Hungary	1.61	1.66	1.70
Ireland	2.00	2.00	2.00
Italy	1.51	1.55	1.58
Lithuania	1.71	1.73	1.75
Luxembourg	1.69	1.71	1.75
Latvia	1.68	1.69	1.70
Malta	1.67	1.75	1.80
Netherlands	1.75	1.75	1.76
Poland	1.47	1.52	1.55
Portugal	1.37	1.41	1.44
Romania	1.79	1.87	1.93
Sweden	1.93	1.93	1.93
Slovenia	1.67	1.70	1.72
Slovakia	1.38	1.38	1.39
United Kingdom	1.93	1.93	1.93

Source: Eurostat data, study calculations

Annex 2
E3ME model description

Overview

E3ME is a computer-based model of the world's economic and energy systems and the environment. It was originally developed through the European Commission's research framework programmes and is now widely used in Europe and beyond for policy assessment, for forecasting and for research purposes. The global edition of E3ME expands the model's geographical coverage from 33 European countries to 59 global regions. It thus incorporates the global capabilities of the previous E3MG model.

This is the most comprehensive model version of E3ME to date and it includes all the previous features of the previous E3MG model.

Recent applications

Recent applications of E3ME include:

- a macroeconomic assessment of the feasibility of a European unemployment benefit system for DG Employment
- contribution to the CEDEFOP skills panorama
- contribution to the EU's Impact Assessment of its 2030 climate and energy package
- an assessment of the potential for green jobs in Europe
- an economic evaluation for the EU Impact Assessment of the Energy Efficiency Directive

This model description provides a short summary of the E3ME model. For further details, the reader is referred to the full model manual available online from www.e3me.com.

E3ME's basic structure and data

The structure of E3ME is based on the system of national accounts, with further linkages to energy demand and environmental emissions. The labour market is also covered in detail, including both voluntary and involuntary unemployment. In total there are 33 sets of econometrically estimated equations, also including the components of GDP (consumption, investment, international trade), prices, energy demand and materials demand. Each equation set is disaggregated by country and by sector.

E3ME's historical database covers the period 1970-2014 and the model projects forward annually to 2050. The main data sources for European countries are Eurostat and the IEA, supplemented by the OECD's STAN database and other sources where appropriate. For regions outside Europe, additional sources for data include the UN, OECD, World Bank, IMF, ILO and national statistics. Gaps in the data are estimated using customised software algorithms.

The main dimensions of the model

The main dimensions of E3ME are:

- 59 countries – all major world economies, the EU28 and candidate countries plus other countries' economies grouped
- 43 or 69 (Europe) industry sectors, based on standard international classifications
- 28 or 43 (Europe) categories of household expenditure
- 22 different users of 12 different fuel types
- 14 types of air-borne emission (where data are available) including the six greenhouse gases monitored under the Kyoto protocol

The countries and sectors covered by the model are listed at the end of this annex.

Standard outputs from the model

As a general model of the economy, based on the full structure of the national accounts, E3ME is capable of producing a broad range of economic indicators. In addition, there is range of energy and environment indicators. The following list provides a summary of the most common model outputs:

- GDP and the aggregate components of GDP (household expenditure, investment, government expenditure and international trade)
- sectoral output and GVA, prices, trade and competitiveness effects
- international trade by sector, origin and destination
- consumer prices and expenditures
- sectoral employment, unemployment, sectoral wage rates and labour supply

- energy demand, by sector and by fuel, energy prices
- CO_2 emissions by sector and by fuel
- other air-borne emissions
- material demands

This list is by no means exhaustive and the delivered outputs often depend on the requirements of the specific application. In addition to the sectoral dimension mentioned in the list, all indicators are produced at the national and regional level and annually over the period up to 2050.

Treatment of international trade

An important part of the modelling concerns international trade. E3ME solves for detailed bilateral trade between regions (similar to a two-tier Armington model). Trade is modelled in three stages:

- econometric estimation of regions' sectoral import demand
- econometric estimation of regions' bilateral imports from each partner
- forming exports from other regions' import demands

Trade volumes are determined by a combination of economic activity indicators, relative prices and technology.

The labour market

Treatment of the labour market is an area that distinguishes E3ME from other macroeconomic models. E3ME includes econometric equation sets for employment, average working hours, wage rates and participation rates. The first three of these are disaggregated by economic sector while participation rates are disaggregated by gender and five-year age band.

The labour force is determined by multiplying labour market participation rates by population. Unemployment (including both voluntary and involuntary unemployment) is determined by taking the difference between the labour force and employment. This is typically a key variable of interest for policy makers.

Labour market interactions

There are important interactions between the labour market equations. They are summarised below:

Employment = F (Economic output, Wage rates, Working hours, …)

Wage rages = F (Labour productivity, Unemployment, …)

Working hours = F (Economic output in relation to capacity, …)

Participation rates = F (Economic output, Wage rates, Working hours, …)

Labour supply = Participation rate * Population

Unemployment = Labour supply – Employment

Analysis of skills

E3ME does not include measures of skills demand and supply explicitly, but the model results for sectoral employment and labour supply may be used to derive both of these. Cambridge Econometrics works in collaboration with the Institute for Employment Research (IER) at Warwick University in the UK to produce these results.

Nevertheless, it is important to be aware of the limitation in skills treatment within the main model structure. If a modelled scenario shows an increase in employment it is implicitly assumed that workers with the necessary skills are available. For studying large changes in employment, a supplementary bottom-up analysis is require to test feasibility of the model results.

Incomes

Due to limitations in available time-series data, E3ME adopts a representative household for each region. Household income is determined as:

Income = Wages – Taxes + Benefits + Other income

The taxes currently distinguished are standard income taxes and employees' social security payments (employers' social security payments are not included in wages). A single benefit rate is used for each region.

'Other income' includes factors such as dividend payments, property rent and remittances. At present it is not possible to derive data for these financial flows and so they are either estimated, fixed, or held constant in relation to wages.

Household income, once converted to real terms, is an important component in the model's consumption equations, with a one-to-one relationship assumed in the long run.

Comparison with CGE models and econometric specification

E3ME is often compared to Computable General Equilibrium (CGE) models. In many ways the modelling approaches are similar; they are used to answer similar questions and use similar inputs and outputs. However, underlying this there are important theoretical differences between the modelling approaches.

In a typical CGE framework, optimal behaviour is assumed, output is determined by supply-side constraints and prices adjust fully so that all the available capacity is used. In E3ME the determination of output comes from a post-Keynesian framework and it is possible to have spare capacity. The model is more demand-driven and it is not assumed that prices always adjust to market clearing levels.

The differences have important practical implications, as they mean that in E3ME regulation and other policy may lead to increases in output if they are able to draw upon spare economic capacity. This is described in more detail in the model manual.

The econometric specification of E3ME gives the model a strong empirical grounding. E3ME uses a system of error correction, allowing short-term dynamic (or transition) outcomes, moving towards a long-term trend. The dynamic specification is important when considering short and medium-term analysis (e.g. up to 2020) and rebound effects[37], which are included as standard in the model's results.

Key strengths of E3ME

In summary the key strengths of E3ME are:

- the close integration of the economy, energy systems and the environment, with two-way linkages between each component
- the detailed sectoral disaggregation in the model's classifications, allowing for the analysis of similarly detailed scenarios
- its global coverage, while still allowing for analysis at the national level for large economies
- the econometric approach, which provides a strong empirical basis for the model and means it is not reliant on some of the restrictive assumptions common to CGE models
- the econometric specification of the model, making it suitable for short and medium-term assessment, as well as longer-term trends

Applications of E3ME

Scenario-based analysis

Although E3ME can be used for forecasting, the model is more commonly used for evaluating the impacts of an input shock through a scenario-based analysis. The shock may be either a change in policy, a change in economic assumptions or another change to a model variable. The analysis can be either forward looking (ex-ante) or evaluating previous developments in an ex-post manner. Scenarios may be used either to assess policy, or to assess sensitivities to key inputs (e.g. international energy prices).

For ex-ante analysis a baseline forecast up to 2050 is required; E3ME is usually calibrated to match a set of projections that are published by the European Commission and the IEA but alternative projections may be used. The scenarios represent alternative versions of the future based on a different set of inputs. By comparing the outcomes to the baseline (usually in percentage terms), the effects of the change in inputs can be determined.

It is possible to set up a scenario in which any of the model's inputs or variables are changed. In the case of exogenous inputs, such as population or energy prices, this is straight forward. However, it is also possible to add shocks to other model variables. For example, investment is endogenously determined by E3ME, but additional exogenous investment (e.g. through an increase in public investment expenditure) can also be modelled as part of a scenario input.

37 Where an initial increase in efficiency reduces demand, but this is negated in the long run as greater efficiency lowers the relative cost and increases consumption. See Barker et al (2009).

Table 1 Main dimensions of the E3ME model

	Regions	Industries (Europe)	Industries (non-Europe)
1	Belgium	Crops, animals, etc	Agriculture etc
2	Denmark	Forestry & logging	Coal
3	Germany	Fishing	Oil & Gas etc
4	Greece	Coal	Other Mining
5	Spain	Oil and Gas	Food, Drink & Tobacco
6	France	Other mining	Textiles, Clothing & Leather
7	Ireland	Food, drink & tobacco	Wood & Paper
8	Italy	Textiles & leather	Printing & Publishing
9	Luxembourg	Wood & wood prods	Manufactured Fuels
10	Netherlands	Paper & paper prods	Pharmaceuticals
11	Austria	Printing & reproduction	Other chemicals
12	Portugal	Coke & ref petroleum	Rubber & Plastics
13	Finland	Other chemicals	Non-Metallic Minerals
14	Sweden	Pharmaceuticals	Basic Metals
15	UK	Rubber & plastic products	Metal Goods
16	Czech Rep.	Non-metallic mineral prods	Mechanical Engineering
17	Estonia	Basic metals	Electronics
18	Cyprus	Fabricated metal prods	Electrical Engineering
19	Latvia	Computers etc	Motor Vehicles
20	Lithuania	Electrical equipment	Other Transport Equipment
21	Hungary	Other machinery/equipment	Other Manufacturing
22	Malta	Motor vehicles	Electricity
23	Poland	Other transport equip	Gas Supply
24	Slovenia	Furniture; other manufacture	Water Supply
25	Slovakia	Machinery repair/installation	Construction
26	Bulgaria	Electricity	Distribution
27	Romania	Gas, steam & air cond.	Retailing
28	Norway	Water, treatment & supply	Hotels & Catering
29	Switzerland	Sewerage & waste	Land Transport etc
30	Iceland	Construction	Water Transport
31	Croatia	Wholesale & retail MV	Air Transport
32	Turkey	Wholesale excl MV	Communications
33	former Yugoslav Republic of Macedonia, the	Retail excl MV	Banking & Finance
34	USA	Land transport, pipelines	Insurance
35	Japan	Water transport	Computing Services
36	Canada	Air transport	Professional Services
37	Australia	Warehousing	Other Business Services
38	New Zealand	Postal & courier activities	Public Administration
39	Russian Fed.	Accommodation & food serv	Education

	Regions	Industries (Europe)	Industries (non-Europe)
40	Rest of Annex I	Publishing activities	Health & Social Work
41	China	Motion pic, video, television	Miscellaneous Services
42	India	Telecommunications	Unallocated
43	Mexico	Computer programming etc.	
44	Brazil	Financial services	
45	Argentina	Insurance	
46	Colombia	Aux to financial services	
47	Rest Latin Am.	Real estate	
48	Korea	Imputed rents	
49	Taiwan	Legal, account, consult	
50	Indonesia	Architectural & engineering	
51	Rest of ASEAN	R&D	
52	Rest of OPEC	Advertising	
53	Rest of world	Other professional	
54	Ukraine	Rental & leasing	
55	Saudi Arabia	Employment activities	
56	Nigeria	Travel agency	
57	South Africa	Security & investigation, etc	
58	Rest of Africa	Public admin & defence	
59	Africa OPEC	Education	
60		Human health activities	
61		Residential care	
62		Creative, arts, recreational	
63		Sports activities	
64		Membership orgs	
65		Repair comp. & pers. goods	
66		Other personal serv.	
67		Hholds as employers	
68		Extraterritorial orgs	
69		Unallocated/Dwellings	

Source(s): Cambridge Econometrics.

Annex 3
Displacement Effects

The model results show that there are increases in total employment, but that some of the additional jobs that are filled by women come at the expense of male employment. This is particularly relevant to Pathways 1 and 2, where there are improvements in the quality and size of the female labour force. The displacement rate is important because it determines whether increases in female employment reflect additional economy-wide jobs, or simply a more equal distribution of employment among women and men.

For the policy scenarios that target female employment, we define the displacement rate associated with the policy as the reduction in male employment divided by the increase in female employment.

$$Displacement\ Rate = \frac{Male\ Employment_{Policy\ Scenario} - Male\ Employment_{Baseline\ Scenario}}{Female\ Employment_{Policy\ Scenario} - Female\ Employment_{Baseline\ Scenario}}$$

A displacement rate of -1 implies that for each additional woman employed, one less man is employed. It reflects the case of more equal opportunities for women in a scenario where there are no increases in aggregate labour demand. A displacement rate of between 0 and -1, suggests that two effects are taking place: i) more jobs are being created (compared to baseline) and ii) women are more likely to take the additional jobs, leading to a reduction in male employment (compared to baseline). A positive figure would indicate that employment of men (and women) is higher than in the baseline.

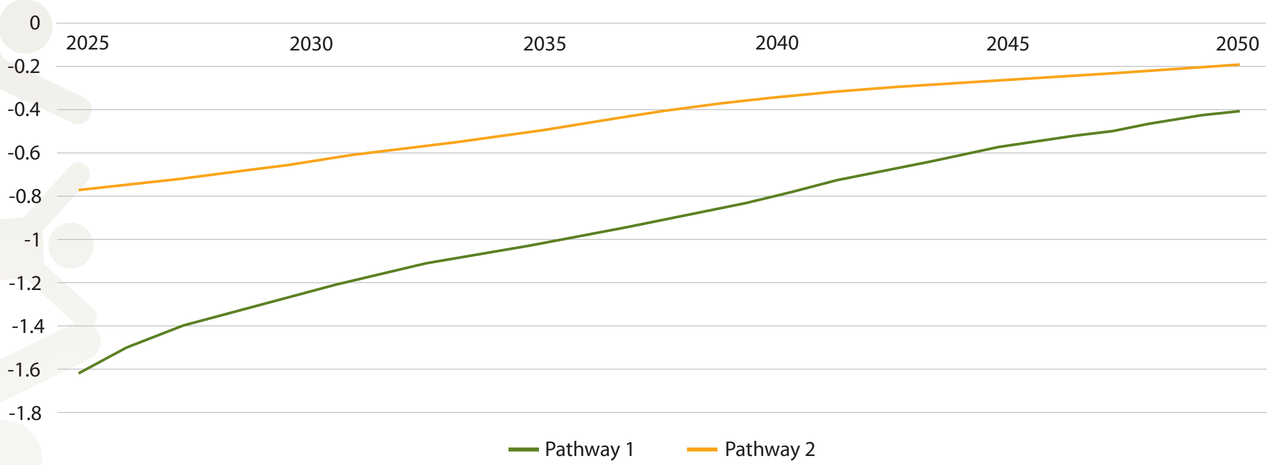
In Pathway 1, some women in the workforce become more productive due to their additional educational attainment. This increases average total productivity in the labour force, meaning that, at least initially, there is downward pressure on total employment and a displacement factor greater than one (i.e. male employment falls by more than female employment increases). Over time, however, wage rates adjust and the better performance in the economy creates additional jobs. These factors benefit both men and women equally, so the displacement effect falls to around -0.4 by 2050. A rate of -0.4 means that roughly two men do not have jobs for every five women that gain employment.

While Pathway 2 relates to the quantity of labour (due to an increase in the female participation rate), Pathway 1 considers the quality of labour (due to higher educational attainment). With more women in the labour force, each additional job opening is more likely to be filled by a woman compared to in the baseline. Again, the initial displacement effect is large, and close to -1 as, until the wider economy reacts, each additional job that is filled by a woman must be at the expense of a man. However, as in Pathway 1, the displacement effect falls in magnitude over time, and by 2050 is only -0.2. This reflects the adjustments to wage rates and the expanding economy in the pathway, which both benefit men and women equally. By 2050, the displacement effect has fallen to -0.2, meaning that for every man that loses employment there are five women entering employment.

Pathway 3 does not have a displacement effect as it is wages, rather than employment levels, that are affected. In Outcome 4 both female and male employment increase. In Pathway 5, which considers all options combined, there is an overall increase in the number of women and men in employment relative to the baseline.

The figure below shows how the displacement effects change over time at EU level for the rapid progress cases.

Figure 1: Size of the displacement effect



Annex 4
Methodological report on testing of the model

1 Impact modelling of economic outcomes attributable to gender equality measures - outcome scenarios

1.1 Pathway 1: Reduced gender gap in tertiary education

1.1.1 Introduction

This note presents the approach and initial assumptions necessary to model the economic impacts from reducing gender gaps in tertiary education. It focuses largely on two specific fields of tertiary education[38] in the EU: *computing*; and *engineering & engineering trade*. Other fields such *mathematics& statistics*, *physical sciences* and *law* have been also analysed.

Overall, this document:

- Briefly summarises the general approach to the economic modelling;
- Describes the methodology used to estimate the expected decrease in gender gaps in education in the EU Member States by 2030;
- Provides initial value of these estimates for each Member State.

38 Level 5 and 6, ICSED97, as defined in the following Eurostat data: http://ec.europa.eu/eurostat/statistics-explained/index.php/Tertiary_education_statistics

1.1.2 The general approach

The general approach is summarised in Figure 1.1.

The general method of policy evaluation is to establish the intermediate steps between the introduction of policy measures and the subsequent effects on the economy and society.

In the context of gender equality measures and the interest in their macro-economic impacts, significant levels of uncertainty and gaps are acknowledged in the empirical evidence relating measures to labour market outcomes and to wider economic impacts. The agreed evaluation response in this study is to develop outcome scenarios setting out plausible descriptions of how far particular labour market outcomes might change as a result of additional gender equality measures (using selected benchmarks and trend analysis) and to use these scenarios and related assumptions with an economic model (E3ME) to project the possible range of macro-economic impacts associated with the outcome scenarios.

1.1.3 Gender gaps in tertiary education

This note focuses on developing scenarios of future trends in gender gaps in tertiary education as a result of additional

Figure 1.1 Overview of the approach to economic modelling of economic impacts of gender equality measures

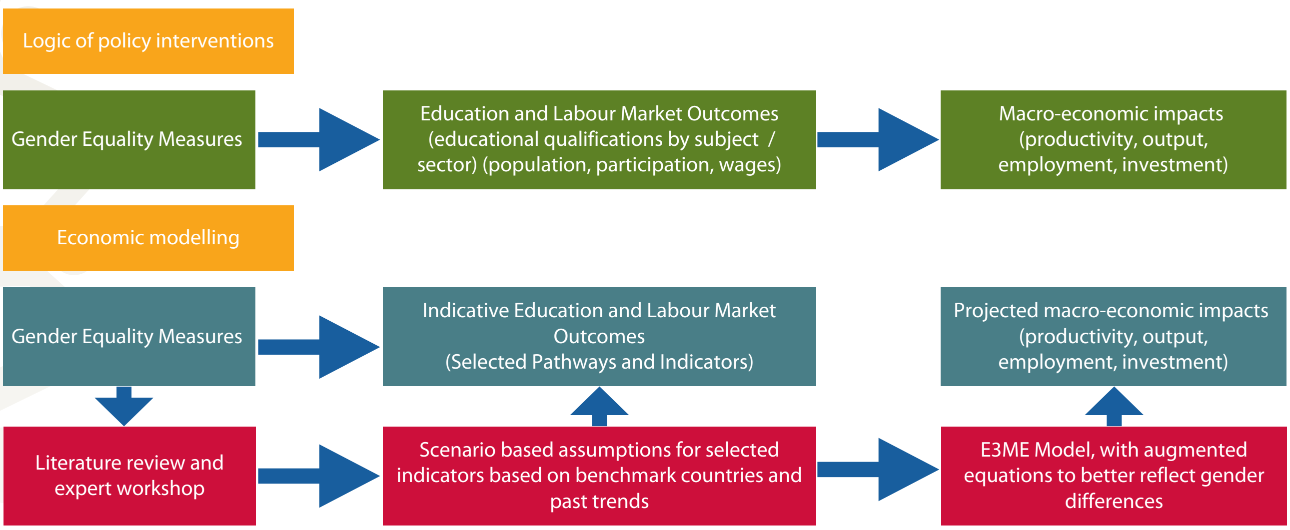


Table 1.1 Pathway 1 description – Tertiary education

Gender equality measures	Outcome Scenario assumptions	Economic impacts (from modelling)	
		Labour market impacts	Economic impacts
Gender equality measures leading to increased participation in areas of education that: ■ Have lower proportion of women participating than men ■ Are in strong demand from employers on the labour market	■ Increased number of female qualifications in STEM subjects ■ This does not displace other qualifications	■ A more productive labour force ■ Wages likely to increase	■ Benefits to sectors that employ STEM workers ■ Increased capacity in these sectors – they can produce more at lower cost ■ Lower prices leads to higher real consumption and a better trade balance

gender equality measures, specifically in the context of a shortage of certain skills in science, technology, engineering and mathematics (STEM)[39]. STEM graduates in EU28 Member States accounted for 17% of all graduates as of 2012[40]. The scenarios are based on a selected benchmark and trend analysis to establish plausible rates of progress in the period to 2030.

The scenarios are described using assumptions of future changes in the gaps between female and male participation in certain areas of education, selected based on the size of the related skills gap and its potential impact on the economy. These scenarios and related assumptions are then used as inputs to the economic model, which projects the macro-economic consequences of the outcome scenarios. These outcomes will be modelled using the E3ME model once assumptions are agreed on. Some sensitivity analysis will be undertaken to establish the sensitivity of economic impacts to assumed rates of change in the gender gap in participation rates.

This note presents three scenarios describing the future rates of decrease in the gender gap in education based on analysis of trend data. These estimates may need to be revised in the light of the modelled economic impacts to reach credible results.

39 Other potentially relevant fields such as law and business and administration were analysed as well but no substantial and consistent gaps across Member States exist in those fields.

40 STEM graduates defined as graduates from the first and second stage of tertiary education from the fields of science, mathematics, computing and engineering & engineering trade. Based on the Eurostat data available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Tertiary_education_statistics

1.1.3.1 General pathway description

Participation in certain areas of education such as STEM (Science, Technology, Engineering and Mathematics) tends to be lower for women than men despite the fact that there is a high employer demand for graduates in these areas, causing bottleneck and skill mismatches on the labour market. The general proposition behind the scenario assumptions is that gender equality measures[41] can result in an increase in female participation in these areas and thus contribute to a resolution of these skill mismatches and labour market bottlenecks. This is likely to result in an increase in output, employment, and possibly higher employer wage related costs, product prices and consumer spending, which will affect levels of economic activity.

The remaining part of this note is structured into three following sections:

- Section 1.1.4: Identification of gender gaps in relevant fields of tertiary education
- Section 1. 1.5: Identification of the benchmark Member State and complementary indicators to establish the plausible future rate of reduction in gender gap in selected fields of tertiary education; and
- Section 1. 1.6: Estimates of the future reduction in gender gaps in selected field of tertiary education under different scenario assumptions based on the analysis of previous trends.

41 Including measures aimed at human resources policies of companies, personal expectations of candidates for jobs or gender policies on labour market insertion

- Section 1.1.7: Presents detailed tables illustrating the evolution of the gender gaps in tertiary education.

1.1.4 Identification of gender gaps in relevant areas of tertiary education

The departure for the analysis was the review of the available data on the number and gender distribution among EU graduates from tertiary education institutions. The objective was to identify the fields of tertiary education where the disproportion between the share of male and female graduates (here broadly defined as gender gap in education) would be substantial and would persist over the longer term.

At the same time, the existence of a gender gap in the educational fields that are typically associated with positive labour market outcomes such as relatively high wages and high employment rate could in turn suggest the existence of unexplored potential stemming from the under-representation of women in those fields.

The following approach was chosen to estimate the gender gap in education:

$$Gap_{edu} = \left(1 - \frac{Share_W}{Share_M}\right)$$

where $Share_w$ stands for proportion of women graduates in the total number of graduates from specific field in a given year and $Share_m$ stands for proportion of men graduates in the total number of graduates from specific field in a given year.

The following sources of data were used to select and analyse the relevant fields of tertiary education:

- Eurostat data related to gender distribution and number of students graduating from tertiary education institutions (Level 5 and 6 of ICSED97 corresponding to Bachelor and Master degrees) across all EU Member States during the period 1998 and 2012[42];
- Other type of publications and data identified through a literature review and desk research covering, *inter alia*, Skills Panorama data[43], Country Specific Recommendation reports published by European Commission, European Parliament Studies[44], and supporting information about gender policy frameworks in the area of labour market performance based on various national reports/ sources.

The Eurostat data on graduates from tertiary education allows the disaggregation into 23 specific educational fields. We have omitted at the outset from the further analysis those fields from which graduates typically do not enjoy favourable labour market conditions (i.e. social services and agriculture, forestry and fishery), whether in the form of relatively high employment rate or relatively high wages. As a consequence of the data review that covered all 28 Member States, we have narrowed down our analysis to four specific fields for which gender gaps in education over the period 1998-2012 were then calculated. Those four fields were: *physical science, mathematics & statistics, computing*, and *engineering and engineering trade*.

Because the data[45] shows that in some Member States there has been considerable variation of the proportion of men and women in the total population of graduates from a specific educational field between two consecutive years, we have therefore applied a 4 years' moving average of the gender gaps in education in order to smooth the trend of the data and eliminate some annual anomalies. Hence, adjusted time series of 4 years simple moving averages[46] of gender gap covered consequently the period 2001-2013

$$SMAGap_{edu} = \frac{1}{4}\sum_{i}^{4} GapEdu_i$$

where $SMAGap_{edu}$ stands for 4 years simple moving average and $GapEdu_i$ is a gap from previous year i[47].

Table 1.2 presents the level of the average gender gap in those four fields for each of the EU Member State for the year 2013 ($SMAGap_{edu}$ for 2013). In brief, higher values gender gap indicate higher level of gender inequality – for example, an 80% gender gap indicates that the proportion of women participating in a certain educational field reaches only 20% of the proportion of men in that same field.

42 Eurostat, 2016. Number of students graduating from tertiary education. Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Tertiary_education_statistics

43 Cedefop, 2016. Skills Panorama. Available at: http://skillspanorama.cedefop.europa.eu/en

44 For instance, the European Parliament STEM Encouraging studies, 2015. Available at: http://www.europarl.europa.eu/RegData/etudes/STUD/2015/542199/IPOL_STU(2015)542199_EN.pdf and European Parliament, 2015. The Policy on Gender Equality in Denmark – Update. Available at: http://www.europarl.europa.eu/RegData/etudes/IDAN/2015/510026/IPOL_IDA(2015)510026_EN.pdf

45 Eurostat, 2016. Number of students graduating from tertiary education. Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Tertiary_education_statistics

46 The four year period was chosen for practical reasons relating to data availability - it could not be far longer due to limited number of data points but at the same time a shorter period would mean that the volatility of data in some MS would not have been reduced.

47 2013 is an only year where $SMAGap_{edu}$ was an average of 3 and not 4 years.

Tables in section 1.1.7 show the trend of the $SMAGaps_{edu}$ in the individual EU Member States over the period 2001 – 2013.

Table 1.2 Average gender gap [calculated as: 1 – $Share_w/Share_m$] in selected fields of tertiary education, as of 2013

European Union (28 countries)	Computing	Physical science	Mathematics & Statistics	Engineering and engineering trade
Belgium	91%	47%	25%	83%
Bulgaria	34%	-91%	-17%	58%
Czech Republic	84%	9%	-10%	87%
Denmark	71%	33%	26%	56%
Germany	81%	27%	-50%	87%
Estonia	68%	-9%	-242%	84%
Ireland	57%	27%	51%	85%
Greece	38%	2%	8%	72%
Spain	80%	0%	2%	75%
France	82%	37%	36%	78%
Croatia	80%	-37%	N/A	81%
Italy	73%	30%	-18%	72%
Cyprus	62%	-71%	-97%	75%
Latvia	74%	-14%	-209%	78%
Lithuania	79%	0%	-68%	83%
Luxembourg	N/A	N/A	N/A	N/A
Hungary	80%	18%	3%	86%
Malta	69%	-48%	N/A	77%
Netherlands	86%	66%	57%	85%
Austria	82%	50%	42%	85%
Poland	81%	-102%	-93%	68%
Portugal	70%	4%	-56%	71%
Romania	57%	-94%	-54%	53%
Slovenia	88%	27%	-49%	91%
Slovakia	86%	-17%	-11%	72%
Finland	64%	8%	15%	77%
Sweden	70%	15%	40%	67%
United Kingdom	77%	27%	32%	84%

Source: study calculation based on the Eurostat data
Note: Positive values indicates the larger share of men than women in the cohort of graduates.

Two things can be immediately observed. Firstly, for both fields, *computing* and *engineering and engineering trade*[48], there is no single Member State where there are more women than men in the total cohort of graduates. In fact, men clearly outnumber women across all Member States in both fields (4 years' average gender gap in 2013 varies between 53% and 91% in *engineering* and *trade engineering* and 34% and 91% in *computing*). Secondly, however, and somehow against the conventional perception, although there are Member States with a clear prevalence of men in the cohort of graduates, *mathematics & statistics* and *physical sciences* are two fields for which there are also some Member States where higher proportion of women than

48 As defined according to ISCED codes: http://www.uis.unesco.org/Education/Documents/isced-fields-of-education-training-2013.pdf

man in the total cohort of graduates can be observed (grey shaded cells in Table 1.2).

Consequently, as the data for *mathematics & statics* and *physical science* reveals a more complex picture, we concentrate in our analysis on *engineering and engineering trade* and *computing* field. This is also supported by the following characteristics of the EU labour markets that suggest good employment opportunities for graduates in these fields:

- There are significant labour shortages in STEM (Science, Technology, Engineering and Mathematics) area across the EU and those are particularly acute in engineering ad IT[49]. Out of 28 Member States, 21 report difficulties for science and engineering professionals and 20 for ICT professionals[50]. For instance, according to the organization's report, *Engineering 2015 — The State of Engineering*, there is a current annual shortfall of 55,000 engineers in the United Kingdom[51]. Among the central reason of the shortages the European Parliament's report indicates insufficient number of graduates which in is determined also by '*gender issues and the image of most STEM occupations which is not gender-neutral*'
- The unemployment rate for STEM skilled labour has been very low and drastically below the average unemployment rate in the EU. In 2013, the STEM unemployment rate was 2% while the unemployment rate for the EU28 was 11%[52].
- The employment opportunities for engineers and IT specialists are expected rise and exceed many other occupations. For instance, while zero employment growth in the pharmaceutical sectors between 2013 and 2025 is expected, employment in computing over the same period is expected to rise by 8%[53].

In terms of male/ female share in the cohort of *law* graduates in the EU, women have accounted for clear majority of all graduates in majority of the EU Member States over the last decade[54]. Therefore, *law* field has been dropped from further analysis.

1.1.5 Identification of the benchmark Member State and complementary indicators for estimation of future gender gap in education

1.1.5.1 Selecting the benchmark Member State and complementary indicators

Already cited Eurostat data was a central source that was used to analyse the trends in gender gaps in education among the EU Member States and consequently to identify the benchmark Member State against which scenario assumptions in terms of future gender gaps in education could be established.

Table 1.9 and Table 1.10 for *engineering & engineering trade* and *computing* respectively presented in section 1.1.7 illustrate the evolution of the gender gap in education in those two fields and allow to single out those Member States where the average gap as of 2013 was lower than in 2001. From this narrowed group of Member States (shaded *in grey* in tables Table 1.9 and Table 1.10) final selection of the benchmark Member State was made guided by the complementary criteria:

10. Has a good employment opportunities for graduates from the areas where gender gaps occur;
11. Has a strong labour market overall and hence the capacity to continue to set challenging goals for other Member States. In particular, the country should have no major issues in wage setting process and positive forecasts in terms of future GDP growth in the 2016 Country Specific Recommendation report by the European Commission;
12. Has an efficient education system which results into efficient progression from education into employment – the efficiency was assessed qualitatively based on recommendations provided in the most recent Country Specific Reports published by European Commission[55];
13. Has a robust gender policy framework in place to reduce gender gaps in education.

49 European Parliament, 2015. Encouraging STEM studies. Available at: http://www.europarl.europa.eu/RegData/etudes/STUD/2015/542199/IPOL_STU(2015)542199_EN.pdf

50 European Commission, 2014. Mapping and analysis bottleneck vacancies in EU labour markets. Available at: http://www.europarl.europa.eu/RegData/etudes/STUD/2015/542199/IPOL_STU(2015)542199_EN.pdf

51 http://careers.ieee.org/article/European_Job_Outlook_0315.php

52 European Parliament, 2015. Encouraging STEM studies. Available at: http://www.europarl.europa.eu/RegData/etudes/STUD/2015/542199/IPOL_STU(2015)542199_EN.pdf

53 European Parliament, 2015. Encouraging STEM studies. Available at: http://www.europarl.europa.eu/RegData/etudes/STUD/2015/542199/IPOL_STU(2015)542199_EN.pdf

54 Eurostat, 2016. Number of students graduating from tertiary education. Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Tertiary_education_statistics

55 http://ec.europa.eu/europe2020/making-it-happen/country-specific-recommendations/2015/index_en.htm

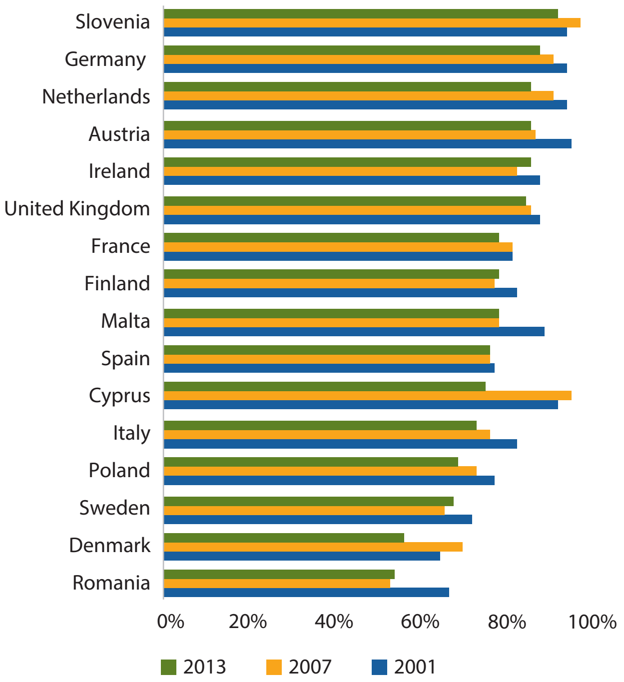
In the same vein, the past trend in the Eurostat data was also used to derive some simple descriptions of the past trends (i.e. mean, median, percentiles) which could be also used in extrapolating for future trends for individual Member States.

1.1.5.2 *The benchmark Member State and complementary indicators*

Based on the criteria presented above, we selected Denmark as the benchmark Member State for both considered fields, *computing* and *engineering & engineering trade*. In particular, the selection was motivated by the following arguments:

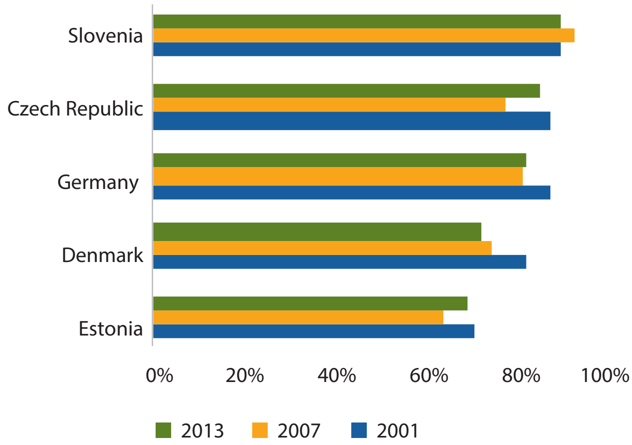
- Low number of females in proportion to males graduating from *computing* and *engineering & trade engineering* is a rule across all EU Member States. And even among those Member States where the gap shrank between 2001 and 2013, significant disproportions persist. In this context, however, Denmark belongs to the group of the Member States with the lowest gaps for both fields as of 2013 (see Figure 1.2 and Figure 1.3).

Figure 1.2 EU MS with the reduction in gap in engineering & engineering trade field



Source: study calculation based on the Eurostat data

Figure 1.3 EU MS with the reduction in gap in computing field



Source: study calculation based on the Eurostat data

- Apart from a comparatively low gender gap, Denmark has also been among those Member States where the gender gap in education has been falling at a faster rate. The average gender gap in *engineering & engineering trade* in Denmark reduced from 64% in 2011 to 56% in 2013 (hence a reduction by 8 percentages points), the gap in computing fell from 81% in 2001 to 71% in 2013 (hence a reduction by 10 percentage points). Figure 1.4 and Figure 1.5 show the reported overall decline in gender gap in the two selected fields.
- Although the recovery from the crisis in Denmark has been moderate, it is expected to continue and gain some pace in the coming years (European Commission, 2016). The real GDP grew by 1.3% in 2014, 1.2% in 2015 and is forecasted to rise by 1.2% and 1.9% in 2016 and 2017 respectively;
- With the total unemployment rate of 5.7% (EU average of 9.4%) and female unemployment rate of 5.8% (EU average of 9.8%) in 2015, Denmark has enjoyed one of the lowest unemployment rates in the whole EU[56].

56 Eurostat, 2016. Labour Force Survey/ Total unemployment rate. Available at: http://ec.europa.eu/eurostat/web/lfs/data/main-tables

Figure 1.4 Cumulative rate of reduction in gender gap in engineering and engineering trade field [2001-2013]

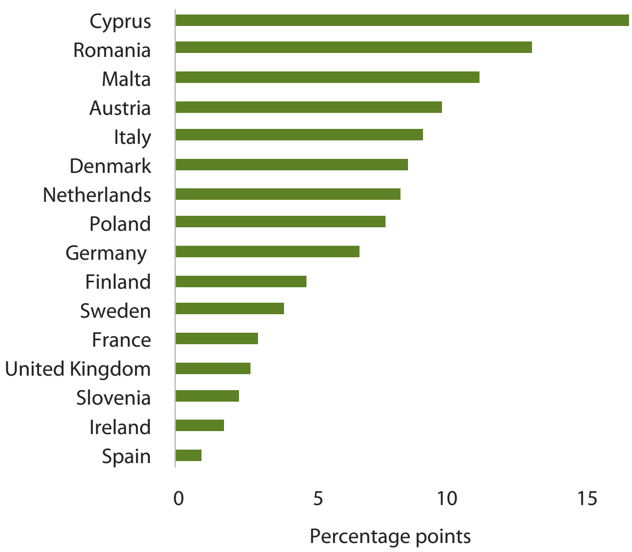
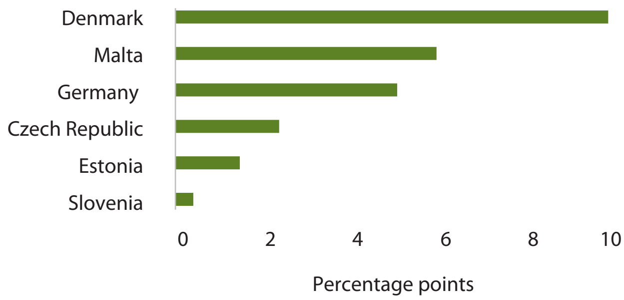


Figure 1.5 Cumulative rate of reduction in gender gap in *computing* field [2001-2013]



Source: Study calculation based on the Eurostat data

By analogy, the employment rate of women has been high (72.7% as oppose to 64.3% as EU average). Yet, it must be noted that it varies very substantially depending on the educational attainment from below 50% to circa 90% for women with higher education degrees;

- In general, the Danish authorities have also adopted a series of substantial labour market reforms over recent years that particularly aim at increasing work incentives and improving the efficiency of the active labour market policies (European Commission, 2016);

- The Danish educational system is generally performing well (European Commission, 2016). Although some challenges remain, in particular regarding low level of skills of migrants, the tertiary attainment level has been high (44.1% in 2014 as oppose to 37.9% as EU average) and transition from higher education to job market has been relatively smooth. Unemployment rate of population aged 25-64 with tertiary degree in 2015 was 4.8% as oppose to 5.2% EU average;

- The job prospects for engineers in Denmark are buoyant. In 2015, IDA's index of available positions contained 600% more opening positions for engineers in comparison to 2009[57].

- Denmark has been a leading European country in terms of number and scale of campaigns on gender stereotypes in education and employment focusing, *inter alia*, on promotion of women's educational choices for science and technology. The Danish Ministry of Gender Equality has been partly funding some of the campaigns over several years (European Parliament, 2015). Many Science departments at Danish universities have also been pursuing active policies to retain and attract women employees (European Commission, 2015). More generally, Box 1.1 presents a brief illustration of how can gender equality measures reduce of the gap in tertiary education

In terms of complementary indicators that could be used in the extrapolation of future trends in the reduction of a gender gap in education for individual Member States, simple descriptive indicators were derived for two fields based only on the group of Member States where a reduction in gap occurred and on performance of Denmark as the benchmark Member State (countries shown in Figure 1.4 for *engineering & engineering trade* and Figure 1.5 for *computing*).

Table 1.3 presents those specific indicators for two fields which were in turn used as key inputs for formulation of assumptions illustrated in full detail in Table 1.6. More specifically, they determine the rate of annual reduction in gender gaps presented in that Table 1.6.

57 IDA, 2015. Record number of jobs adverts for engineers in Denmark. Available at: http://english.ida.dk/danish-labour-market-0/record-number-job-adverts-engineers-denmark

Box 1.1 Gender equality measure and reduction in gender gap in tertiary education

There is a fairly substantial literature available on the policies focusing on the reduction of gender gap in STEM education at the tertiary level specifically and their effect. In terms of determinants of gender gap, the literature (OECD, 2011 & Sikora and Pokropek, 2011) often refers to stereotyping in education and training choices and lack of female role models as major problems contributing to the gap. The policy responses have frequently focused on tackling those aspects, as illustrated by the following examples:

- Mexico earmarked the funding to include gender dimension in educational programmes and initiatives, content of the free textbooks was analysed from the gender perspective, teachers and school administrators were also trained to think/act consistently with gender equality perspectives (OECD,2011).
- Some research indicated that attracting more women to pursue the career in STEM field in academia as effective way to tacking the problem of gap in tertiary education[58]. In the UK, the initiatives such as Athena Swan Charter implemented by the Equality Change Unit, WISE[59] and Soapbox Science[60] (a public outreach platform for promoting women in science) are well recognised examples of campaigns focusing on change in perceptions and promotion of women role models in science that received high publicity.
- The recent European Commission project "Practising Gender Equality in Science" (PRAGES), led by Italy's Department for Equal Opportunities[61], took stock of programmes and initiatives aimed at promoting gender equality in scientific research within public institutions in Europe, North America and Australia

Table 1.3 Reduction in gender gap in education among Member States that reduced gap over period 2001-2013

Measure of reduction in pay gap	*For the whole period 2001-2013 (percentage points)*	*On annual basis (percentage points)*
	Computing	
Denmark	10.0	0.83
Median	3.70	0.28
Average	4.21	0.35
75 percentile	5.74	0.44
25 percentile	1.66	0.13
	Engineering & engineering trade	
Denmark	8.4	0.70
Median	7.11	0.59
Average	6.82	0.57
75 percentile	9.14	0.71
25 percentile	2.91	0.25

58 See for instance Research Council of Canada, 2010. Women in Science and Engineering in Canada and Mavriplis, 2010. Mind the Gap: Women in STEM Career Breaks'.

59 WISE, 2016. About us. Available at: https://www.wisecampaign.org.uk/

60 Soapbox, 2016. public outreach platform for promoting women scientists

61 European Commission, 2010. PRAGES. Available at: http://cordis.europa.eu/result/rcn/86075_en.html

1.1.6 Estimates of decrease in gender gaps in education

1.1.6.1 Scenarios and assumptions

The estimates of future changes in the gender gaps in education for individual Member States which are presented under this section are based on assumptions related to the plausible decrease in the gender education gap by year due to gender equality measures. The past trends in the rate of increase/ decrease in gender gap in education have been critical in the process of establishing these assumptions. More specifically, we produce the following scenarios:

- Current trends scenario, which provides estimates of future gender gaps in education based solely on past developments in the Member States.

- Rapid and slow progress scenarios, which estimate the potential impact of additional gender equality measures compared to current trends scenario.

1.1.6.2 Current trends scenario

The estimates in this scenario describe change in gender gap in education that would be achieved if Member States continued developing according to existing trends between 1998 and 2012. This implicitly assumes that current trends in variables (including adoption of relevant gender equality measures) affecting education participation of women would continue unchanged into the future. No additional gender equality measures beyond those that could be expected to happen based on existing policy trends in the country are considered.

The estimates were produced by extrapolating existing trends (between 1998 and 2012) in education participation for each sex into the future, using univariate regression analysis in STATA[62]. There were a few Member States where existing trends were very volatile and thus did not provide good basis for estimating future trends – in these cases it was assumed that current gap in education participation (for year 2013) would stay roughly the same in the future. This concerned mainly states where there were few students in the fields of engineering and computing, and thus it is unlikely to affect overall modelling results to a large degree. More specifically, this approach was used in the cases of Belgium, Ireland, and Sweden in the field of computing.

Data on participation in is not available for Greece, Croatia, Luxembourg (both engineering and computing data not available) and Romania (only engineering available).

We relied on simple forward projection of past trends with no further assumptions about convergence of country outcomes. The application of gender equality measures to STEM is not yet a common tendency among Member States – gender gaps in this area are very high across Member States (see Table 1.2) and their significant reductions are not that common (see Figure 1.4 and 1.5). Even where reductions in gender gaps occur, they frequently happen in Member States that already had some of the lowest gender gaps among the EU-28, not in Member States that had the highest gaps. Thus there is very little evidence that suggests we should assume that development in different countries will converge in the foreseeable future.

It must be highlighted that the current trends scenario estimates should be interpreted as very coarse indicators of potential future development, given that they rely solely on extrapolation of past education participation data. This is in a way inevitable consequence of current lack of predictive studies on this topic – for example, Cedefop does not currently provide estimates on future participation numbers in the fields of computing and engineering & engineering trades. A more robust modelling of future trends in these educational fields is perceived to be beyond the scope of this study – producing robust estimates would require a specialist study on this topic.

The estimates of gender gap in education based on current trends are presented in Table 1.4 and Table 1.5 below.

62 $Y = a + bX$ where X – time, Y – number of graduates in a given year. Actual number of graduates for a given sex as of 1998 (start date) constituted the intercept a while slope of the regression line b was derived based on the parameter value calculated for the period 1998-2012. Final extrapolation based on a, b and given known X provided therefore Y values for the forecast period 2013-2030.

Table 1.4 Estimates of the decrease in gender gap in education by Member State in different modelling scenarios (computing)

Member State	Gender gap in education in 2013 (%)	Gender gap in education in 2030 based on current trends (%)	Reduction in gender education gap between 2013 and 2030
Austria	82%	81%	-1%
Belgium	91%	91%	0%
Bulgaria	34%	49%	15%
Croatia	80%	Insufficient data	Insufficient data
Cyprus	62%	77%	15%
Czech Republic	84%	82%	-2%
Denmark	71%	67%	-4%
Estonia	68%	68%	0%
Finland	64%	77%	13%
France	82%	84%	2%
Germany	81%	80%	-1%
Greece	38%	Insufficient data	Insufficient data
Hungary	80%	78%	-2%
Ireland	57%	57%	0%
Italy	73%	75%	2%
Latvia	74%	82%	8%
Lithuania	79%	90%	11%
Luxembourg	N/A	Insufficient data	Insufficient data
Malta	69%	66%	-3%
Netherlands	86%	88%	2%
Poland	81%	81%	0%
Portugal	70%	82%	12%
Romania	57%	Insufficient data	Insufficient data
Slovakia	86%	87%	1%
Slovenia	88%	89%	1%
Spain	80%	88%	8%
Sweden	70%	70%	0%
United Kingdom	77%	90%	13%

Source: Eurostat data, study calculations

1.1.6.3 Rapid and slow progress scenarios

These scenarios provide estimates of change in gender gap in education as result of future gender equality measures that could take place in addition to the current trends scenario.

The estimates made about the future potential decrease in gender gaps in education have been prepared for *computing* and *engineering & engineering trade* fields separately. For each of these two fields three groups of Member States were distinguished: *Leading Group*, *Following Group*, and *Lagging Group*. The criterion to assign a given Member State into one of the three groups was its performance in terms of the cumulative rate of reduction of gender gap in education over the period between 2001 and 2013:

- ***Leading Group:*** Composed of top 50% of Member States in a given field in terms of rate of reduction in the gender gap in education. Selected only from the

Table 1.5 Estimates of the decrease in gender gap in education by Member State in different modelling scenarios (engineering and engineering trades)

Member State	Gender gap in education in 2013 (%)	Gender gap in education in 2030 based on current trends (%)	Reduction in gender education gap between 2013 and 2030
Austria	85%	81%	-4%
Belgium	83%	80%	-3%
Bulgaria	58%	72%	14%
Croatia	81%	Insufficient data	Insufficient data
Cyprus	75%	66%	-9%
Czech Republic	87%	89%	2%
Denmark	56%	51%	-5%
Estonia	84%	83%	-1%
Finland	77%	70%	-7%
France	78%	85%	7%
Germany	87%	83%	-4%
Greece	72%	Insufficient data	Insufficient data
Hungary	86%	90%	4%
Ireland	85%	77%	-8%
Italy	72%	64%	-8%
Latvia	78%	80%	2%
Lithuania	83%	86%	3%
Luxembourg	Data not available	Insufficient data	Insufficient data
Malta	77%	76%	-1%
Netherlands	85%	62%	-23%
Poland	68%	62%	-6%
Portugal	71%	74%	3%
Romania	53%	52%	-1%
Slovakia	72%	70%	-2%
Slovenia	91%	91%	0%
Spain	75%	73%	-2%
Sweden	67%	63%	-2%
United Kingdom	84%	79%	-5%

Source: Eurostat data, study calculations

group of Member States where reduction in gap occurred. For instance, Denmark, Malta and Germany for *computing* field (see Figure 1.5).

- ***Following Group*:** The remaining 50% of the Member States where reduction in the gender gap between 2001 and 2013 took place. Selected only from the group of Member States where reduction in gap occurred. For instance, Czech Republic, Estonia and Slovenia for *computing* field (see Figure 1.5).

- ***Lagging Group*:** Member States where the gender gap in education has been constant or increased over the period 2001and 2013. For *computing* and *engineering & engineering trade* those are all the Member States that are not included in Figure 1.4 and Figure 1.5[63].

63 Excluding individual Member States where sufficient level of past data did not allow to establish the trend between 1998-2013.

Table 1.6 Overview of outcome scenario assumptions for the reduction in gender gaps in selected STEM fields to 2030

	Scenario: *Fast Progress*		Scenario: *Slow Progress*	
	Computing	*Engineering & engineering trade*	*Computing*	*Engineering & engineering trade*
Leading Group	Reduction in the gender gap in *computing* by **0.83 percentage point per year** (equivalent of the Denmark rate). Applied to: DK, DE and MT	Reduction in the gender gap in *engineering and engineering trade* by **0.70 percentage point per year** (equivalent of the Denmark rate). Applied to: CY, RO, MT, AT, IT, DK, NL and PL	Reduction in the gender gap in *computing* by **0.83 percentage point per year** (equivalent of the Denmark rate). Applied to: DK, DE and MT.	Reduction in the gender gap in *engineering and engineering trade* by **0.70 percentage point per year** (equivalent of the Denmark rate). Applied to: CY, RO, MT, AT, IT, DK, NL and PL
Following Group	Reduction in the gap in *computing* by **0.44 percentage point per year** (value representing a 75 percentile of all annual rates in those Member States where reduction over the period 2001-2013 was reported). Applied to: SI, CZ and ET.	Reduction in the gap in *engineering and engineering trade* by **0.70 percentage point per year** (value representing a 75 percentile of all annual rates in those Member States where reduction over the period 2001-2013 was reported). Applied to: DE, FI, SE, FR, UK, SI, IE, ES	Reduction in the gap in *computing* by **0.28 percentage point per year** (value representing a median of all annual rates in those Member States where reduction over the period 2001-2013 took place). Applied to: SI, CZ and ET	Reduction in the gap in *engineering & engineering trade* by **0.55 percentage point per year** (value representing a median of all annual rates in those Member States where reduction over the period 2001-2013 took place). Applied to: DE, FI, SE, FR, UK, SI, IE, ES
Lagging Group	Reduction in the gap in *computing* by **0.28 percentage point per year** (value representing a median of all annual rates in those Member States where reduction over the period 2001-2013 was reported). Applied to: remaining Member States	Reduction in the gap in *engineering & engineering trade* by **0.55 percentage point per year** (value representing a median of all annual rates in those Member States where reduction over the period 2001-2013 was reported). Applied to: remaining Member States	Gender gap in *computing* assumed to be **0.13 percentage point per year** (value representing 25 percentile of all annual rates in those Member States where reduction over the period 2001-2013 was reported). Applied to: remaining Member States	Gender gap in *engineering & engineering trade* assumed to be **0.22%** (value representing 25 percentile of all annual rates in those Member States where reduction over the period 2001-2013 was reported). Applied to: remaining Member States
**additional rationale for selection of Denmark as a benchmark Member State*	Denmark selected as a benchmark Member State for *Leading Group*. Denmark had a highest cumulative rate of reduction in gender gap in *computing* that amounted to 9.9 percentage points between 2001 – 2013. This is an equivalent of 0.8 percentage point per year.	Denmark chosen as a benchmark Member State *Leading Group*. Although it did not have the highest cumulative rate of reduction of gender gap in *engineering & engineering trade* (8.4 percentage point as oppose to 16 percentage points in Cyprus) over the analysed period, the reduction had continuous character since 2005 and overall, Denmark had the second lowest gap level in *engineering & engineering trade* field as of 2013.	Denmark selected as a benchmark Member State for *Leading Group*. Denmark had a highest cumulative rate of reduction in gender gap in *computing* that amounted to 9.9 percentage points between 2001 – 2013. This is an equivalent of 0.8 percentage point per year.	Denmark chosen as a benchmark Member State for *Leading Group*. Although it did not have the highest cumulative rate of reduction of gender gap in *engineering & engineering trade* (8.4 percentage point as oppose to 16 percentage points in Cyprus), the reduction had continuous character since 2005 and overall, Denmark had the second lowest gap level in *engineering & engineering trade* field as of 2013.

Effectively, this grouping assumes that prior historical trend is a barrier to the positive impact of additional gender equality measures. This is a conservative assumption based on the fact that prior negative historical trends are likely to at least partially result from a variety of factors (i.e. cultural attitudes towards gender equality) other than policy, which can inhibit policy impact. Unfortunately, there is little evidence of macroeconomic impact of individual gender equality measures at Member State level, which prevents a more detailed analysis of its potential policy impact.

The current size of gender gap was not used to create these groupings - this was because the size of the gap was high among all EU Member States and thus did not provide useful basis for grouping. Thus the groupings indicate solely the potential to reduce gaps based on past performance, rather than differences in current size of the gap.

Two specific scenarios have been defined, namely *Slow Progress* and *Rapid Progress*. The scenarios differ in terms of the assumed rate of reduction assigned to each of the three Groups for the forecasted period 2013-2030. Table 1.6 outlines the details on the specific assumption per Scenario, Group and educational field.

In short, while Denmark was used as a benchmark Member State for the *Leading Group* for two fields, rates of reduction for *Following Group* and *Lagging Group* were assumed based on the indicators presented in Table 1.3. These assumptions imply that faster reduction in gender gaps can be expected from leading rather than following and lagging groups.

The assumption that Member States in Leading Group can reduce gender gap in education faster than other states is based on their past performance - while all of these Member States still face considerable gaps, they have proved the most able to reduce it over time in the past. In contrast, Member States from the *Lagging Group* are those where the educational gap has widened (or at best remained constant) over the period 2001-2013. *Ergo*, it seems plausible to argue that a given policy intervention may have a smaller impact as it would have to work against the existing trend. Trend in this context may encapsulate the existing barriers for effective response to policy intervention and ultimately more balanced distribution of males and females.

Specific assumption values chosen in Table 1.6 were chosen because they:

- They result into noticeably faster decrease in gender inequality compared to current trend estimates described in Section 1.1.6.2, for both slow and rapid progress scenarios;
- They result into noticeable differences in outcomes of low and rapid progress policy scenarios; and
- They do not exceed maximum decreases in gender inequality recorded in the past (i.e. decreases achieved by Denmark).

Thus they yield a reasonable range of potential decrease in gender inequality due to further gender equality measures adopted in addition to current trends scenario.

1.1.6.4 Results

Table 1.7 and Table 1.8 present the estimation of the cumulative reduction of the level of the gender gap in the field of *computing* and *engineering & engineering trade*. Estimations are provided based on the two scenarios: Fast Progress and Slow Progress. All estimations show the reduction in percentage points between 2013 and 2030 – for each Member State, this reduction was calculated by taking appropriate annual reduction in gender gap based on Table 1.6 and multiplying it by the number of years between 2013 and 2030 (17). This yields the total reduction in gender gap over the period.

For instance, gender gap in Denmark in the field of *computing* is estimated to decrease annually by 0.83 percentage points, which means that it is estimated to decline by 14.1 percentage points compared to current trends scenario (i.e. under current trends scenario Denmark is predicted to have gender gap of 67% whereas under both progress scenario it is 52.9%) by 2030. By the same token, gender gap in Poland would fall by 4.8% from 81% to 76.2% under Fast Progress Scenario and by 2.2% from 81% to 78.8% under Slow Progress Scenario compared to currents trends scenario.

Table 1.7 Results Table: Cumulative reduction in gender gap in education in *computing* over the period 2013-2030 [by percentage points]

Group	Member State	Gender gap in education in 2030 under current trends (%)	Estimated reduction under Fast Progress Scenario (p.p)	Estimated reduction under Slow Progress Scenario (p.p)
Leading Group	Denmark	67%	14.1	14.1
	Germany	80%	14.1	14.1
	Czech Republic	82%	14.1	14.1
Following Group	Malta	66%	7.5	4.8
	Estonia	68%	7.5	4.8
	Slovenia	89%	7.5	4.8
Lagging Group	Bulgaria	49%	4.8	2.2
	Ireland	57%	4.8	2.2
	Spain	88%	4.8	2.2
	Italy	75%	4.8	2.2
	Cyprus	77%	4.8	2.2
	Latvia	82%	4.8	2.2
	Lithuania	90%	4.8	2.2
	Hungary	78%	4.8	2.2
	Netherlands	88%	4.8	2.2
	Austria	81%	4.8	2.2
	Poland	81%	4.8	2.2
	Portugal	82%	4.8	2.2
	Slovakia	87%	4.8	2.2
	Finland	77%	4.8	2.2
	Sweden	70%	4.8	2.2
	United Kingdom	90%	4.8	2.2
	Belgium	94%	4.8	2.2
	France	84%	4.8	2.2
No data available	Luxembourg	N/A	N/A	N/A
No data available	Romania	N/A	N/A	N/A
No data available	Croatia	N/A	N/A	N/A
No data available	Greece	N/A	N/A	N/A

Source: study estimation

Table 1.8 Results Table: Cumulative reduction in gender gap in education in *engineering and engineering trade* over the period 2013-2030 [by percentage points]

Group	Member State	Gender gap in education in 2030 under current trends (%)	Estimated reduction under Fast Progress Scenario (p.p)	Estimated reduction under Slow Progress Scenario (p.p)
Leading Group	Cyprus	66%	11.9	11.9
	Romania	52%	11.9	11.9
	Malta	76%	11.9	11.9
	Austria	81%	11.9	11.9
	Italy	64%	11.9	11.9
	Denmark	51%	11.9	11.9
	Netherlands	62%	11.9	11.9
	Poland	62%	11.9	11.9
Following Group	Germany	83%	11.9	9.4
	Finland	70%	11.9	9.4
	Sweden	63%	11.9	9.4
	United Kingdom	79%	11.9	9.4
	Slovenia	91%	11.9	9.4
	France	85%	11.9	9.4
	Ireland	77%	11.9	9.4
	Spain	73%	11.9	9.4
Lagging Group	Belgium	80%	9.4	3.7
	Bulgaria	72%	9.4	3.7
	Czech Republic	89%	9.4	3.7
	Estonia	83%	9.4	3.7
	Latvia	80%	9.4	3.7
	Lithuania	86%	9.4	3.7
	Hungary	90%	9.4	3.7
	Portugal	74%	9.4	3.7
	Slovakia	70%	9.4	3.7
No data available	Luxembourg	N/A	N/A	N/A
No data available	Croatia	N/A	N/A	N/A
No data available	Greece	N/A	N/A	N/A

Source: study estimation

1.1.7 Gender gap in education – detailed tables

Table 1.9 4 years' moving average of gender gap in education in engineering & engineering trade field

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Belgium	80%	N/A	85%	86%	85%	84%	83%	83%	84%	84%	84%	84%	83%
Bulgaria	41%	44%	47%	48%	48%	49%	52%	55%	57%	58%	58%	58%	58%
Czech Republic	80%	77%	76%	77%	80%	84%	84%	85%	86%	86%	87%	88%	87%
Denmark	64%	69%	73%	74%	74%	72%	69%	67%	65%	61%	58%	57%	56%
Germany	94%	93%	93%	92%	92%	91%	90%	90%	89%	89%	88%	87%	87%
Estonia	78%	76%	73%	75%	73%	70%	73%	71%	74%	78%	80%	82%	84%
Ireland	86%	85%	84%	83%	82%	N/A	N/A	N/A	N/A	N/A	N/A	85%	85%
Greece	N/A	N/A	N/A	N/A	N/A	N/A	58%	61%	N/A	N/A	N/A	N/A	72%
Spain	76%	76%	76%	76%	76%	75%	75%	74%	74%	74%	74%	75%	75%
France	81%	N/A	N/A	N/A	N/A	N/A	N/A	81%	82%	N/A	N/A	N/A	78%
Croatia	N/A	N/A	N/A	N/A	N/A	85%	84%	82%	82%	81%	N/A	N/A	81%
Italy	81%	81%	80%	79%	77%	76%	75%	75%	75%	75%	74%	73%	72%
Cyprus	91%	91%	90%	90%	90%	92%	94%	95%	92%	88%	84%	77%	75%
Latvia	74%	74%	72%	69%	71%	73%	74%	74%	75%	74%	76%	77%	78%
Lithuania	77%	77%	77%	77%	77%	78%	79%	79%	80%	80%	80%	82%	83%
Luxembourg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hungary	84%	84%	84%	84%	84%	85%	86%	87%	87%	88%	88%	86%	86%
Malta	88%	84%	78%	N/A	N/A	N/A	N/A	74%	77%	75%	77%	78%	77%
Netherlands	93%	93%	93%	93%	92%	92%	90%	90%	89%	88%	87%	86%	85%
Austria	95%	93%	91%	89%	88%	87%	86%	86%	85%	86%	85%	85%	85%
Poland	76%	76%	79%	79%	77%	75%	72%	70%	70%	70%	69%	69%	68%
Portugal	65%	65%	65%	66%	67%	69%	70%	72%	73%	74%	73%	72%	71%
Romania	66%	65%	61%	57%	54%	52%	52%	53%	55%	57%	55%	55%	53%
Slovenia	93%	95%	96%	96%	96%	96%	96%	96%	95%	95%	94%	92%	91%
Slovakia	72%	69%	65%	63%	63%	63%	63%	64%	66%	68%	70%	71%	72%
Finland	82%	80%	79%	78%	77%	76%	76%	76%	76%	77%	77%	77%	77%
Sweden	71%	70%	67%	66%	65%	65%	65%	65%	66%	67%	67%	67%	67%
United Kingdom	87%	N/A	87%	86%	86%	85%	85%	85%	85%	85%	85%	85%	84%

Source: study calculation based on Eurostat data [http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do]
Note: in grey countries where the 4 years average gap in education in 2013 reduced in comparison to 2011.

Table 1.10 4 years' moving average of gender gap in education in computing field

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Belgium	86%	N/A	86%	86%	88%	88%	90%	91%	92%	92%	92%	92%	91%
Bulgaria	-56%	-56%	-43%	-13%	3%	0%	-2%	3%	5%	13%	24%	30%	34%
Czech Republic	86%	85%	83%	79%	77%	76%	77%	79%	81%	82%	83%	84%	84%
Denmark	81%	80%	78%	75%	73%	74%	74%	74%	76%	75%	74%	73%	71%
Germany	86%	87%	86%	84%	83%	81%	80%	80%	81%	81%	82%	81%	81%
Estonia	70%	70%	66%	64%	67%	62%	63%	65%	66%	68%	67%	68%	68%
Ireland	26%	27%	32%	41%	48%	N/A	N/A	N/A	N/A	N/A	N/A	59%	57%
Greece	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	38%
Spain	66%	67%	68%	69%	70%	72%	73%	75%	76%	78%	79%	80%	80%
France	76%	N/A	N/A	N/A	N/A	N/A	N/A	82%	82%	N/A	N/A	N/A	82%
Croatia	N/A	N/A	N/A	N/A	N/A	73%	76%	78%	78%	80%	N/A	N/A	80%
Italy	64%	68%	70%	72%	73%	72%	72%	72%	74%	76%	76%	74%	73%
Cyprus	36%	36%	40%	44%	52%	51%	60%	63%	64%	59%	60%	60%	62%
Latvia	49%	44%	42%	48%	58%	63%	66%	68%	70%	72%	74%	74%	74%
Lithuania	45%	44%	46%	50%	56%	62%	68%	71%	74%	76%	78%	79%	79%
Luxembourg	96%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hungary	73%	79%	76%	71%	67%	67%	67%	70%	75%	75%	78%	79%	80%
Malta	75%	N/A	N/A	N/A	N/A	N/A	N/A	68%	69%	72%	70%	69%	69%
Netherlands	85%	85%	84%	85%	87%	88%	90%	90%	90%	89%	88%	86%	86%
Austria	76%	84%	86%	85%	83%	81%	79%	79%	79%	80%	81%	82%	82%
Poland	51%	63%	71%	76%	76%	76%	75%	75%	77%	79%	80%	81%	81%
Portugal	36%	40%	42%	48%	50%	50%	50%	50%	53%	58%	64%	69%	70%
Romania	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	59%	60%	57%
Slovenia	89%	90%	89%	90%	89%	90%	91%	90%	92%	91%	90%	89%	88%
Slovakia	86%	85%	85%	84%	84%	83%	84%	85%	86%	87%	87%	87%	86%
Finland	37%	35%	30%	28%	28%	33%	39%	48%	56%	60%	62%	64%	64%
Sweden	32%	32%	28%	34%	40%	48%	56%	62%	67%	69%	72%	70%	70%
United Kingdom	65%	65%	66%	66%	68%	70%	72%	74%	75%	76%	76%	77%	77%

Source: study calculation based on Eurostat data [http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do]
Note: in grey countries where the 4 years average gap in education in 2013 reduced in comparison to 2011

Table 1.11 4 years' moving average of gender gap in education in mathematics & statistics field

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Belgium	N/A	N/A	5%	6%	10%	12%	13%	19%	18%	24%	24%	25%	25%
Bulgaria	-47%	-46%	-51%	-58%	-47%	-40%	-26%	-7%	-7%	-17%	-21%	-17%	-17%
Czech Republic	23%	19%	10%	10%	7%	6%	6%	4%	1%	-3%	-6%	-10%	-10%
Denmark	36%	31%	34%	47%	52%	57%	57%	52%	43%	40%	35%	26%	26%
Germany	26%	23%	18%	8%	-1%	-28%	-51%	-68%	-81%	-73%	-63%	-55%	-50%
Estonia	-127%	-102%	-97%	-162%	-254%	-279%	-373%	-384%	-312%	-371%	-292%	-224%	-242%
Ireland	26%	22%	23%	24%	33%	N/A	N/A	N/A	N/A	N/A	N/A	41%	51%
Greece	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8%
Spain	-16%	-21%	-24%	-26%	-26%	-30%	-27%	-14%	-12%	-4%	2%	-2%	2%
France	27%	N/A	N/A	N/A	N/A	N/A	N/A	37%	36%	N/A	N/A	N/A	36%
Croatia	N/A	N/A	N/A	N/A	N/A	-116%	-135%	-160%	-153%	-145%	N/A	N/A	N/A
Italy	-72%	-64%	-59%	-56%	-53%	-52%	-56%	-54%	-46%	-37%	-26%	-19%	-18%
Cyprus	N/A	-103%	-65%	-86%	-112%	-96%	-124%	-131%	-147%	-138%	-105%	-110%	-97%
Latvia	-410%	-387%	-327%	-285%	-272%	-231%	-232%	-249%	-223%	-233%	-221%	-197%	-209%
Lithuania	-61%	-51%	-57%	-80%	-85%	-110%	-109%	-94%	-86%	-61%	-64%	-66%	-68%
Luxembourg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hungary	18%	35%	27%	14%	1%	-1%	1%	10%	16%	10%	10%	1%	3%
Malta	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Netherlands	64%	62%	60%	55%	51%	50%	50%	53%	55%	55%	54%	56%	57%
Austria	9%	44%	39%	43%	44%	43%	41%	37%	36%	39%	41%	42%	42%
Poland	-208%	-223%	-200%	-178%	-175%	-165%	-159%	-157%	-136%	-119%	-104%	-97%	-93%
Portugal	-110%	-130%	-128%	-121%	-112%	-107%	-101%	-94%	-99%	-91%	-77%	-74%	-56%
Romania	-11%	-11%	-11%	-8%	-7%	-6%	-5%	-17%	-42%	-38%	-61%	-68%	-54%
Slovenia	56%	51%	52%	33%	3%	-6%	-24%	-36%	-32%	-38%	-45%	-49%	-49%
Slovakia	20%	7%	10%	13%	-4%	-3%	-10%	-18%	-16%	-20%	-23%	-15%	-11%
Finland	32%	28%	27%	29%	20%	21%	22%	12%	14%	10%	10%	13%	15%
Sweden	57%	55%	56%	50%	52%	50%	47%	50%	49%	46%	44%	41%	40%
United Kingdom	51%	45%	39%	37%	37%	37%	37%	39%	38%	36%	34%	32%	32%

Source: study calculation based on Eurostat data [http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do]
Note: in grey countries where the 4 years average gap in education in 2013 reduced in comparison to 2011.

Table 1.12 4 years' moving average of gender gap in education in physical science field

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Belgium	N/A	N/A	41%	38%	36%	37%	40%	39%	43%	46%	46%	48%	47%
Bulgaria	-62%	-70%	-57%	-45%	-45%	-42%	-51%	-55%	-67%	-70%	-76%	-87%	-91%
Czech Republic	43%	39%	33%	33%	30%	24%	16%	12%	6%	6%	8%	8%	9%
Denmark	47%	48%	52%	48%	45%	42%	37%	40%	39%	39%	37%	34%	33%
Germany	64%	61%	58%	55%	51%	45%	38%	31%	26%	25%	25%	27%	27%
Estonia	31%	23%	20%	9%	0%	-9%	-16%	-16%	-13%	-10%	-10%	-7%	-9%
Ireland	2%	-1%	-3%	-6%	-7%	N/A	N/A	N/A	N/A	N/A	N/A	27%	27%
Greece	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2%
Spain	0%	-4%	-6%	-11%	-14%	-19%	-23%	-23%	-23%	-18%	-9%	-4%	0%
France	41%	N/A	N/A	N/A	N/A	N/A	N/A	38%	37%	N/A	N/A	N/A	37%
Croatia	N/A	N/A	N/A	N/A	N/A	-33%	-42%	-47%	-46%	-37%	N/A	N/A	-37%
Italy	27%	29%	30%	31%	29%	30%	30%	31%	32%	32%	32%	31%	30%
Cyprus	N/A	-157%	-134%	-155%	-114%	-115%	-118%	-132%	-139%	-111%	-92%	-71%	-71%
Latvia	-141%	-158%	-134%	-88%	-59%	-38%	-32%	-24%	-27%	-29%	-16%	-19%	-14%
Lithuania	-3%	-11%	2%	-4%	6%	6%	-3%	-2%	3%	4%	6%	4%	0%
Luxembourg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hungary	34%	40%	43%	41%	41%	38%	31%	33%	27%	23%	24%	18%	18%
Malta	16%	-4%	5%	N/A	N/A	N/A	N/A	-11%	-73%	-67%	-94%	-88%	-48%
Netherlands	67%	65%	66%	64%	62%	61%	60%	62%	64%	67%	66%	66%	66%
Austria	55%	56%	59%	58%	57%	55%	51%	51%	51%	50%	50%	51%	50%
Poland	-57%	-64%	-67%	-70%	-67%	-68%	-77%	-84%	-86%	-89%	-92%	-96%	-102%
Portugal	-54%	-54%	-52%	-48%	-48%	-40%	-31%	-27%	-19%	-12%	-7%	0%	4%
Romania	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-109%	-97%	-94%
Slovenia	33%	34%	44%	40%	31%	28%	22%	18%	16%	21%	22%	25%	27%
Slovakia	24%	21%	17%	11%	7%	4%	5%	5%	1%	-3%	-10%	-14%	-17%
Finland	18%	18%	13%	5%	2%	4%	2%	-2%	-2%	-6%	-3%	8%	8%
Sweden	19%	19%	18%	19%	17%	19%	17%	17%	14%	11%	12%	12%	15%
United Kingdom	36%	35%	34%	31%	30%	28%	26%	26%	26%	25%	26%	26%	27%

Source: study calculation based on Eurostat data [http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do]

Note: in grey countries where the 4 years average gap in education in 2013 reduced in comparison to 2011.

1.1.8 References

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1.2 Pathway 2: Labour market activity modelling

1.2.1 Introduction

This note presents the approach and initial assumptions necessary to model the economic impacts from reducing gender gaps in labour market activity rates, where activity rates are defined as the share of employed and unemployed population aged 20 to 64 in total population aged 20 to 64[64].

More specifically, this document:

- Briefly summarises the general approach to the economic modelling;
- Describes the methodology used to estimate the expected decrease in gap between male and female activity rates in each Member State by 2030;
- Provides initial value of these estimates for each Member State.

1.2.2 The general approach

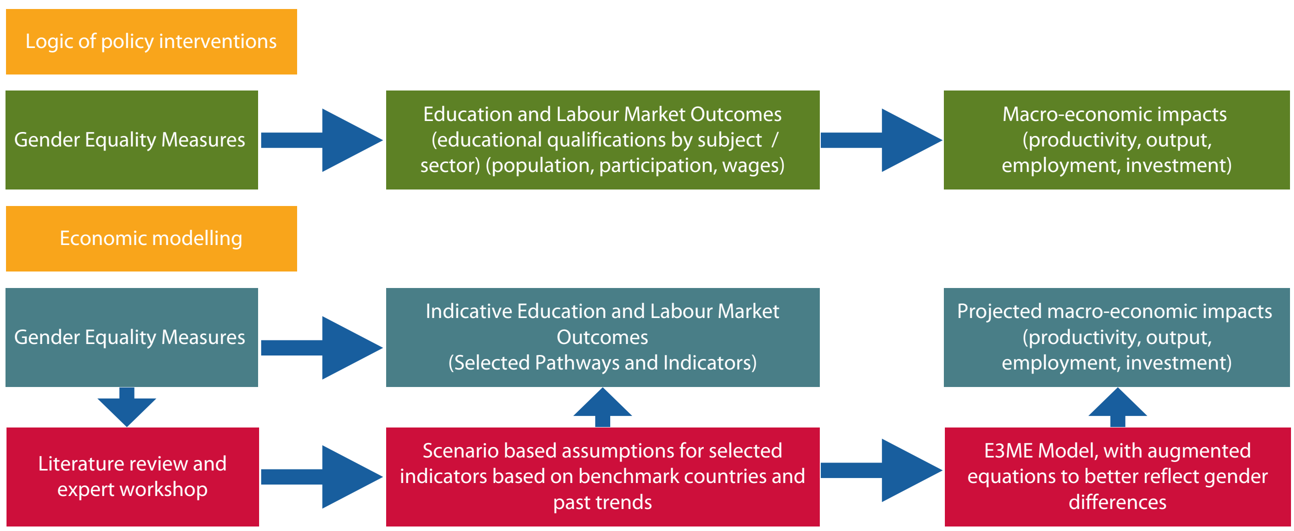
The general approach is summarised in Figure 1.6.

The general method of policy evaluation is to establish the intermediate steps between the introduction of policy measures and the subsequent effects on the economy and society.

In the context of gender equality measures and the interest in their macro-economic impacts, significant levels of uncertainty and gaps are acknowledged in the empirical

64 The exact Eurostat definition of activity rates used can be found on http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Activity_rate. The selection of the age group 20 to 64 follows the measures used to define EU 2020 targets - labour market targets are defined for people between the ages of 20-64 in these policy documents. People in those age groups who are not counted as participating in the labour force are typically students, homemakers, non-civilians, institutionalized people, and persons under the age of 64 who are retired.

Figure 1.6 Overview of the approach to economic modelling of economic impacts of gender equality measures



evidence relating measures to labour market outcomes and to wider economic impacts. The agreed evaluation response in this study is to develop outcome scenarios setting out plausible descriptions of how far particular labour market outcomes might change as a result of additional gender equality measures (using selected benchmarks and trend analysis) and to use these scenarios and related assumptions with an economic model (E3ME) to project the possible range of macro-economic impacts associated with the outcome scenarios.

1.2.3 Labour market activity rates

This note focuses on developing scenarios of future trends in labour market activity rates as a result of additional gender equality measures. The scenarios are based on a selected benchmark and trend analysis to establish plausible rates of progress in the period to 2030.

The scenarios are described using assumptions of future changes in the gaps between female and male activity rates. These scenarios and related assumptions are then used as inputs to the economic model, which projects the macro-economic consequences of the outcome scenarios. These outcomes will be modelled using the E3ME model once assumptions are agreed on. Some sensitivity analysis will be undertaken to establish the sensitivity of economic impacts to assumed rates of change in the gender gap in activity rates.

This note presents two scenarios describing the future rates of decrease in the gender gap based on analysis of trend data.

1.2.3.1 General pathway description

Labour market activity rates tend to be lower for women than men. This gap varies by country and sector. The general proposition behind the scenario assumptions is that gender equality measures can result in inactive women in the formal economy becoming active in the formal economy raising the female activity rate. This results in an increase in labour supply, which will affect levels of economic activity, depending on the skills of the female entrants.

The rest of this note is structured into three sections, which describe:

- Section 1.2.4: Identification of the benchmark Member State establishing the goal for future labour market activity of women; and
- Section 1.2.5: Estimates of the future decrease in gender gaps in activity rates under different scenario assumptions, based on a review of previous trends.
- Section 1.2.6: Estimates of the mix of qualifications of females becoming economically active.

Table 1.13 Pathway 2 description – Labour Market Activity Rates

Gender equality measures	Outcome Scenario assumptions	Economic impacts (from modelling)	
		Labour market impacts	Economic impacts
Gender equality measures[65] leading to increased women's labour force participation– Change from currently formal inactive to active participants	■ Increase in female activity rates	Direct impact ■ Increase in size of labour force ■ Indirect impacts ■ Lower wage rates ■ Higher employment demand ■ Higher unemployment (at least in short run)	■ A reduction in wage rates benefits firms' competitiveness. ■ Household incomes may increase or decrease as there is higher employment but lower average wage rates. ■ In the long run, capacity to produce more leads to higher production and lower prices.

65 These include gender-sensitive flexible working arrangements, child and elderly care, social infrastructure, removed tax distortion and reduced segregation (vertical and horizontal) by sector and occupation/work function.

1.2.4 Identification of the benchmark Member State in terms of gender gaps in labour market activity

1.2.4.1 Describing trends in labour market activity

The following four sources were used to describe labour market participation trends by Member State and to identify the benchmark Member State against which to establish scenario assumptions in terms of future gender gaps in labour market participation:

- Gender gaps in activity rates of men and women calculated as,

$$Gap_{Part} = \left(1 - \frac{P\_rate_W}{P\_rate_M}\right)$$

  where P_rate_w stands for activity rate of women aged 20 to 64 and P_rate_m stands for activity rate of men from the same age group based on Eurostat labour force survey data;

- Supporting information about overall labour market performance by Member State from the latest Country Specific Recommendation reports published by European Commission; and

- Supporting information about gender policy frameworks in the area of labour market performance based on national reports.

1.2.4.2 Selecting the benchmark Member State

We applied three criteria to select the benchmark Member State. The Member State had to:

1. Be among the three EU-28 Member States with the lowest gender gaps in activity rates.

2. Have a strong labour market overall and hence the capacity to continue to set challenging goals for other Member States. In particular, the country is assumed to have a strong labour market if it has an above average EU2020 target for employment rates and positive forecasts in terms of future GDP growth in the 2016 Country Specific Recommendation report by the European Commission.

3. Have a robust gender policy framework in place to support labour market activity of women.

1.2.4.3 The benchmark Member State

Based on the criteria presented above, we selected Sweden as the benchmark Member State. In particular, Sweden had:

- One of the lowest gender gaps in activity rates among EU 28 where female activity rates reach 94% of male activity rates (see Figure 1.7).The only other country with lower gender gap in activity rates was Finland where female activity rates were 96% of male ones. Lithuania also had a similar gender gap in labour market participation as Sweden, with women's activity rates reaching 93% of men's.

  In addition, activity rates of Swedish women were the highest among EU-28 Member States, reaching 83.2% in 2014 according to Eurostat. Women's activity rates were lower in both Finland and Lithuania when compared to Sweden, reaching around 78% in 2014 according to Eurostat.

- Strong labour market performance, Sweden had the highest employment rates in the EU both for men and women (82.5 % and 78.3 % respectively for the population aged 20-64) in 2015 according to Eurostat. Its economic growth has risen gradually since 2012 primarily due to the increasing contribution from total labour. Real GDP expanded by 3.6 % in 2015 according to the European Commission's 2016 winter forecast, making it one of the fastest growing economies in the EU (Country report Sweden 2016, EC). Its GDP was projected to grow by 3.2% in 2016 and 2.9% in 2017 (ibid).

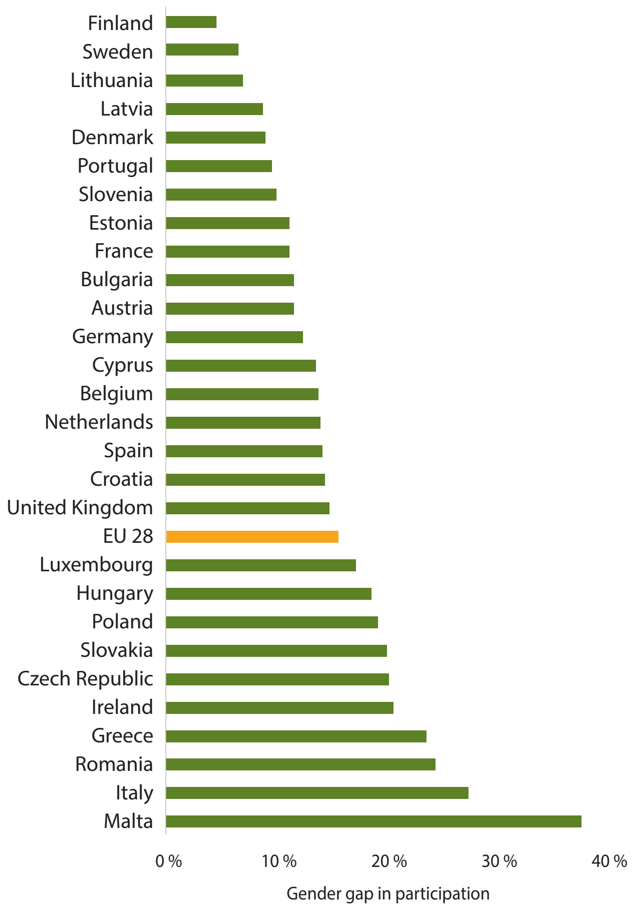
  Finnish labour market performance was much less positive compared to Sweden. The employment rate was lower than in Sweden, reaching 71.8% for women and 73.9% for men aged 20 to 64 in 2015 according to Eurostat. Its real GDP was projected to grow only by 0.5 % in 2016 and 0.9 % in 2017 (Country report Finland 2016, EC). Lithuania also had lower employment rates than Sweden (74.6% for men and 72.2% for women in 2015 according to Eurostat) but had similar prospects in terms of economic growth – its real GDP was projected to grow by 2.9% in 2016 and 3.4% in 2017 (Country report Lithuania 2016, EC).

- A long standing commitment to gender equality policy related to labour market participation. The Swedish Discrimination Act (2008:567) implements all relevant EU legislation on gender employment discrimination; there is a generous and very flexible social security parental leave scheme in place and collectively bargained parental wages to top up income; there are 90 non-transferable highly-paid days to encourage fathers to go on parental leave[66]; and there are guaran-

66 https://sweden.se/society/gender-equality-in-sweden/

teed child-care facilities for children one year or older at municipal level (European Parliament, 2015)[67].

Figure 1.7 Gender gaps in activity rates (1- (female rates as a % of male rates))



Source: Eurostat data for 2014

1.2.5 Estimates of decrease in gender gaps in activity rates – scenario assumptions

The estimates of future changes in the gender gap in activity rates, by Member State, presented below are based on assumptions describing the possible decrease in gender gap in activity rates by 2030 due to gender equality measures.

Firstly, we estimate the gender gaps in activity rates in 2030 that result would from currently forecasted population (by Eurostat) and labour force (by Cedefop) trends. The Eurostat and Cedefop forecasts are the key projections produced at EU level in this area. They rely on projecting historical data forward, reflecting past policy trends and thus implicitly assuming some further policy changes in the future based on historical data. They assume no change in activity rates as a result of additional gender equality measures that cannot be predicted based on past trends. Thus they can treated as baseline scenarios, with no additional changes assumed compared to historical trends.

Secondly, we produce estimates of potential decrease in gender gaps in activity rates as a result of additional gender equality measures that cannot be predicted based on historical data (i.e. assuming there is a higher number of gender equality measures than can be expected based on analysis of historic data).

These estimates have been prepared for two groups based on Member State performance:

- The best performing Member State (Sweden) and Member States with similar performance in terms of gender gaps in activity rates (Finland, Lithuania).
- The remainder of the Member States that have a worse performance in terms of gender gaps - the other 25 Member States.

In these estimates, we assume that additional gender equality measures can be implemented compared to current trend estimates (except in best performing Member States, which have already high levels of equality). Furthermore we assume that such additional gender equality measures will have at least some positive effect on female activity rates. These assumptions reflect the fact that most Member States (except the best performing ones) still have sizeable gender gaps in activity rates.

However, it must be acknowledged that implementing additional gender equality measures may be difficult in practice. This is reflected in producing two sets of scenarios, each assuming a different rate of implementing additional gender equality measures:

- Rapid progress estimates assume a higher increase in number of gender equality measures compared to current trends;
- Slow progress estimates assume a lower increase in number of gender equality measures compared to current trends.

1.2.5.1 Estimating current trends

The current trend estimates describe the gender gap in activity rates by 2030 assuming that the size of the labour

67 Sweden has consistently had the best outcomes of gender equality measures captured by the EIGE Gender Equality Index. It reached the highest overall index score among all EU-28 Member States in 2012 (index score 74.2), 2009 (74.4) and 2005 (72.8). In 2012, it had the best index score in the domain of work and ranked among the top three Member States in the domains of money, time, knowledge and power.

force (total number of employed and unemployed people) and the overall population develop according to available predictions by Cedefop and Eurostat.

More specifically, the current trend estimates were calculated as follows for each Member State:

1. The number of men and women aged 20 to 64 active on the labour market in 2014 was extracted from Eurostat.
2. The projected growth rate in number of men and women (available separately for each gender) active on the labour market was extracted from Cedefop.
3. The total active population of women (men) was multiplied by expected growth rate in active population of women (men) to estimate the total number of women (men) active on the labour market by 2030.
4. The expected size of total population (aged 20 to 64) in 2030 was extracted from Eurostat population projections, disaggregated by gender.

Table 1.14 Estimates of the decrease in gender gap in activity rates by Member State under current trends

Member State	Gender gap in activity rates in 2014 (%)	Gender gaps in activity rates in 2030 based on current trends (%)	Reduction in gender activity rate gap between 2014 and 2030
Finland	4%	6%	-2%
Sweden	6%	6%	0%
Lithuania	7%	6%	1%
Latvia	8%	7%	1%
Denmark	9%	8%	1%
Portugal	9%	9%	0%
Slovenia	10%	11%	-1%
Estonia	11%	10%	1%
France	11%	10%	1%
Bulgaria	11%	7%	4%
Austria	11%	16%	-5%
Germany	12%	9%	3%
Cyprus	13%	12%	1%
Belgium	13%	9%	4%
Netherlands	13%	16%	-3%
Spain	14%	11%	3%
Croatia	14%	9%	5%
United Kingdom	14%	14%	0%
Luxembourg	16%	14%	2%
Hungary	18%	14%	4%
Poland	18%	17%	1%
Slovakia	19%	12%	7%
Czech Republic	19%	15%	4%
Ireland	20%	17%	3%
Greece	23%	24%	-1%
Romania	23%	17%	6%
Italy	26%	24%	2%
Malta	36%	31%	5%
EU-28	15%	13%	2%

Source: Study calculations, Eurostat population projections, Cedefop labour force projections

5. The active population of women (men) was divided by total population of women (men) to estimate the activity rates for each gender in 2030.

6. The total gender gap in activity rates in 2030 was calculated according to formula presented in section 1.2.4.1.

There is a general trend across Member States of mild increase in female activity rates as a share of male rates, with the EU-28 gender gap in activity rates projected to decline from 15% in 2014 to 13% in 2030 (see Table 1.14). Thus, some reduction in the difference between Sweden and other Member States can be expected to occur in the current trend estimates, i.e. even in the absence of additional gender equality measures.

1.2.5.2 The best performing Member State

There are three options proposed for estimating the performance of Sweden in terms of gender gaps in activity rates. It can be assumed that:

- Sweden has already reached a very favourable situation in terms of women labour market activity, which is unlikely to improve much in the future. Thus the gap between female and male activity rates will be estimated as the lower of the following two values: the estimated gender gap in activity rate in 2030 based on current trends; and the current gender gap in activity rate as of 2014. In other words, the gender gap is assumed to evolve along the predicted trends unless this leads to its increase (in which case it will be assumed to remain at 2014 levels).

- Sweden can further reduce the gender gaps in labour market activity to a degree consistent with its past performance in this area. Thus Sweden could be expected to reduce the gap between activity rates of women and men by a further 3% by 2030 (i.e. achieving the same reduction as achieved between 1998 and 2014), so that activity rates of women equal 97% of activity rates of men.

- Sweden can reach full gender parity in labour market participation by 2030, with activity rates of men and women equal at that point in time.

The estimation of performance of Finland and Lithuania would follow an analogous procedure.

For initial modelling purposes we have chosen the first assumption - no further reduction in gaps before 2030. The sensitivity of results to the choice can be estimated but is expected to very small.

1.2.5.3 The remaining Member States

For all other Member States, two scenarios are used to describe the possible progress Member States are expected to make in closing the gender gap in labour market participation by 2030. The plausibility of these scenarios is illustrated in Table 1.15, Figure 1.9 and Figure 1.10, which highlight how the estimated decrease in gender gap in activity rates compares against estimates based on current trends.

- Scenario 1: Rapid progress – Member States reduce the difference in their gap in activity rates compared to Sweden to 15%. Thus, a Member State where female activity rates are currently 30% lower than male rates, would reduce the gap in activity rates over time (female rates would be only 10% lower than male ones). If the current gap is 50%, it would reduce to 13%.[68]

  This assumption implies that gender gap in activity rates will be reduced particularly in Member States that currently have high gender gaps in activity rates (see Figure 1.9 and Figure 1.10 for detail) – in effect, these countries will 'catch up' with the states with the lowest gender gaps in activity rates. This reflects the historical trend between 1998 and 2014, where countries with large gender gaps in activity rates tended to register particularly high decreases in them (see for example Cyprus, Spain and Malta in Figure 1.8). It also reflects the fact that countries with high gender inequality probably have more to gain by implementing additional gender equality measures than countries where gender inequality is low. However, there may be particular reasons for high gender gaps in certain countries that may make their further reduction difficult.

  The assumption is based on past performance of countries that had historically low activity rates of women compared to male rates but managed to catch up to a large extent with Sweden by 2014. More specifically, these countries had to:

  - Eliminate at least 15% of the 1998 difference in gender activity rate gap with Sweden by 2014.
  - Have women activity rates lower by at least 20% than men's in 1998, so that their gender gap in activity rates was at least 10 percentage points higher than in Sweden (Swedish gender gap in activity rates was 9% in 1998). This condition was important to ensure that countries catching up

68 Note that the reduction is based on calculating the % difference between the Swedish gap (expressed as a %) and the MS rate (%), reducing this to 20%, or 55%, and then estimating the new MS gap.

with Sweden achieved meaningful reduction in gender gap in activity rates (on average 14 percentage points), because there was a large original difference between them and Sweden.

Based on these conditions the following countries were selected: Slovakia, Germany, Portugal, Austria, Hungary, Netherlands, Belgium, Ireland, Cyprus, Spain, Luxembourg, Greece, Italy and Malta (see Figure 1.8 for their performance in terms of gender activity rate gap compared to Sweden).

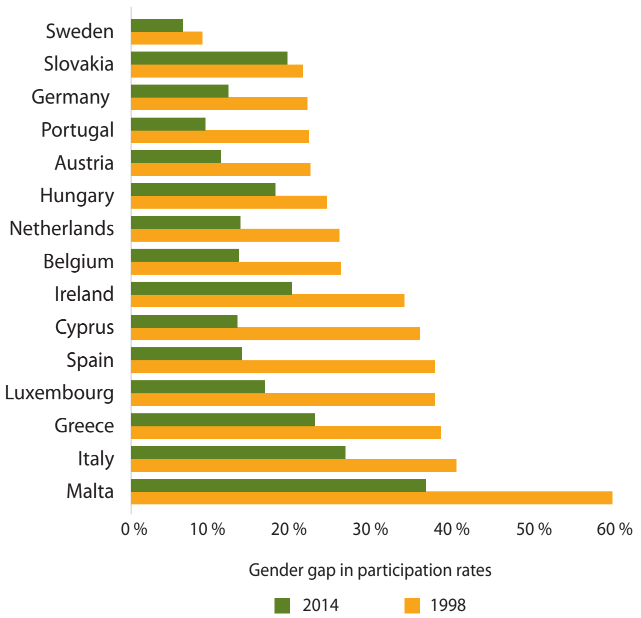
For this selection, we then used the following formula to estimate the extent to which countries can be expected to catch up with Sweden by 2030 in the rapid progress scenario:

$$nProgress_R = Percentile80\left(\frac{GapMS_{1998} - GapMS_{2014}}{GapMS_{1998} - GapSI_{1998}}\right)$$

where $GapMS_{2014}$ expresses the gender gap in activity rates for Member States catching up with Sweden in 2014; $GapMS_{1998}$ expresses the this gap in these Member States in 1998; and $GapSE_{1998}$ expresses the same gap in Sweden in 1998.

Intuitively, the formula assumes that rapid progress can be approximated by what a particularly well performing Member State in terms of catching up with Sweden (80^{th} percentile) achieved between 1998 and 2014. The 80^{th} percentile was chosen because it demonstrates a particularly strong performance in catching up with Sweden, but avoids relying solely on those strong performing countries that are unlikely to be highly representative in the EU context (such as Malta or Greece, see Figure 1.8). Lower value was not chosen to ensure that there is a notable difference between rapid and low progress scenarios.

Figure 1.8 Evolution of gender gaps in activity rates between 1998 and 2014 for Member States with historically high gaps compared to Sweden



Source: Eurostat – EU LFS

- Scenario 2: Slow progress – As Scenario 1 but the percentage difference between Sweden and the Member State reduces only to 40% of the current difference. A Member State where female activity is currently 30% lower than male rates, would reduce this gap over time to 16%. If the current gap is 50%, this would reduce to 24%.

This assumption was calculated in an analogous way to the rapid progress scenario, with the difference that we considered 35th rather than 80th percentile to measure the extent to which Member States managed to catch up with Sweden. The 35th percentile was chosen because it captures a relatively weaker performance among the Member States that managed to significantly catch up with Sweden between 1998 and 2014. It also allows for a reduction in gender activity rate gap significantly lower than in the rapid progress scenario, and thus allows for a meaningful distinction between the two scenarios.

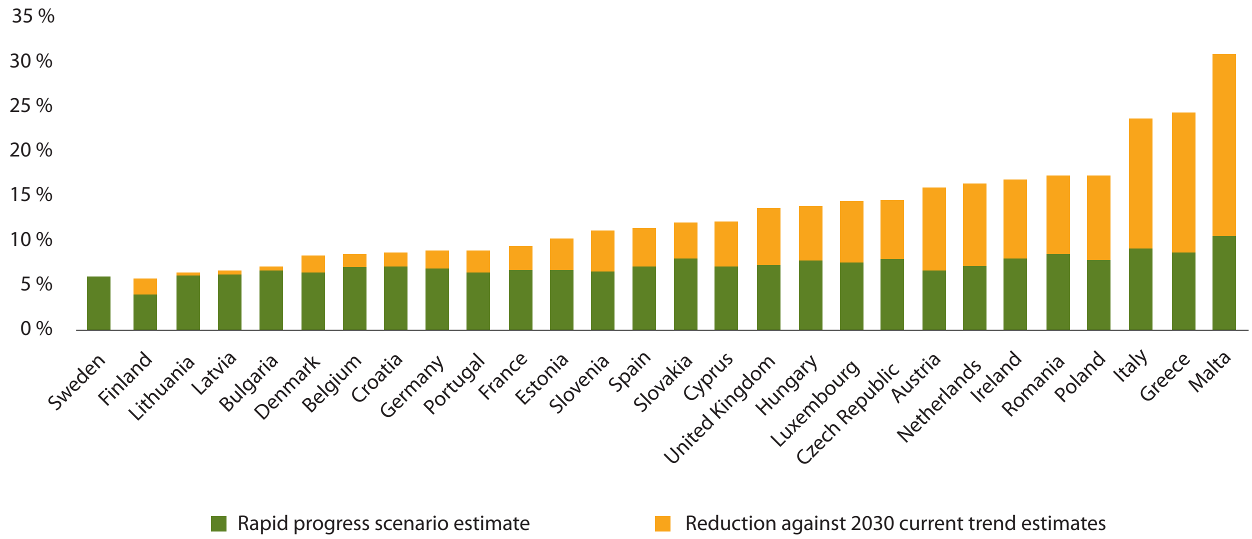
Table 1.15 Estimates of the decrease in gender gap in activity rates by Member State in different modelling scenarios (unadjusted for baseline trends)

Member State	Gender gap in activity rates in 2030 based on current trends (%)	Gender gaps in activity rates by 2030 (%)	
		Slow progress scenario	Rapid progress scenario
Sweden	6%	6% (as current trend)	6% (as current trend)
Finland	6%	4% (as in 2014)	4% (as in 2014)
Lithuania	6%	6% (as current trend)	6% (as current trend)
Latvia	7%	7%	6%
Bulgaria	7%	7%[69]	7%
Denmark	8%	7%	6%
Belgium	9%	9%	7%
Croatia	9%	9%	7%
Germany	9%	8%	7%
Portugal	9%	7%	6%
France	10%	8%	7%
Estonia	10%	8%	7%
Slovenia	11%	8%	7%
Spain	11%	9%	7%
Slovakia	12%	11%	8%
Cyprus	12%	9%	7%
United Kingdom	14%	9%	7%
Hungary	14%	11%	8%
Luxembourg	14%	10%	8%
Czech Republic	15%	11%	8%
Austria	16%	8%	7%
Netherlands	16%	9%	7%
Ireland	17%	12%	8%
Romania	17%	13%	9%
Poland	17%	11%	8%
Italy	24%	14%	9%
Greece	24%	13%	9%
Malta	31%	18%	11%

Source: Study calculations, Eurostat data for 2014, Eurostat population projections, Cedefop labour force projections

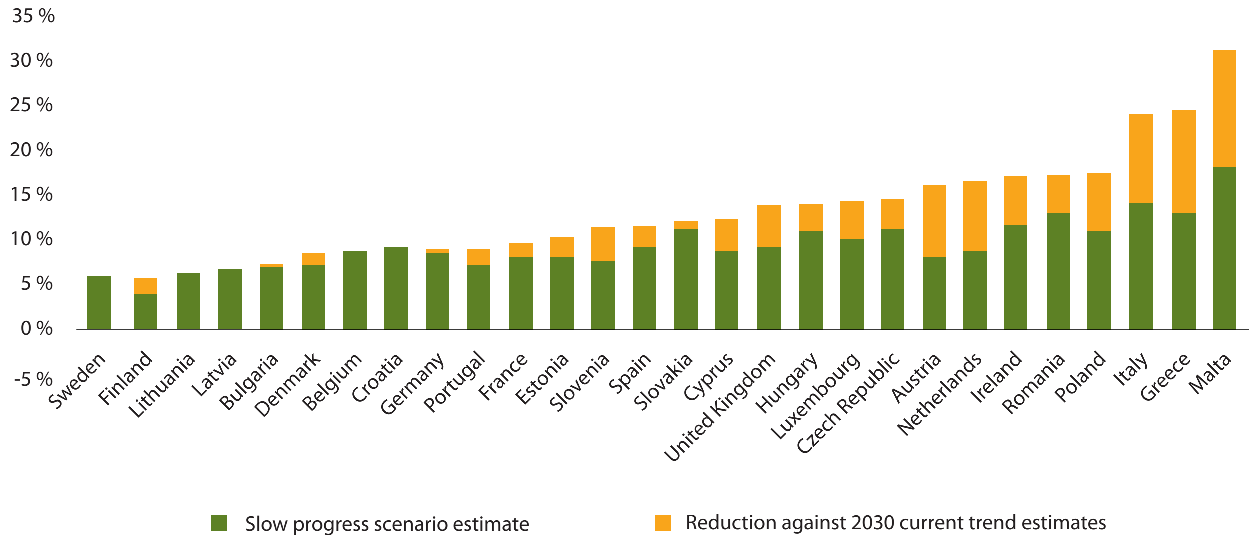
69 Assumed the same as current trend in 2030, because Bulgaria is projected to strongly reduce gender gap in activity rates by 2030 under current trends (see Table 1.14). Thus catching up with Sweden in the slow speed scenario does not yield a sensible value.

Figure 1.9 Estimated decrease in activity rate gender gap in rapid progress scenario against current trend estimates



Source: Study calculations, Eurostat data for 2014, Eurostat population projections, Cedefop labour force projections

Figure 1.10 Estimated decrease in activity rate gender gap in slow progress scenario against current trend estimates



Source: Study calculations, Eurostat data for 2014, Eurostat population projections, Cedefop labour force projections

1.2.6 Qualification levels of women becoming economically active

The economic impact being modelled will also depend on the skills of the females becoming economically active and not just their numbers. The actual mix will partly reflect the extent to which those becoming economically active are new entrants and women who have been missing from the labour market for a relatively short time due to career breaks resulting from childcare or other temporary reasons and therefore have skills similar to those economically active; and those which have been inactive because of a lack of skills.

We developed the following three qualification scenarios (see Tables below):

- **Inactive qualification scenario.** We assume that the mix of qualifications of women becoming economically active is a reflection of the qualification mix of the inactive female population aged 20 to 64. Data was extracted from Eurostat on total number of inactive women by qualification attainment in 2014 and for each qualification attainment group its proportion in total population of women was calculated.

- **Active qualification scenario.** We assume that the mix of qualifications of women becoming economically active is a reflection of the qualification mix of the economically active female population aged 20 to 64. Data was extracted from Eurostat on total number of active women by qualification attainment in 2014 and for each qualification attainment group its proportion in total population of women was calculated.

- **Mixed qualification scenario.** We assume that the mix of qualifications of women becoming economically active is a reflection of the qualification mix of the overall female population aged 20 to 64. The data from previous two scenarios was pooled and for each qualification attainment group its proportion in total population of women was calculated.

To the extent that women are inactive because their skills are not in demand, the inactive scenario would lead to higher levels of unemployment than the active scenario. In the end, the **active qualification scenario** was used, implicitly assuming that additional women entering the labour force would have very similar characteristics to those who already are in the labour market.

Table 1.16 Assumed qualification mix by Member State (age group 20-24)[70]

Member State	Inactive qualification scenarios (proportion of women entering labour market by qualification type)			Mixed qualification scenarios (proportion of women entering labour market by qualification type)			Active qualification scenarios (proportion of women entering labour market by qualification type)		
	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-6 (%)
EU28	36%	44%	20%	21%	56%	23%	15%	61%	24%
Austria	31%	47%	22%	57%	29%	14%	10%	60%	30%
Belgium	44%	35%	22%	21%	44%	35%	12%	48%	40%
Bulgaria	39%	41%	20%	22%	59%	19%	10%	72%	18%
Croatia	23%	67%	10%	10%	74%	16%	4%	77%	19%
Cyprus	26%	40%	34%	7%	32%	62%	3%	30%	68%
Czech Republic	10%	61%	29%	8%	71%	21%	6%	77%	16%
Denmark	37%	38%	25%	20%	66%	14%	17%	72%	12%
Estonia	12%	53%	35%	9%	61%	30%	8%	64%	28%
Finland	17%	44%	38%	10%	75%	15%	8%	83%	9%
France	36%	41%	23%	17%	51%	32%	10%	55%	35%
Germany	31%	52%	17%	22%	68%	10%	19%	73%	8%
Greece	33%	52%	15%	19%	58%	23%	10%	62%	27%
Hungary	27%	48%	25%	16%	63%	21%	10%	71%	19%
Ireland	26%	43%	31%	12%	53%	35%	3%	58%	38%
Italy	47%	40%	13%	34%	55%	11%	20%	71%	9%
Latvia	16%	54%	30%	10%	60%	30%	7%	62%	31%
Lithuania	18%	58%	24%	10%	57%	32%	9%	57%	34%
Luxembourg	23%	37%	40%	20%	53%	27%	18%	63%	20%
Malta	78%	16%	7%	39%	38%	24%	21%	48%	31%
Netherlands	40%	40%	19%	19%	57%	23%	14%	61%	24%
Poland	14%	66%	19%	7%	70%	23%	3%	72%	25%
Portugal	65%	21%	14%	35%	41%	23%	26%	47%	26%
Romania	42%	52%	6%	31%	58%	12%	21%	62%	16%
Slovakia	14%	59%	27%	10%	72%	18%	8%	80%	13%
Slovenia	22%	55%	23%	11%	70%	19%	7%	75%	17%
Spain	50%	22%	28%	40%	30%	29%	36%	34%	30%
Sweden	31%	37%	31%	11%	67%	21%	8%	72%	20%
United Kingdom	35%	37%	27%	17%	50%	33%	11%	54%	35%

Source: Eurostat data for 2014

70 ISCED 0-2 group captures people who achieved qualifications up to lower secondary level. ISCED 3-4 captures people who achieved either upper secondary or post-secondary but no tertiary qualifications. ISCED 5-6 captures people who achieved tertiary qualifications.

Table 1.17 Assumed qualification mix by Member State (age group 25-29)[71]

Member State	Inactive qualification scenarios (proportion of women entering labour market by qualification type)			Mixed qualification scenarios (proportion of women entering labour market by qualification type)			Active qualification scenarios (proportion of women entering labour market by qualification type)		
	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-6 (%)
EU28	36%	44%	20%	16%	43%	41%	11%	43%	47%
Austria	31%	47%	22%	12%	48%	40%	8%	49%	43%
Belgium	44%	35%	22%	16%	33%	51%	10%	33%	57%
Bulgaria	39%	41%	20%	17%	42%	40%	11%	42%	47%
Croatia	23%	67%	10%	5%	59%	35%	2%	58%	41%
Cyprus	26%	40%	34%	11%	23%	66%	10%	21%	70%
Czech Republic	10%	61%	29%	5%	57%	38%	3%	55%	42%
Denmark	37%	38%	25%	15%	35%	50%	10%	34%	56%
Estonia	12%	53%	35%	7%	46%	47%	6%	45%	50%
Finland	17%	44%	38%	8%	46%	46%	6%	46%	48%
France	36%	41%	23%	13%	38%	48%	8%	38%	54%
Germany	31%	52%	17%	12%	60%	27%	8%	62%	30%
Greece	33%	52%	15%	14%	42%	45%	7%	39%	54%
Hungary	27%	48%	25%	13%	50%	37%	8%	50%	41%
Ireland	26%	43%	31%	9%	37%	54%	3%	35%	62%
Italy	47%	40%	13%	29%	46%	25%	17%	50%	33%
Latvia	16%	54%	30%	8%	41%	51%	6%	39%	55%
Lithuania	18%	58%	24%	8%	34%	59%	6%	30%	63%
Luxem-bourg	23%	37%	40%	10%	31%	59%	7%	30%	63%
Malta	78%	16%	7%	37%	30%	33%	21%	36%	43%
Netherlands	40%	40%	19%	14%	38%	48%	9%	38%	54%
Poland	14%	66%	19%	5%	43%	52%	2%	37%	61%
Portugal	65%	21%	14%	30%	33%	37%	24%	35%	41%
Romania	42%	52%	6%	23%	49%	28%	16%	48%	36%
Slovakia	14%	59%	27%	7%	51%	43%	5%	48%	47%
Slovenia	22%	55%	23%	6%	50%	44%	3%	49%	47%
Spain	50%	22%	28%	32%	22%	45%	28%	23%	50%
Sweden	31%	37%	31%	11%	40%	50%	8%	40%	52%
United Kingdom	35%	37%	27%	14%	38%	48%	9%	38%	53%

Source: Eurostat data for 2014

71 ISCED 0-2 group captures people who achieved qualifications up to lower secondary level. ISCED 3-4 captures people who achieved either upper secondary or post-secondary but no tertiary qualifications. ISCED 5-6 captures people who achieved tertiary qualifications.

Table 1.18 Assumed qualification mix by Member State (age group 30-34)[72]

Member State	Inactive qualification scenarios (proportion of women entering labour market by qualification type)			Mixed qualification scenarios (proportion of women entering labour market by qualification type)			Active qualification scenarios (proportion of women entering labour market by qualification type)		
	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-6 (%)
EU28	36%	44%	20%	17%	42%	42%	11%	41%	47%
Austria	31%	47%	22%	12%	47%	41%	9%	47%	44%
Belgium	44%	35%	22%	16%	34%	50%	10%	33%	57%
Bulgaria	39%	41%	20%	16%	44%	39%	10%	45%	45%
Croatia	23%	67%	10%	6%	57%	37%	3%	55%	42%
Cyprus	26%	40%	34%	12%	31%	57%	10%	30%	60%
Czech Republic	10%	61%	29%	5%	64%	31%	4%	65%	31%
Denmark	37%	38%	25%	15%	36%	49%	10%	35%	55%
Estonia	12%	53%	35%	8%	39%	53%	7%	35%	58%
Finland	17%	44%	38%	7%	41%	52%	4%	40%	56%
France	36%	41%	23%	13%	39%	48%	8%	38%	54%
Germany	31%	52%	17%	13%	57%	31%	9%	58%	34%
Greece	33%	52%	15%	17%	43%	41%	13%	40%	47%
Hungary	27%	48%	25%	14%	49%	37%	9%	49%	42%
Ireland	26%	43%	31%	9%	33%	58%	4%	30%	66%
Italy	47%	40%	13%	28%	45%	27%	18%	47%	35%
Latvia	16%	54%	30%	9%	40%	51%	7%	38%	55%
Lithuania	18%	58%	24%	7%	32%	61%	6%	28%	66%
Luxem-bourg	23%	37%	40%	14%	30%	56%	12%	29%	59%
Malta	78%	16%	7%	41%	28%	31%	26%	33%	41%
Netherlands	40%	40%	19%	15%	38%	47%	10%	38%	52%
Poland	14%	66%	19%	4%	45%	50%	2%	40%	57%
Portugal	65%	21%	14%	32%	30%	37%	28%	32%	41%
Romania	42%	52%	6%	25%	49%	27%	19%	47%	34%
Slovakia	14%	59%	27%	8%	62%	31%	6%	63%	32%
Slovenia	22%	55%	23%	6%	42%	52%	3%	40%	56%
Spain	50%	22%	28%	30%	24%	46%	26%	24%	50%
Sweden	31%	37%	31%	12%	31%	57%	9%	30%	60%
United Kingdom	35%	37%	27%	14%	36%	51%	8%	35%	57%

Source: Eurostat data for 2014

72 ISCED 0-2 group captures people who achieved qualifications up to lower secondary level. ISCED 3-4 captures people who achieved either upper secondary or post-secondary but no tertiary qualifications. ISCED 5-6 captures people who achieved tertiary qualifications.

Table 1.19 Assumed qualification mix by Member State (age group 35-39)[73]

Member State	Inactive qualification scenarios (proportion of women entering labour market by qualification type)			Mixed qualification scenarios (proportion of women entering labour market by qualification type)			Active qualification scenarios (proportion of women entering labour market by qualification type)		
	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-6 (%)
EU28	36%	44%	20%	18%	44%	39%	13%	44%	43%
Austria	31%	47%	22%	15%	49%	36%	12%	49%	39%
Belgium	44%	35%	22%	17%	34%	48%	11%	34%	54%
Bulgaria	39%	41%	20%	16%	45%	39%	10%	46%	44%
Croatia	23%	67%	10%	10%	60%	30%	7%	59%	34%
Cyprus	26%	40%	34%	15%	36%	49%	14%	35%	51%
Czech Republic	10%	61%	29%	5%	70%	25%	4%	72%	24%
Denmark	37%	38%	25%	14%	37%	49%	10%	37%	53%
Estonia	12%	53%	35%	8%	40%	52%	7%	37%	56%
Finland	17%	44%	38%	6%	35%	59%	4%	34%	63%
France	36%	41%	23%	14%	38%	48%	10%	37%	53%
Germany	31%	52%	17%	14%	59%	27%	10%	61%	29%
Greece	33%	52%	15%	20%	51%	30%	16%	50%	34%
Hungary	27%	48%	25%	14%	56%	30%	11%	58%	32%
Ireland	26%	43%	31%	10%	33%	56%	5%	30%	65%
Italy	47%	40%	13%	29%	46%	25%	20%	49%	31%
Latvia	16%	54%	30%	10%	46%	44%	9%	45%	46%
Lithuania	18%	58%	24%	10%	41%	49%	8%	39%	52%
Luxembourg	23%	37%	40%	14%	32%	54%	12%	31%	57%
Malta	78%	16%	7%	46%	28%	26%	32%	34%	34%
Netherlands	40%	40%	19%	18%	41%	41%	13%	41%	46%
Poland	14%	66%	19%	5%	52%	43%	3%	49%	48%
Portugal	65%	21%	14%	37%	28%	35%	33%	29%	38%
Romania	42%	52%	6%	25%	53%	21%	20%	54%	26%
Slovakia	14%	59%	27%	6%	67%	28%	4%	68%	28%
Slovenia	22%	55%	23%	6%	50%	44%	4%	49%	47%
Spain	50%	22%	28%	29%	22%	49%	25%	22%	53%
Sweden	31%	37%	31%	11%	34%	55%	8%	33%	59%
United Kingdom	35%	37%	27%	16%	35%	49%	10%	34%	55%

Source: Eurostat data for 2014

73 ISCED 0-2 group captures people who achieved qualifications up to lower secondary level. ISCED 3-4 captures people who achieved either upper secondary or post-secondary but no tertiary qualifications. ISCED 5-6 captures people who achieved tertiary qualifications.

Table 1.20 Assumed qualification mix by Member State (age group 40-44)[74]

Member State	Inactive qualification scenarios (proportion of women entering labour market by qualification type)			Mixed qualification scenarios (proportion of women entering labour market by qualification type)			Active qualification scenarios (proportion of women entering labour market by qualification type)		
	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-6 (%)
EU28	36%	44%	20%	20%	46%	33%	17%	47%	37%
Austria	31%	47%	22%	17%	52%	31%	15%	52%	33%
Belgium	44%	35%	22%	19%	36%	45%	13%	37%	50%
Bulgaria	39%	41%	20%	17%	49%	35%	11%	50%	38%
Croatia	23%	67%	10%	15%	61%	24%	14%	60%	26%
Cyprus	26%	40%	34%	18%	42%	41%	16%	42%	42%
Czech Republic	10%	61%	29%	4%	75%	21%	3%	77%	19%
Denmark	37%	38%	25%	14%	42%	44%	11%	42%	47%
Estonia	12%	53%	35%	7%	46%	47%	6%	44%	50%
Finland	17%	44%	38%	7%	37%	56%	5%	35%	60%
France	36%	41%	23%	18%	40%	42%	15%	40%	45%
Germany	31%	52%	17%	14%	62%	24%	11%	63%	26%
Greece	33%	52%	15%	23%	49%	28%	20%	49%	31%
Hungary	27%	48%	25%	15%	59%	26%	13%	61%	26%
Ireland	26%	43%	31%	13%	37%	49%	9%	35%	56%
Italy	47%	40%	13%	33%	45%	21%	27%	48%	25%
Latvia	16%	54%	30%	6%	53%	40%	4%	53%	42%
Lithuania	18%	58%	24%	8%	52%	40%	7%	51%	42%
Luxembourg	23%	37%	40%	17%	33%	50%	16%	32%	52%
Malta	78%	16%	7%	52%	26%	22%	38%	32%	30%
Netherlands	40%	40%	19%	20%	44%	36%	16%	45%	39%
Poland	14%	66%	19%	7%	61%	32%	5%	59%	35%
Portugal	65%	21%	14%	45%	26%	29%	43%	26%	31%
Romania	42%	52%	6%	22%	62%	17%	16%	64%	20%
Slovakia	14%	59%	27%	6%	72%	21%	4%	76%	20%
Slovenia	22%	55%	23%	12%	51%	37%	10%	51%	39%
Spain	50%	22%	28%	33%	23%	44%	29%	23%	47%
Sweden	31%	37%	31%	12%	39%	49%	10%	39%	51%
United Kingdom	35%	37%	27%	20%	35%	44%	17%	35%	49%

Source: Eurostat data for 2014

74 ISCED 0-2 group captures people who achieved qualifications up to lower secondary level. ISCED 3-4 captures people who achieved either upper secondary or post-secondary but no tertiary qualifications. ISCED 5-6 captures people who achieved tertiary qualifications.

Table 1.21 Assumed qualification mix by Member State (age group 45-49)[75]

	Inactive qualification scenarios (proportion of women entering labour market by qualification type)			Mixed qualification scenarios (proportion of women entering labour market by qualification type)			Active qualification scenarios (proportion of women entering labour market by qualification type)		
	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-6 (%)
EU28	36%	44%	20%	23%	49%	29%	20%	50%	31%
Austria	31%	47%	22%	18%	55%	27%	16%	56%	28%
Belgium	44%	35%	22%	21%	39%	41%	16%	40%	45%
Bulgaria	39%	41%	20%	17%	53%	30%	11%	56%	33%
Croatia	23%	67%	10%	22%	58%	20%	22%	56%	22%
Cyprus	26%	40%	34%	20%	47%	33%	19%	48%	33%
Czech Republic	10%	61%	29%	6%	71%	23%	5%	73%	21%
Denmark	37%	38%	25%	15%	46%	39%	11%	47%	41%
Estonia	12%	53%	35%	7%	50%	43%	6%	49%	45%
Finland	17%	44%	38%	8%	40%	52%	6%	39%	55%
France	36%	41%	23%	23%	46%	32%	20%	47%	33%
Germany	31%	52%	17%	14%	64%	23%	11%	66%	23%
Greece	33%	52%	15%	27%	44%	29%	25%	42%	33%
Hungary	27%	48%	25%	17%	57%	26%	14%	59%	26%
Ireland	26%	43%	31%	16%	42%	42%	12%	41%	47%
Italy	47%	40%	13%	37%	46%	17%	33%	48%	19%
Latvia	16%	54%	30%	6%	57%	37%	4%	57%	38%
Lithuania	18%	58%	24%	8%	54%	38%	7%	54%	39%
Luxembourg	23%	37%	40%	22%	38%	40%	22%	39%	40%
Malta	78%	16%	7%	60%	24%	16%	48%	29%	23%
Netherlands	40%	40%	19%	22%	47%	31%	19%	48%	33%
Poland	14%	66%	19%	8%	66%	27%	6%	66%	29%
Portugal	65%	21%	14%	56%	20%	24%	54%	20%	25%
Romania	42%	52%	6%	23%	62%	15%	17%	66%	17%
Slovakia	14%	59%	27%	8%	73%	19%	7%	76%	17%
Slovenia	22%	55%	23%	15%	54%	31%	15%	53%	32%
Spain	50%	22%	28%	40%	24%	35%	38%	25%	37%
Sweden	31%	37%	31%	12%	48%	40%	9%	49%	42%
United Kingdom	35%	37%	27%	22%	38%	40%	19%	38%	43%

Source: Eurostat data for 2014

75 ISCED 0-2 group captures people who achieved qualifications up to lower secondary level. ISCED 3-4 captures people who achieved either upper secondary or post-secondary but no tertiary qualifications. ISCED 5-6 captures people who achieved tertiary qualifications.

Table 1.22 Assumed qualification mix by Member State (age group 50-54)[76]

Member State	Inactive qualification scenarios (proportion of women entering labour market by qualification type)			Mixed qualification scenarios (proportion of women entering labour market by qualification type)			Active qualification scenarios (proportion of women entering labour market by qualification type)		
	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-6 (%)
EU28	46%	41%	12%	30%	47%	23%	22%	50%	28%
Austria	38%	52%	10%	26%	55%	19%	20%	57%	23%
Belgium	51%	32%	17%	34%	35%	31%	23%	37%	40%
Bulgaria	32%	51%	17%	18%	56%	26%	12%	58%	30%
Croatia	41%	51%	8%	30%	57%	14%	21%	61%	18%
Cyprus	49%	31%	19%	32%	36%	33%	21%	38%	41%
Czech Republic	24%	70%	6%	13%	72%	16%	7%	73%	20%
Denmark	39%	38%	22%	23%	43%	34%	17%	45%	38%
Estonia	12%	60%	28%	5%	53%	42%	3%	51%	46%
Finland	29%	44%	27%	11%	42%	46%	6%	42%	52%
France	48%	37%	16%	33%	44%	23%	26%	47%	27%
Germany	27%	60%	12%	16%	64%	20%	12%	65%	23%
Greece	51%	35%	14%	43%	36%	21%	36%	36%	28%
Hungary	35%	54%	11%	23%	56%	21%	15%	57%	27%
Ireland	48%	34%	18%	28%	40%	32%	16%	44%	40%
Italy	68%	27%	5%	48%	39%	12%	33%	49%	18%
Latvia	14%	71%	14%	6%	66%	28%	4%	64%	33%
Lithuania	10%	74%	16%	7%	61%	32%	6%	58%	36%
Luxembourg	36%	46%	18%	29%	41%	30%	26%	38%	37%
Malta	86%	9%	5%	74%	17%	9%	54%	29%	17%
Netherlands	54%	32%	13%	33%	42%	25%	23%	46%	31%
Poland	21%	70%	9%	13%	69%	17%	7%	69%	24%
Portugal	82%	8%	10%	67%	16%	17%	59%	20%	21%
Romania	45%	51%	5%	34%	57%	9%	23%	63%	14%
Slovakia	24%	69%	7%	13%	74%	13%	8%	76%	16%
Slovenia	33%	53%	14%	23%	54%	24%	17%	54%	29%
Spain	74%	15%	11%	54%	21%	25%	43%	24%	32%
Sweden	40%	40%	21%	18%	45%	37%	13%	46%	41%
United Kingdom	43%	31%	26%	27%	37%	36%	21%	39%	40%

Source: Eurostat data for 2014

76 ISCED 0-2 group captures people who achieved qualifications up to lower secondary level. ISCED 3-4 captures people who achieved either upper secondary or post-secondary but no tertiary qualifications. ISCED 5-6 captures people who achieved tertiary qualifications.

Table 1.23 Assumed qualification mix by Member State (age group 55-59)[77]

Member State	Inactive qualification scenarios (proportion of women entering labour market by qualification type)			Mixed qualification scenarios (proportion of women entering labour market by qualification type)			Active qualification scenarios (proportion of women entering labour market by qualification type)		
	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-6 (%)
EU28	46%	41%	12%	34%	45%	21%	25%	48%	27%
Austria	38%	52%	10%	30%	50%	19%	24%	49%	27%
Belgium	51%	32%	17%	38%	34%	28%	27%	36%	37%
Bulgaria	32%	51%	17%	20%	50%	29%	14%	50%	35%
Croatia	41%	51%	8%	34%	50%	16%	24%	49%	27%
Cyprus	49%	31%	19%	40%	35%	25%	32%	38%	29%
Czech Republic	24%	70%	6%	16%	69%	14%	12%	69%	19%
Denmark	39%	38%	22%	29%	38%	33%	25%	38%	37%
Estonia	12%	60%	28%	5%	49%	45%	3%	46%	51%
Finland	29%	44%	27%	16%	43%	41%	12%	43%	45%
France	48%	37%	16%	39%	39%	22%	34%	41%	25%
Germany	27%	60%	12%	17%	63%	20%	13%	64%	24%
Greece	51%	35%	14%	49%	33%	18%	46%	29%	25%
Hungary	35%	54%	11%	25%	56%	20%	17%	57%	26%
Ireland	48%	34%	18%	33%	40%	26%	22%	45%	33%
Italy	68%	27%	5%	51%	36%	13%	34%	46%	20%
Latvia	14%	71%	14%	7%	67%	27%	4%	65%	31%
Lithuania	10%	74%	16%	8%	60%	32%	8%	54%	38%
Luxembourg	36%	46%	18%	30%	44%	27%	24%	42%	35%
Malta	86%	9%	5%	77%	15%	8%	56%	28%	16%
Netherlands	54%	32%	13%	37%	38%	25%	28%	41%	31%
Poland	21%	70%	9%	15%	69%	16%	9%	68%	22%
Portugal	82%	8%	10%	73%	11%	16%	67%	14%	19%
Romania	45%	51%	5%	41%	50%	9%	37%	50%	14%
Slovakia	24%	69%	7%	18%	69%	14%	13%	68%	18%
Slovenia	33%	53%	14%	26%	51%	24%	19%	48%	33%
Spain	74%	15%	11%	60%	19%	21%	50%	23%	28%
Sweden	40%	40%	21%	23%	41%	35%	19%	42%	39%
United Kingdom	43%	31%	26%	31%	35%	33%	25%	38%	37%

Source: Eurostat data for 2014

77 ISCED 0-2 group captures people who achieved qualifications up to lower secondary level. ISCED 3-4 captures people who achieved either upper secondary or post-secondary but no tertiary qualifications. ISCED 5-6 captures people who achieved tertiary qualifications.

Table 1.24 Assumed qualification mix by Member State (age group 60-64)[78]

Member State	Inactive qualification scenarios (proportion of women entering labour market by qualification type)			Mixed qualification scenarios (proportion of women entering labour market by qualification type)			Active qualification scenarios (proportion of women entering labour market by qualification type)		
	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-8 (%)	ISCED 0-2 (%)	ISCED 3-4 (%)	ISCED 5-6 (%)
EU28	46%	41%	12%	39%	42%	19%	30%	42%	28%
Austria	38%	52%	10%	35%	50%	15%	25%	47%	29%
Belgium	51%	32%	17%	45%	32%	22%	30%	33%	36%
Bulgaria	32%	51%	17%	25%	48%	26%	17%	45%	38%
Croatia	41%	51%	8%	38%	48%	15%	26%	38%	36%
Cyprus	49%	31%	19%	47%	31%	21%	44%	31%	24%
Czech Republic	24%	70%	6%	19%	69%	13%	9%	66%	25%
Denmark	39%	38%	22%	29%	38%	32%	21%	39%	40%
Estonia	12%	60%	28%	7%	54%	39%	5%	50%	45%
Finland	29%	44%	27%	23%	42%	35%	20%	41%	40%
France	48%	37%	16%	42%	36%	22%	34%	35%	31%
Germany	27%	60%	12%	20%	60%	19%	16%	60%	24%
Greece	51%	35%	14%	54%	31%	15%	66%	16%	18%
Hungary	35%	54%	11%	31%	53%	15%	20%	50%	30%
Ireland	48%	34%	18%	41%	37%	23%	30%	41%	29%
Italy	68%	27%	5%	59%	30%	11%	37%	38%	25%
Latvia	14%	71%	14%	9%	63%	28%	5%	57%	38%
Lithuania	10%	74%	16%	13%	59%	28%	16%	47%	37%
Luxembourg	36%	46%	18%	42%	36%	22%	54%	16%	30%
Malta	86%	9%	5%	81%	12%	7%	50%	28%	22%
Netherlands	54%	32%	13%	45%	34%	21%	36%	36%	28%
Poland	21%	70%	9%	19%	68%	14%	11%	59%	30%
Portugal	82%	8%	10%	81%	8%	11%	80%	7%	12%
Romania	45%	51%	5%	52%	43%	5%	70%	24%	6%
Slovakia	24%	69%	7%	21%	67%	12%	11%	61%	28%
Slovenia	33%	53%	14%	35%	49%	16%	46%	32%	23%
Spain	74%	15%	11%	68%	16%	16%	58%	18%	24%
Sweden	40%	40%	21%	26%	38%	36%	22%	37%	41%
United Kingdom	43%	31%	26%	35%	34%	31%	28%	38%	35%

Source: Eurostat data for 2014

78 ISCED 0-2 group captures people who achieved qualifications up to lower secondary level. ISCED 3-4 captures people who achieved either upper secondary or post-secondary but no tertiary qualifications. ISCED 5-6 captures people who achieved tertiary qualifications.

1.3 Pathway 3: Reduced gender pay gaps

1.3.1 Introduction

This note presents the approach and initial assumptions necessary to model the economic impacts from reducing gender pay gaps, where the gender pay gap is defined as the difference between the average gross hourly earnings of men and women expressed as a percentage of the average gross hourly earnings of men without correcting for national differences in individual characteristics of employed men and women (as calculated by Eurostat).[79]

Overall, this document:

- Briefly summarises the general approach to the economic modelling;
- Describes the methodology used to estimate the expected decrease in the gender pay gap in each Member State by 2030;
- Provides initial values of these estimates for each Member State.

1.3.2 The general approach

The general approach is summarised in Figure 1.11.

The general method of policy evaluation is to establish the intermediate steps between the introduction of policy measures and the subsequent effects on the economy and society.

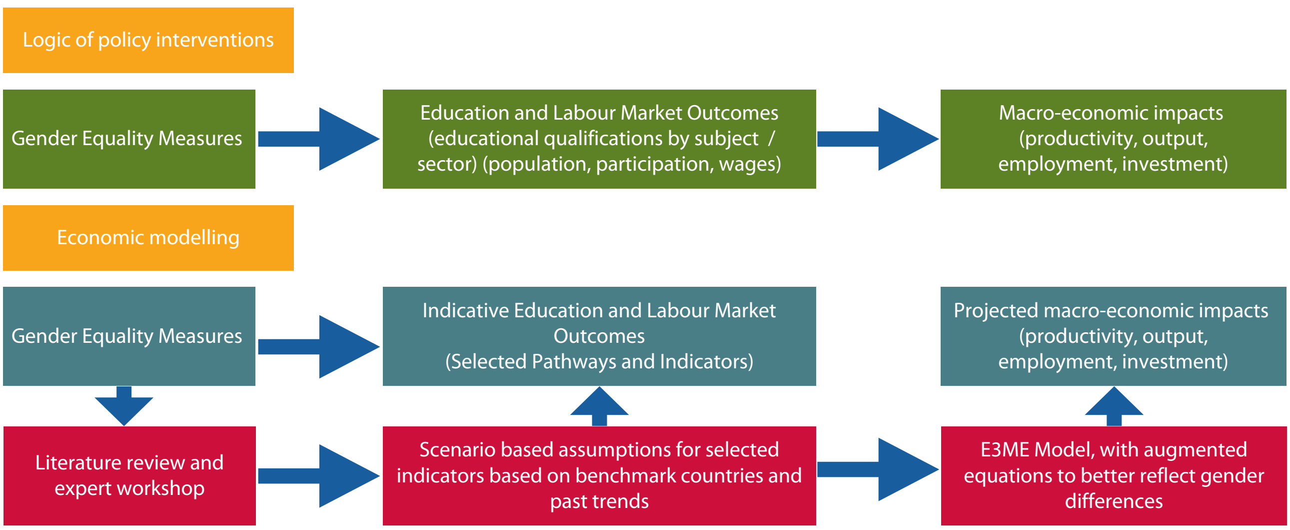
In the context of gender equality measures and the interest in their macro-economic impacts, significant levels of uncertainty and gaps are acknowledged in the empirical evidence relating measures to labour market outcomes and to wider economic impacts. The agreed evaluation response in this study is to develop outcome scenarios setting out plausible descriptions of how far particular labour market outcomes might change as a result of additional gender equality measures (using selected benchmarks and trend analysis) and to use these scenarios and related assumptions with an economic model (E3ME) to project the possible range of macro-economic impacts associated with the outcome scenarios.

1.3.3 Gender pay gaps

This note focuses on developing scenarios of future trends in the gender pay gap as a result of additional gender equality measures. The scenarios are based on a conservative estimate of the gender pay gap, which can be plausibly eliminated by 2030.

The scenarios are described using assumptions of future changes in the gaps between female and male hourly earnings. These scenarios and related assumptions are then used as inputs to the economic model, which projects the macro-economic consequences of the outcome scenarios. These outcomes will be modelled using the E3ME model once assumptions are agreed on. Some sensitivity analysis will be undertaken to establish the sensitivity of economic impacts to assumed rates of change in the gender pay gap.

Figure 1.11 Overview of the approach to economic modelling of economic impacts of gender equality measures



79 http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Gender_pay_gap_(GPG)

This note presents two scenarios describing the future rates of decrease in the gender pay gap based on analysis of trend data.

1.3.3.1 General pathway description

Hourly earnings tend to be lower for women than men and this gap varies by country and sector. The general proposition behind the scenario assumptions is that gender equality measures can result in an increase in female hourly earnings relative to male hourly earnings (note that this change relates only to hourly earnings – we do not investigate the change in average earnings per woman due to changes in employment or hours worked). This is likely to result in an increase in employer wage related costs, product prices and consumer spending, which will affect levels of economic activity and spending.

Table 1.25 Pathway 3 description – Gender pay gaps

Gender equality measures	Outcome Scenario assumptions	Economic impacts (from modelling)	
		Labour market impacts	Economic impacts
Gender equality measures leading to reduction in gender pay gap – with an increase in female earnings	■ Reduced gender pay gap in the form of higher female earnings ■ It is assumed that higher female pay does not discriminate against female employment	■ Higher average wage rates leads to lower employment levels ■ Labour supply may increase in response to higher wages	■ There is a cost to firms in terms of competitiveness ■ Aggregate household incomes may increase due to higher wage rates but could also fall due to lower employment levels

1.3.3.2 Relationship of gender pay gap to other gender inequalities

Gender pay gap is likely to result from a variety of factors such as demographic characteristics, sectoral and occupational segregation, levels of human capital, personal preferences, family related issues, wage bargaining differences between men and women and/or employer discrimination.

This means that the gender pay gap modelling scenario is likely to overlap to a certain extent with modelling of labour market participation and education inequalities. For example, improving labour market participation of women may be associated with less women taking career breaks and thus have important consequences for women's hourly earnings. If this is not taken into consideration, the modelling of gender pay gaps is likely to double-count some of the effects of improving gender equality modelled in labour market participation and education scenarios.

In order to avoid this overlap, we considered to focus on the part of the gender pay gap unrelated to gender inequalities in labour force participation and education (i.e. resulting from such factors as employer discrimination against women or different bargaining attitudes of women in wage setting).

For this purpose, a literature review was undertaken to assess whether any plausible assumptions can be made about the proportion of the gender pay gap[80] unrelated to labour force participation and education inequalities. This literature review focused on available research assessing the determinants gender pay gaps.

The literature review did not enable us to separate the proportion of gender pay gap unrelated to labour force participation and education inequalities. Its results are briefly summarised in Section 1.3.4.

Given this lack of findings, we decided to focus on modelling of the overall unadjusted gender pay gap as presented in Eurostat database. The rest of this note describes our approach to this pay gap modelling in three sections:

- Section 1.3.5: Analysis of current gender pay gaps and past trends across EU-28 Member States
- Section 1.3.6: Selection of benchmark country against which to model future changes in gender pay gap in EU Member States

80 Another way to identify the proportion of unexplained gender pay gap would be to run a regression with the overall gender pay gap as the explained variable and a set of key economic indicators (such as employment by sector and occupation) as explanatory variables. However, data on pay gaps is currently very limited (only available for years 2007 to 2014 with some gaps). In addition, the estimation of the causes of gender pay gap requires extensive collection of microeconomic data at national level to be accurate. This is precisely why Eurostat does not aim to provide estimates of gender pay gap adjusted for sectoral and occupational segregation. We do not attempt such modelling for the same reasons.

- Section 1.3.7: Estimation of changes in gender pay gap over time

1.3.4 Summary of the literature review on the determinants of gender pay gap

In total, we identified 14 studies at Member State level that provided estimates of the determinants of gender pay gap. The review however presented significant difficulties in comparing these studies which resulted from:

- **Methodological differences between studies.** The studies considered different explanatory variables and often were not sufficiently comprehensive in scope to enable a like for like comparison of pay gap determinants (see Table 1.26). The scope of the studies was also restricted in some cases to specific subsets of the total population (e.g. young people, or within employees in specific sectors).

- **Year of publication.** Some of the available literature pre-dated the economic recession and thus did not reflect potential structural and policy changes that could have a bearing on the determinants of gender pay gaps.

Given the large differences in methodology and year of publishing, it was not possible to identify the proportion of gender pay gap that unrelated to labour force participation and education inequalities. There was significant variation across studies in the proportion of gender pay gap left unexplained after accounting for several determinants of pay gaps. The unexplained proportion of pay gap ranged from 17 per cent in Romania to 90 per cent in Belgium. It was not possible to establish what proportion of this variation was likely to be attributable to national differences as opposed to differences in study methodology and year of publication.

Thus, the modelling approach presented in the sections below focuses on modelling of the overall gender pay gap, without attempting to exclude determinants of gender pay gap that may be already modelled under the education and labour market outcome scenarios.

Table 1.26 Studies on composition of gender pay gaps in Member States

Study	Country coverage	Factors considered	Proportion of gender pay gap unexplained by factors considered
Andrén, D.; Andrén, T., 2015	RO	Endowments (age, education, and other socioeconomic factors); occupational differences; selectivity effect (self-selection into occupations, which is driven by unobservables e.g. occupational choice is made on the basis of an individual's preferences, skills, or abilities related to different work tasks)	17%
Holst, E., Busch, A., 2011	DE	Human capital: education, experience; horizontal segregation: percentage of women in each job; occupational differences; family status/children	35%
Livanos, I. and Pouliakas, K., 2012.	EL	Occupational differences; demographic differences	7% (public) 32% (private)
Bensidoun, I., Trancart, D., 2015	FR	Non-cognitive characteristics (risk attitude; career preferences; optimism over professional future); experience; age; education; family status	60%
Albæk, K., and Brink Thomsen, L., 2014	DK	Occupational differences; human capital (schooling, experience, tenure)	50%
Rycx F. and Tojerow I., 2002	BE	Occupational differences	90%

Rycx, F. and Tojerow, I., 2004	BE	Firm profits-per-employee; inter-industry differences; working conditions; individual and firm characteristics; wage-profit elasticities	86%
Christofides, L. and Vra-chimis, K., 2007.	CY	Occupational differences; education	30%
Anspal, S., Rõõm, T., 2011	EE	Occupational differences; education; family factors & length of work experience; public/private sector; size of enterprise	24%
Jurajda, Š., 2003.	SK, CZ	Age; education; firm-level controls - industrial classification, public/non-public, ownership type, and geographical location of the firm; occupational segregation; firm level segregation; job cell segregation	33% (public); 66% (private)
Russell, H., Smyth, E., and O'Connell, P.J., 2010	IE	Education; occupational differences	66%
Manning, A, Swaffield, J., 2005	UK	Human capital factors: job-shopping; psychological theories	44%
Albrecht, J., A. Van Vuuren, S. Vroman, 2004	NL	Occupational differences	75%
Johansson, M. and Katz, K., 2006	SE	Experience; education; occupational differences	74%

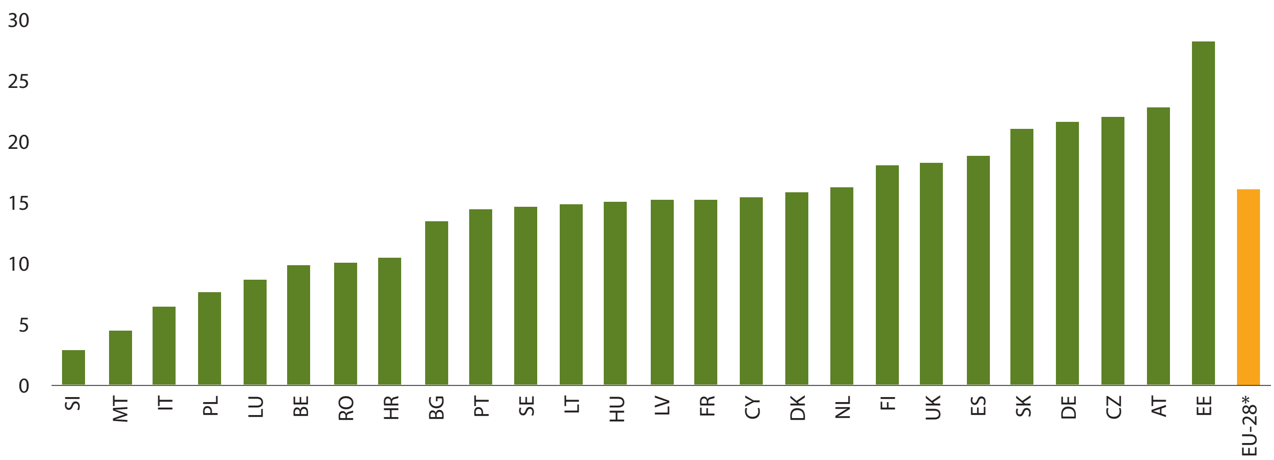
1.3.5 Current gender pay gaps by Member State

The total gender pay gap varies significantly across Member States. Slovenia had the lowest gender pay gap at 2.9% of male hourly earnings. This was considerably lower than the EU-28 average of 16.1%. Estonia had the highest gender pay gap at 28.3%.

Gender pay gaps in the large majority of Member States have reduced over time. In most cases, pay gaps (in hourly earnings) have closed by around three per cent or less between 2007 and 2014[81], although a few countries have seen more significant reductions of between six to eight per cent over the same period. Gender pay gaps increased only in five countries over this period, most notably in Portugal.

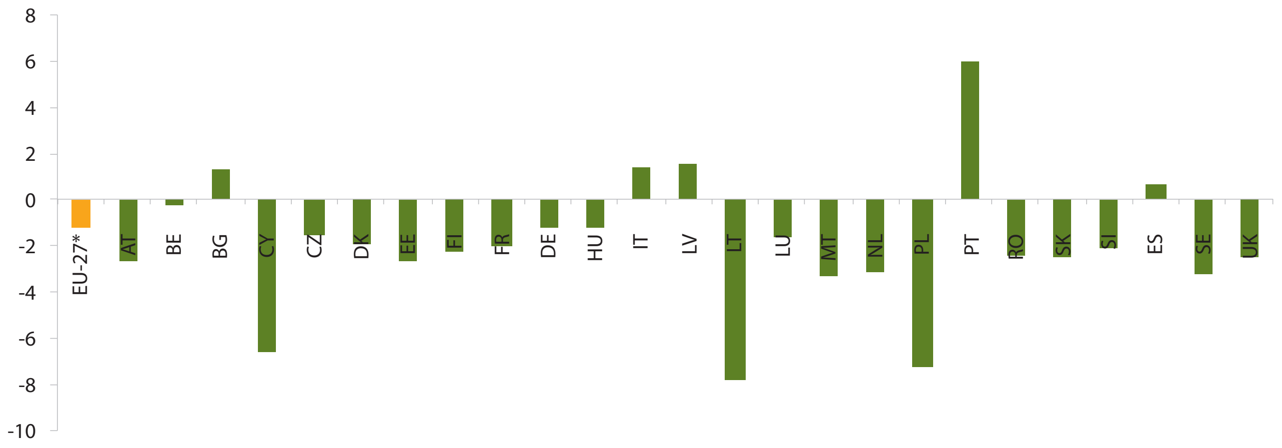
81 Note that 2007 is the earliest year for which comprehensive data on gender pay gaps is available

Figure 1.12 Total gender pay gap (male/female difference as % of male earnings) by Member State, 2014



*Source: Eurostat, 2014. *Data on Greece and Ireland was not available*

Figure 1.13 Change in gender pay gap, 2007-2014, by Member State



*Source: Eurostat, 2014. *EU-27 data available from 2008 (EU-28 data on pay gap not available before 2010); data on Croatia, Greece and Ireland was not available.*

1.3.6 Selection of benchmark Member State

In order to model changes in the gender pay gap over time, a benchmark country was selected, against which potential changes in the gender pay gap in other Member States can be modelled and assessed,

Four criteria were applied to select the benchmark Member State:

- Be among the three EU-28 Member States with the lowest total gender pay gaps.
- Have an employment rate higher than EU-28 average. Higher employment rates of women are likely to be associated with smaller effect of selection of the most able women into the labour force (see Mulligan and Rubinstein, 2008 for more detailed discussion). It was not considered appropriate to select as a benchmark Member State a country in which low gender pay gap could be interpreted to result from substantially higher selection effects than in other Member States.
- Have a strong labour market overall and hence the capacity to continue to set challenging goals for other Member States. In particular, the country should have no major issues in wage setting process and positive forecasts in terms of future GDP growth in the 2016 Country Specific Recommendation report by the European Commission.
- Have a robust gender policy framework in place to decrease gender pay gaps.

Based on the criteria presented above, **Slovenia was selected as the benchmark Member State** because:

- Slovenia had the lowest gender pay gap of all EU Member States, reaching only 2.9% in 2014.[82]
- Gender pay gaps in Slovenia are consistently low across different sectoral groupings. Slovenia has the lowest absolute gender gap[83] in industry and construction[84] and in the trade, transportation, accommodation and information sectors[85] among all EU Member States. Its gender gap is also among the five lowest in the EU in other broad sectoral groupings.[86]
- The female employment rate[87] in Slovenia stood at 64.7 per cent in 2015, which was marginally above the EU average of 64.2 per cent (Eurostat, 2015). Only in one Member State (Sweden) did female employment rates exceed Slovenia by more than ten percentage points. This suggests that the extent to which Slovenian gender pay gap is lower than in other countries due to selection effects (i.e. due to selection of only the most able women into employment, see Mulligan and Rubinstein, 2008) is likely to be limited.

82 http://ec.europa.eu/eurostat/statistics-explained/index.php/Gender_pay_gap_statistics
83 Based on Eurostat data on unadjusted gender pay gaps by area of economic
84 Sectors B to F according to Nace Rev. 2 classification, see http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2&StrLanguageCode=EN
85 Sectors G to J according to Nace Rev. 2 classification
86 Sectors K to N and Sectors O to S according to Nace Rev. 2 classification
87 Percentage of the female population aged 20-64 in employment.

- There are no significant structural macroeconomic or wage setting issues affecting the Slovenian economy. Slovenia has seen steady economic growth in recent years and has successfully emerged from the recession. Real GDP is growth is expected to continue in the coming years. Wage growth is in line with productivity gains and will continue to support external competitiveness. Slovenia also has the highest minimum wage in the EU as a proportion of average gross earnings (52.9 per cent in 2014) (European Commission, 2016).

- An effective policy framework is in place to support gender equality in the workforce, particularly in relation to parental leave and pre-school childcare:

  - Slovenia passed the Act on Equal Opportunities for Women and Men in 2002 which provides the legal basis for gender equality measures. An implementing regulation, the Resolution on the National Programme for Equal Opportunities of Women and Men (2005 -2013), was adopted in 2005. The Programme had four aims, including decreasing vertical and horizontal segregation and the gender pay gap (UN Global Database on Violence Against Women, 2011).

  - Slovenia has the highest full-time employment rate of mothers of small children in Europe. Almost all parents in Slovenia are employed full-time, even those with small children. Part-time work is rare among Slovenian women (just above 13.1 per cent compared to an EU average of 32.5 per cent). Slovenia has a system of shared parental leave that allows for the transfer of leave between mother and father. Paternity leave for fathers is also longer, enabling greater opportunities for women to return to work. Women receive 100 percent of their pay during maternity (European Union, European Platform for Investing in Children, 2016).

  - An integrated system of pre-school childcare for children from age one (end of eligible maternity leave) to compulsory schooling age is in place. Public pre-school institutions are founded and partly financed by local communities as well as from parents' contributions (Focus Consultancy, 2008).

1.3.7 Estimates of decrease in gender pay gaps – scenario assumption

The estimates of future changes in the gender pay gap, by Member State, presented below are based on assumptions describing the possible decrease in gender pay gap by 2030 due to gender equality measures.

Firstly, we estimate the gender pay gaps in 2030 that would result from current trends in earnings forecasted by the E3ME model. These estimates are called 'current trend estimates' because they describe future development in gender pay gaps based on extrapolation of historical data (from 2003 to 2013) on earnings of men and women. They rely on projecting historical data forward, reflecting past policy trends and thus implicitly assuming some further policy changes in the future based on historical data. They assume no change in gender pay gaps as a result of additional gender equality measures that cannot be predicted based on past trends. Thus they can treated as baseline scenarios, with no additional changes assumed compared to historical trends.

Secondly, we produce estimates of potential decrease in gender pay gaps as a result of additional gender equality measures that cannot be predicted based on historical data (i.e. assuming there is a higher number of gender equality measures than can be expected based on analysis of historic data).

- These estimates have been prepared for two groups based on Member State performance: The best performing Member State (Slovenia); and

- The remaining 27 Member States that have a worse performance in terms of gender pay gap than Slovenia.

In these estimates, we assume that additional gender equality measures can be implemented compared to current trend estimates (except in best performing Member States, which have already very low degree of inequality). Furthermore we assume that such additional gender equality measures will have at least some positive effect on female hourly earnings. These assumptions reflect the fact that most Member States (except the best performing ones) still have sizeable gender pay gaps.

However, it must be acknowledged that implementing additional gender equality measures may be difficult in practice. This is reflected in producing two sets of scenarios, each assuming a different rate of implementing additional gender equality measures:

- Rapid progress estimates assume a higher increase in number of gender equality measures compared to current trends;

- Slow progress estimates assume a lower increase in number of gender equality measures compared to current trends.

1.3.7.1 Estimating current trends

The current trend estimates describe the gender pay gap by 2030 assuming that the hourly earnings of men and women develop according to forecasts from the E3ME model based on historical data on earnings (from 2003 to 2013).

The current trend estimates are presented in Table 1.27. These estimates need to be treated with caution because of the low quality of data on earnings and pay gaps – they are only available over a ten year period and there is a lot of missing data in different years and sectors. Thus they provide a possible indication of future development in pay gaps rather than a precise estimate.

Table 1.27 Estimates of the decrease in gender pay gap by Member State under current trends

Member State	Gender pay gap in 2014 (%)[88]	Gender pay gap by 2030 based on current trends (%)	Reduction in gender pay gap between 2014 and 2030
SI	3%	2%	-0.7
MT	5%	4%	-1.0
IT	7%	5%	-1.1
PL	8%	6%	-1.5
LU	9%	7%	-1.3
BE	10%	9%	-0.6
HR	10%	9%	-1.0
RO	10%	10%	0.0
BG	13%	10%	-3.1
PT	15%	13%	-1.2
SE	15%	12%	-2.3
LT	15%	13%	-2.1
HU	15%	13%	-2.5
LV	15%	12%	-3.1
FR	15%	12%	-3.6
CY	15%	12%	-3.0
DK	16%	12%	-3.7
NL	16%	13%	-3.4
FI	18%	14%	-4.3
UK	18%	14%	-4.6
EL	19%	16%	-3.0
ES	19%	15%	-4.2
SK	21%	16%	-5.5
DE	22%	17%	-4.9
CZ	22%	17%	-4.7
AT	23%	18%	-5.3
EE	28%	25%	-3.4
IE	34%	24%	-10.0

Source: Eurostat, E3ME projections based on Eurostat data

88 Data not available from Eurostat on hourly pay gap in Greece and Ireland. The pay gap was therefore calculated in E3ME model.

1.3.7.2 Estimating change in gender pay gap due to additional gender equality measures

The best performing Member State

There are two possible trajectories along which the gender pay gap in Slovenia may evolve up to 2030. It can be assumed that:

- Slovenia has already reached an almost optimal situation in terms of the gender pay gap, and thus the gap between female and male pay will remain the same as in current trend estimates.
- Slovenia can further marginally reduce its gender pay gap compared to current trend estimates (based on historic performance) to reach full gender equality in pay before or by 2030.

For initial modelling purposes we have chosen the first assumption - no further reduction in gaps before 2030. This is because the gender pay gap in Slovenia is already very close to equality. The sensitivity of results to the choice can be estimated but is expected to very small.

The remaining Member States

For all other Member States, two scenarios are used to describe the additional progress Member States are expected to make in closing the gender pay gap by 2030 compared to current trend estimates:

- Scenario 1: Rapid progress – Member States reduce their gender pay gap to 50 per cent of their original difference (in 2014) to the Slovenian gap. Thus, a Member State where the gender pay gap is currently 15 per cent would reduce the gap over time (female pay would be only 9 per cent lower than male pay). If the current gap is 10 per cent, it would reduce to 6 per cent.[89]

  This assumption implies that gender pay gap will be reduced particularly in Member States that currently have high gender pay gaps – in effect, these countries will 'catch up' with the states with the lowest gender pay gaps. This reflects the fact that countries with high gender inequality probably have more to gain by implementing additional gender equality measures than countries where gender inequality is low. However, there may be particular reasons for high gender gaps in certain countries that may make their further reduction difficult.

The assumption is based on past performance of Member States that managed to catch up to a large extent with Slovenia by 2014. More specifically, these countries had to:

- Eliminate at least 10% of the 2007 difference in gender pay gap with Slovenia by 2014.
- Reduce gender pay gap at least by 2 percentage points between 2007 and 2014. This condition was important to ensure that countries catching up with Slovenia achieved meaningful absolute reduction in gender pay gap – countries with similar pay gap as Slovenia in 2007 could catch up even through a very small pay gap decrease. It would be misleading to include such countries in our selection, since they were similar to Slovenia in terms of gender pay gap already in 2007.

Based on these conditions the following countries were selected: Malta, Poland, Romania, France, Sweden, Netherlands, Finland, United Kingdom, Cyprus, Lithuania, Slovakia, Austria and Estonia (see Figure 1.13 for their performance).

For this selection, we then used the following formula to calculate the extent to which countries can be expected to catch up with Slovenia by 2030 in the rapid progress scenario:

$$nProgress_R = Percentile90\left(\frac{GapMS_{2007} - GapMS_{2014}}{GapMS_{2007} - GapSI_{1998}}\right)$$

where $GapMS_{2014}$ expresses the gender pay gap for Member States catching up with Slovenia in 2014; $GapMS_{2007}$ expresses the gap in these Member States in 2007; and $GapSI_{2007}$ expresses the same gap in Slovenia in 2007.[90]

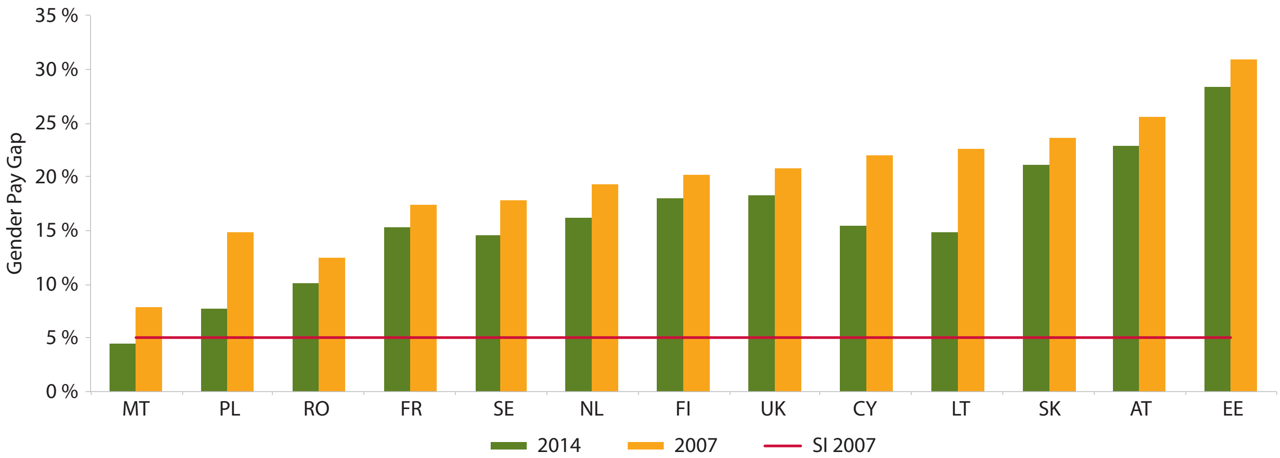
Intuitively, the formula assumes that rapid progress can be approximated by what a particularly well performing Member State in terms of catching up with Slovenia (90th percentile) achieved between 2007 and 2014. The 90th percentile was chosen because it demonstrates a particularly strong performance in

89 Note that the reduction is based on the following calculation process: 1.Subtract Slovenian gender pay gap from the pay gap of a given Member State; 2. Multiply this number by 0.5 (50%) to yield the estimated decrease in gender pay gap; 3. Subtract this estimated decrease from the 2014 Member State pay gap to arrive at the estimated pay gap in 2030 for the Member State.

90 As gender pay gap data was not available for 1998, figures are estimates extrapolated backwards based on the change in gender pay gap over the years for which data was available 2007-2014.

catching up with Slovenia, but avoids relying solely on those strong performing countries that are unlikely to be highly representative in the EU context (such as Malta, see Figure 1. 13). Lower value was not chosen to ensure that there is a notable difference between rapid and low progress scenarios.

Figure 1.14 Evolution of gender pay gaps between 1998 and 2014 for Member States with historically high gaps compared to Slovenia



- Scenario 2: Slow progress – As Scenario 1 but the percentage difference between Slovenian and the Member State reduces only to 75 per cent of the current difference. A Member State where female pay is currently 15 per cent lower than the male rate would reduce this gap over time to about 12 per cent. If the current gap is 10 per cent, this would reduce to about 8 per cent.

  This assumption was calculated in an analogous way to the rapid progress scenario, with the difference that we considered 70th rather than 90th percentile to measure the extent to which Member States managed to catch up with Slovenia.

Note that reduction in gender pay gaps under the slow and rapid progress scenarios is assumed to be caused by an increase in hourly earnings of women compared to current trends scenario. Earnings of men are assumed to remain the same as in the current trends scenario. This assumption is partly used to simplify analysis and partly follows the logic that gender pay gap is to a large extent caused by too low hourly earnings of women rather than too high hourly earnings of men (it is also difficult to imagine gender equality measures that would aim to reduce gender pay gap by decreasing pay of men).

Table 1.28 Estimates of the decrease in gender pay gap by Member State in different modelling scenarios (unadjusted for baseline trends)

Member State	Gender pay gap by 2030 (%)[91] under current trends	Reduction in gender pay gaps by 2030 (p.p.)	
		Slow progress scenario	Rapid progress scenario
SI	2%	0.0	0.0
MT	4%	0.0	0.1
IT	5%	0.1	1.4
PL	6%	0.2	1.8
LU	7%	0.7	2.7
BE	9%	1.8	4.3
HR	9%	1.5	4.0
RO	10%	2.5	5.0

91 Data not available from Eurostat on hourly pay gap in Greece and Ireland. The pay gap was therefore calculated in E3ME model.

BG	10%	0.6	4.2
PT	13%	2.9	7.0
SE	12%	1.8	5.9
LT	13%	2.0	6.2
HU	13%	1.8	6.1
LV	12%	1.2	5.5
FR	12%	0.8	5.1
CY	12%	1.3	5.7
DK	12%	0.8	5.3
NL	13%	1.2	5.9
FI	14%	1.0	6.3
UK	14%	0.8	6.2
EL	16%	2.5	8.0
ES	15%	1.3	6.9
SK	16%	0.9	7.2
DE	17%	1.7	8.2
CZ	17%	2.0	8.7
AT	18%	1.7	8.7
EE	25%	5.4	14.3
IE	24%	0.9	11.7

Source: Study calculations and Eurostat data for 2014

Estimates for different groups of economic activity

While the estimates in Table 1.28 approximate the scope of decrease in gender pay gaps possible at national level, they need to be refined to reflect the variation in pay gaps by sector.

To adjust the national estimates for sectoral variation, we weigh them by the relative size of gender pay gaps in four broad sectoral groupings used in the Eurostat Structure of Earning Survey in 2010 (based on NACE Rev2):

- **Group 1 (NACE Rev2 activities A-F)**[92]**:** Mining and quarrying; Manufacturing; Electricity, gas, steam and air conditioning supply; Water supply, sewerage, waste management and remediation activities; and Construction.
- **Group 2 (NACE Rev2 activities G-J):** Wholesale and retail trade, repair of motor vehicles and motorcycles; Transportation and storage; Accommodation and food service activities; Information and communication.
- **Group 3 (NACE Rev2 activities K-N):** Financial and insurance activities; Real estate activities; Professional, scientific and technical activities; and Administrative and support service activities.
- **Group 4 (NACE Rev2 activities O-S):** Public Administration; Education; Health and social work; Arts, entertainment and recreation; Other service activities.

These sectoral groupings reflect some of the overall variation in gender pay gaps across sectors, while remaining practical for the purposes of high-level analysis. Thus they are preferred to using statistics for individual sectors that can vary excessively due to specific national circumstances (and sometimes also due to small number of workers).

The estimated change in gender pay gap, adjusted for sectoral variation in pay gaps, is presented in Table 1.29 and Table 1.30 below for low and rapid progress scenarios. These estimates update the national estimates presented in Table 1.28 for sectoral variation in gender pay gap.

92 Note that the sectoral grouping used in the Eurostat Structure of Earning Survey consists only of activities B-F. However, we also include agriculture, forestry and fishing under this sectoral grouping, because gender pay gap statistics in this sector are not reliable enough to be analysed separately.

Table 1.29 Estimates decrease in gender pay gap by 2030 under the low progress scenario, by Member State and sectoral grouping

Member State	Decrease in gender pay gaps by 2030 (p.p.) against current trend			
	Activities A-F[93]	Activities G-J	Activities K-N	Activities O-S
BE	1.3	1.6	2.7	1.7
BG	1.0	0.7	0.0	0.6
CZ	2.1	2.4	1.7	1.7
DK	0.7	1.0	0.9	0.6
DE	2.1	1.5	1.8	1.2
EE	6.2	7.1	3.8	4.6
IE	0.7	0.8	1.2	0.7
EL	2.5	2.4	2.7	2.3
ES	1.4	1.3	1.7	1.0
FR	0.6	0.7	1.2	0.6
HR	1.5	1.2	1.2	2.0
IT	0.1	0.1	0.2	0.2
CY	1.3	1.4	2.0	0.7
LV	1.3	2.1	1.0	0.6
LT	3.2	1.8	1.9	1.3
LU	0.5	0.8	0.9	0.5
HU	2.5	1.8	1.6	1.2
MT	0.0	0.0	0.0	0.0
NL	1.2	1.3	1.2	1.3
AT	1.8	1.6	2.1	1.4
PL	0.2	0.2	0.1	0.1
PT	3.1	2.7	3.2	2.7
RO	5.6	3.1	0.0	1.3
SI	0.0	0.0	0.0	0.0
SK	1.2	1.2	0.3	0.8
FI	0.7	1.1	1.1	1.1
SE	1.1	1.8	2.7	1.6
UK	0.6	0.7	1.2	0.8

Source: Study calculations and Eurostat data from Structure of Earning Survey in 2010

93 Based on NACE Rev2

Table 1.30 Estimates decrease in gender pay gap by 2030 under the rapid progress scenario, by Member State and sectoral grouping

Member State	Decrease in gender pay gaps by 2030 (p.p.) against current trend			
	Activities A-F[94]	Activities G-J	Activities K-N	Activities O-S
BE	3.0	3.7	6.3	4.1
BG	7.3	4.9	0.0	4.7
CZ	9.3	10.7	7.5	7.3
DK	4.9	6.4	5.9	4.2
DE	10.2	7.6	9.0	6.0
EE	16.4	18.7	10.1	12.2
IE	9.1	11.4	16.7	9.7
EL	8.2	7.6	8.7	7.3
ES	7.1	6.8	8.6	5.2
FR	4.2	4.9	7.6	3.8
HR	4.0	3.3	3.2	5.4
IT	1.1	1.1	1.7	1.6
CY	5.6	5.9	8.4	3.1
LV	5.7	9.3	4.6	2.6
LT	9.8	5.4	5.7	3.9
LU	1.8	3.3	3.7	1.9
HU	8.5	6.2	5.5	4.0
MT	0.1	0.1	0.1	0.2
NL	5.6	6.1	5.9	6.0
AT	9.3	8.2	10.6	6.9
PL	2.2	2.5	1.5	1.1
PT	7.4	6.4	7.7	6.5
RO	11.3	6.2	0.0	2.6
SI	0.0	0.0	0.0	0.0
SK	9.5	9.8	2.8	6.9
FI	4.3	6.7	7.0	7.1
SE	3.7	5.8	8.9	5.2
UK	4.7	5.5	9.0	5.7

Source: Study calculations and Eurostat data from Structure of Earning Survey in 2010

94 Based on NACE Rev2

1.3.8 References

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1.4 Outcome 4: Demographic change due to more equal distribution of unpaid care work

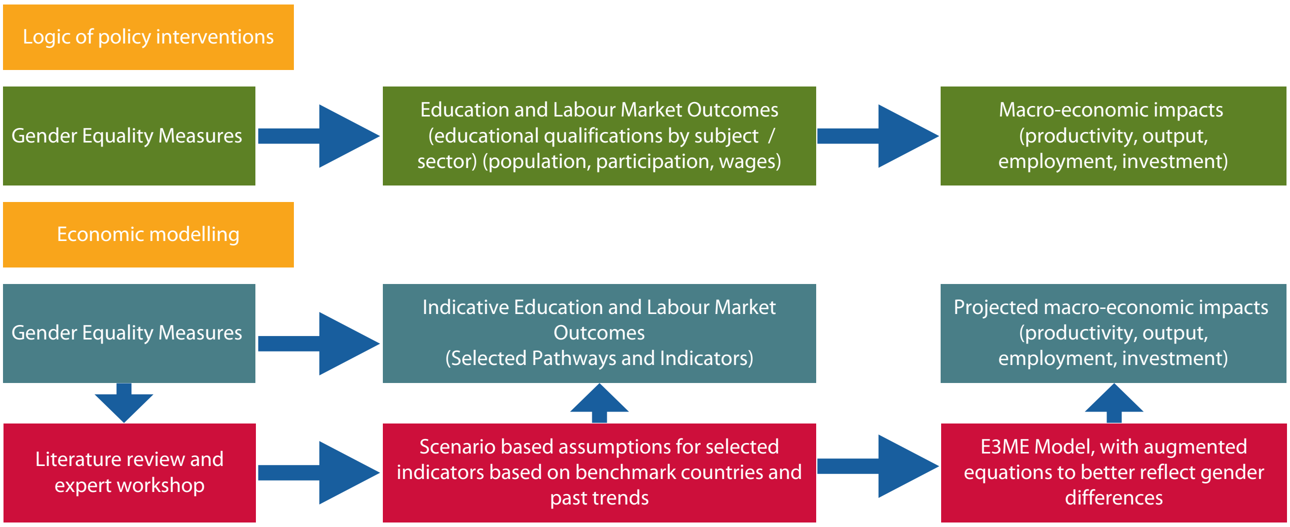
1.4.1 Introduction

This note presents the approach and initial assumptions necessary to model future fertility rates and their impact to economic outcomes. Fertility is generally measured by the total fertility rate which is expressed by the number of children per woman.[95]

Fertility rates in European countries have declined substantially over the past 50 years, and today all European nations have fertility rates below the long-term replacement rate,

95 The mean number of children that would be born alive to a woman during her lifetime if: (1) she were to experience the exact current age-specific fertility rates; and (2) she were to survive from birth through the end of her reproductive life. The total fertility rate is obtained by summing the single-year age-specific rates at a given time (http://ec.europa.eu/eurostat/en/web/products-datasets/-/TSDDE220).

Figure 1.15 Overview of the approach to economic modelling of economic impacts of gender equality measures



which is equal to 2.1[96]. By now migration into Europe has preserved Member States from experiencing population decline. However the changes in age structure and the population ageing are expected to cause a population decline in the near future. This might result into decreased economic growth and lower standards of living (Bloom and Canning 2008),

Due to the potential consequences of demographic change for economic growth in Europe, increasing attention has been given to the determinants of fertility rates and facilitating the materialisation of fertility intentions, and, consequently rising fertility rates, has increasingly been perceived as an important policy goal.

Furthermore, as reported below many studies have suggested that gender equality and fertility are linked and that gender equity represent an important challenge for fertility trends (Miettinen et al. 2011).

This pathway, thus, has a twofold impact in our modelling exercise. On the one hand, it highlights the expected effect of increasing gender equality in terms of future fertility rates. On the other, however, because fertility rates will result into future population level it is going to influence the future level of active, employed and unemployed population.

Overall, this document:

- Briefly summarises the relation between gender equality and fertility;
- Describes the methodology used to estimate the expected increase in fertility rates in each Member State;
- Provides values in 2030 of these estimates for each Member State.

1.4.2 The general approach

The general approach is summarised in Figure 1.15.

The general method of policy evaluation is to establish the intermediate steps between the introduction of policy measures and the subsequent effects on the economy and society.

In the context of gender equality measures and the interest in their macro-economic impacts, significant levels of uncertainty and gaps are acknowledged in the empirical evidence relating measures to labour market outcomes and to wider economic impacts. The agreed evaluation response in this study is to develop outcome scenarios setting out plausible descriptions of how far particular labour market outcomes might change as a result of additional gender equality measures (using selected benchmarks and trend analysis) and to use these scenarios and related assumptions with an economic model (E3ME) to project the possible range of macro-economic impacts associated with the outcome scenarios.

1.4.3 Fertility rates

This note focuses on developing scenarios of future trends in fertility rates as a result of a more equal distribution of unpaid care work and related gender equality measures. The scenarios are based on findings from reviewed literature assessing the impact of gender equality measures on fertility rates.

96 Assuming no net migration and unchanged mortality, a total fertility rate of 2.1 children per woman ensures a broadly stable population. Together with mortality and migration, fertility is an element of population growth, reflecting both the causes and effects of economic and social developments (OECD 2016, Fertility rates indicator)

The scenarios are described using assumptions of future changes in fertility rates. These scenarios and related assumptions are then used as inputs to the economic model, which projects the macro-economic consequences of the outcome scenarios. These outcomes will be modelled using the E3ME model once assumptions are agreed upon. Some sensitivity analysis will be undertaken to establish the sensitivity of economic impacts to assumed rates of change in the gender gap in participation rates.

This note presents two scenarios describing the future rates of increase in fertility rates based on analysis of relevant literature and trend data.

1.4.3.1 General pathway description

Several studies highlight the positive impact of gender equality in education, the labour market and within families on fertility rates of developed countries (McDonald 2000a and 2000b; Brewster and Rindfuss 2000; Ahn and Mira 2002; Engelhardt, Kögel, and Prskawetz 2004; Castles 2003; Mencarini and Tanturri 2004; Puur et al. 2008). Rising fertility rates in Europe in recent years have been attributed to the development in gender equality in the field of employment, care support, and in the distribution of financial resources in society and/or within the family (Neyer et al. 2013).

The general proposition behind the scenario assumptions is that further gender equality measures[97] can result in an increase in fertility rates, which in turn will increase the labour supply in the long term (this effect will be considered up until 2050). The increase in labour supply will affect levels of economic activity, depending on the skills of the female entrants.

The rest of this note is structured into two sections, which describe:

- Section 1.4.4: Analysis of fertility rates and their relation to gender equality measures
- Section 1.4.5: Estimating potential increase in fertility rates

1.4.4 Analysis of fertility rates and their relation to gender equality measures

1.4.4.1 Current fertility rates

In 2014, the total fertility rate in the EU-28 was 1.58 live births per woman, below the replacement level of 2.1. However all the Member States, with the only exception of Portugal, reported rates higher than 1.30 live births per woman which is described as 'lowest-low fertility' (Kohler et al. 2002).

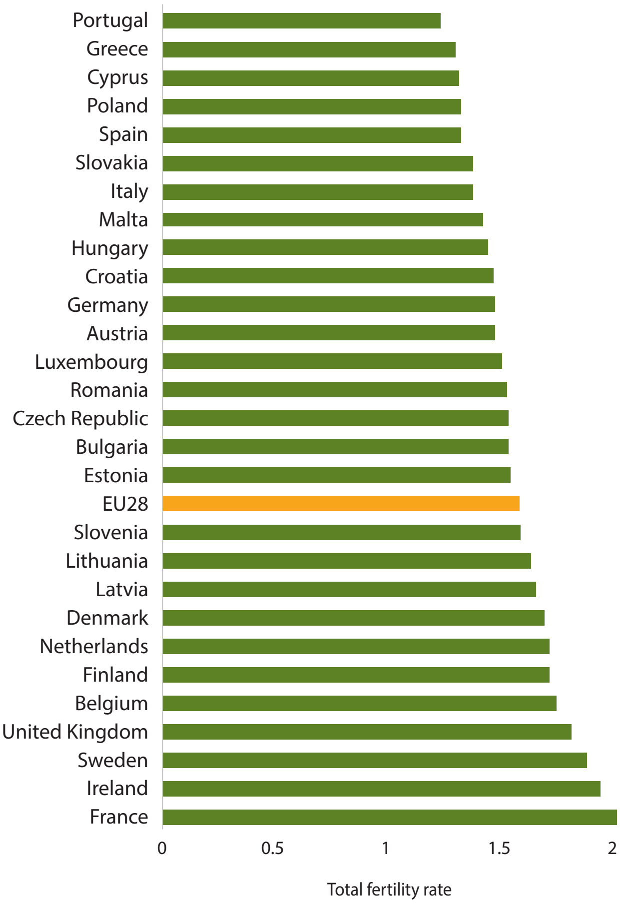
Among the EU Member States, France reported the highest fertility rate in 2014 (2.01 live births per woman) while the lowest fertility rates in 2014 were recorded in Portugal (1.23 live births per woman), Greece (1.30 live births per woman) and Cyprus (1.31 live births per woman). These values provide a context for estimating the increase in fertility rates as a result of additional and/or improved gender equality measures.

Table 1.31 Pathway 4 description – Fertility Rates

Gender equality measures	Outcome Scenario assumptions	Economic impacts (from modelling)	
		Labour market impacts	Economic impacts
Reduce gender inequality in education, the labour market and within families – long-term increase in working population resulting from changes in fertility rates	■ MS fertility rates increase by a given proportion ■ Population increases accordingly, with additional potential workers by the early 2030s	■ By the early 2030s an increase in the labour force ■ Through indirect effects, an increase in employment levels	■ Consumption increases immediately due to higher population ■ Eventually the wider economy benefits from a larger labour force

97 Note that effects of gender neutral policies aimed at fertility (such as certain child subsidies) are not considered in slow and rapid progress scenarios presented below, because they do not reduce gender inequality and thus do not fall within the scope of this study.

Figure 1.16 Fertility rates in EU Member States



Source: Eurostat data for 2014

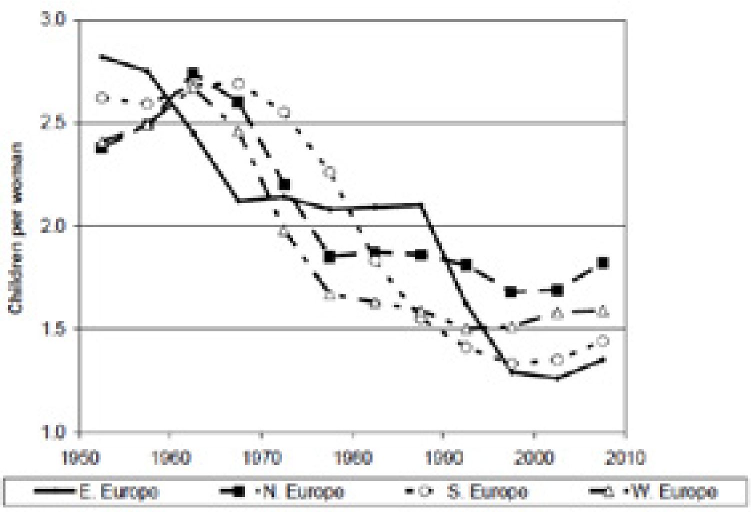
1.4.4.2 Trends in fertility rates

The highest fertility rates in Europe were recorded in the 1960s. From then up to the beginning of the 21st century, fertility rates declined substantially to a low of 1.46 in 2001. After reaching a low point in 2001, the total fertility rate increased in most Member States (see Figure 1.17). One explanation for the increase in the fertility rate is related to a catching-up process: following the trend to give birth later in life (witnessed by the increase in the mean age of women at childbirth), the total fertility rate might have declined first, before a subsequent recovery (Eurostat, 2016).

The recent evolution in European fertility rates since 2000 is an increase in the number of live births per woman on average in European MS from 1.46 to 1.58 (Figure 1.18). This increase has occurred in most Member States with some exceptions: Cyprus, Portugal, Malta and Luxembourg. In Denmark, where fertility rates were among the highest in 2000, rates have slightly declined starting from 2011.

The highest increases in fertility rates are recorded in Eastern European countries (Latvia, Czech Republic, Slovenia, Bulgaria, Lithuania, Romania, Estonia and Hungary) followed by a number of continental countries (France, Austria and Germany), two Southern European countries (Italy and Spain) and the United Kingdom.

Figure 1.17 Trends in fertility rates in EU regions[98]



Source: Bloom and Sousa-Poza (2010)

98 Eastern Europe consists of Belarus, Bulgaria, Czech Republic, Hungary, Poland, Republic of Moldova, Romania, Russian Federation, Slovakia, and Ukraine; Northern Europe of Channel Islands, Denmark, Estonia, Faeroe Islands, Finland, Iceland, Ireland, Isle of Man, Latvia, Lithuania, Norway, Sweden, and United Kingdom; Southern Europe of Albania, Andorra, Bosnia and Herzegovina, Croatia, Gibraltar, Greece, Holy See, Italy, Malta, Portugal, San Marino, Slovenia, Spain, and the former Yugoslav Republic of Macedonia, Yugoslavia; and Western Europe of Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands, and Switzerland.

Figure 1.18 Recent trend in fertility rates in EU Member States

Source: Eurostat data for 2000 and 2014
Note: data for Hungary, Poland and EU28 refers to 2001

Every three years Eurostat produces population projections taking into account the recent developments in population trends. Within population projections, Eurostat develops fertility rate projections according to two scenarios: main scenario - produced based on 'main input dataset' of assumptions on future developments for fertility - and a lower fertility variant assuming that the total fertility rate is reduced by 10% by 2060. Eurostat projections cover the time period up to 2080[99].

The current projections provided by Eurostat are summarised in Table 1.32. These indicate that, according to their main scenario, fertility rates are expected to increase in every Member State between 2014 and 2030; and further still to 2050 (with the exception of Ireland, Sweden and UK where the rate is estimated to level out at just under 2 live births per woman).

In the lower fertility scenario Member States with high fertility rates (around 1.7 births per woman) experience a decline in the fertility rate from 2014 to 2030, and the rate continues to decline to 2050. For Member States with lower fertility rates, rates are expected to increase even in the low fertility scenario to 2030, but then to decrease to 2050.

Between 2014 and 2030, fertility rates (main scenario) in a number of eastern European countries (Romania, Estonia, Check Republic, Hungary, Poland) and in Malta, Cyprus, Luxemburg and Greece are projected to have the highest increase (between 0.15 and 0.27). Fertility rates are projected to increase by between 0.15 and 0.10 in Portugal, Bulgaria, Italia, Croatia, Denmark, Finland, UK, Belgium and Spain, and to increase at the lowest rate (below 0.10) in all the other Member States (Slovenia, Lithuania, Austria, Ireland, Sweden, Germany, Netherlands, Latvia, Slovakia and France).

In the low fertility scenario, the country ranking is almost the same, but in this case changes in fertility rates ranges between 0.04 and 0.14 for the countries with the highest projected gains; between +0.03 and -0.02 for the MS ranking in the middle; and between -0.03 and -0.16 for the countries with highest projected fertility decrease.

1.4.4.3 Fertility rates and gender equality

Fertility rates and gender equity are strongly linked. However historically this link worked in opposite directions (Miettinen, Basten & Rotkirch 2011). In the past traditional family arrangements were correlated with higher numbers of children. During the first demographic transition to smaller families women became much more equal with men. However, at the same time women were burdened by the stress of combining paid and unpaid household and care work. In recent years fertility rates have increased in the most developed societies, which score high in gender equity, reflecting, among other factors, the positive effect of a more equal distribution of unpaid care work and related measures such as improved provisions for child care (e.g. improvements in maternity and paternity care, extended child care services) on the propensity to have children.

Figure 1.19 highlights the positive correlation between gender equality as measured by the EIGE's Index and fertility rates. Countries that score high on gender equality also experience higher fertility rates. The existence of a positive link between gender equality and fertility is further supported by numerous literature findings as reported in the following sub-section.

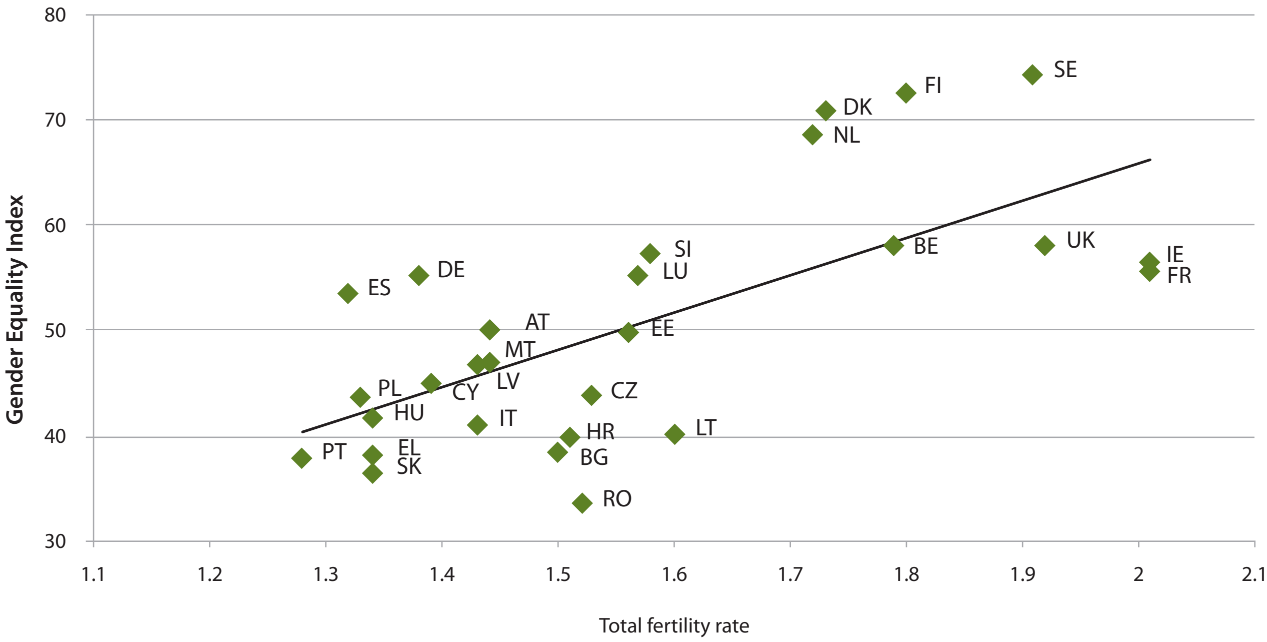
99 The assumptions dataset used by Eurostat to develop population projections include age-specific fertility rates, age-specific mortality rates and international net migration figures

Table 1.32 Projected age specific fertility rates, by Member State, to 2030, 2050

Member State	Fertility rates in 2014	Main Fertility Eurostat Scenario		Low Fertility Eurostat Scenario	
		2030	2050	2030	2050
AT	1.47	1.53	1.59	1.41	1.34
BE	1.74	1.84	1.86	1.7	1.57
BG	1.53	1.67	1.75	1.55	1.48
CY	1.31	1.5	1.58	1.39	1.33
CZ	1.53	1.72	1.79	1.6	1.51
DE	1.47	1.51	1.6	1.4	1.34
DK	1.69	1.81	1.85	1.68	1.56
EE	1.54	1.75	1.81	1.62	1.53
EL	1.3	1.45	1.54	1.34	1.29
ES	1.32	1.42	1.51	1.31	1.27
FI	1.71	1.83	1.85	1.7	1.56
FR	2.01	2.00	1.98	1.85	1.67
HR	1.46	1.59	1.65	1.48	1.39
HU	1.44	1.61	1.72	1.5	1.45
IE	1.94	2.00	1.99	1.85	1.67
IT	1.37	1.51	1.58	1.4	1.33
LT	1.63	1.71	1.77	1.59	1.49
LU	1.5	1.69	1.76	1.57	1.48
LV	1.65	1.68	1.76	1.56	1.48
MT	1.42	1.67	1.76	1.55	1.48
NL	1.71	1.75	1.78	1.62	1.5
PL	1.32	1.47	1.58	1.36	1.33
PT	1.23	1.37	1.47	1.28	1.24
RO	1.52	1.79	1.82	1.66	1.54
SE	1.88	1.93	1.92	1.79	1.62
SI	1.58	1.67	1.73	1.55	1.46
SK	1.37	1.38	1.48	1.28	1.25
UK	1.81	1.93	1.93	1.79	1.62
EU-28	**1.58**	**N/A**	**N/A**	**N/A**	**N/A**

Source: Eurostat projections: http://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-projections-/database

Figure 1.19 Gender equality and fertility



Source: EIGE and Eurostat data for 2012

1.4.5 Estimating potential increase in fertility rates

1.4.5.1 Methodology to estimate potential increases in fertility rates attributable to further gender equality measures

A number of studies in Western Europe countries point to the importance of gender equality in influencing fertility intentions and fertility behaviour. Results of empirical analyses on whether gender equality increases fertility vary considerably depending on which indicators of gender equality are included, whether women or men are studied, on the number of children women had prior to current fertility decisions, and which country is considered in the analysis (Nyer et al.2013).

For the purpose of our modelling exercise, particularly relevant appear those studies that explore the effects on fertility of gender equality in the economic domain. Although literature results are sometimes contrasting, many studies provide evidence that greater gender equality in **employment**, **economic resources**, and **unpaid care work** tends to lead to increases in fertility intentions[100] (Neyer et al. 2013, Begall and Mills 2011, Vignoli et al. 2012, Mills et al. 2008, Mills 2010, Esping-Andersen et al. 2007, Matysiak and Vignoli 2008).

However, due to the high variability in results found in the literature, it is not possible to derive a straightforward measure of how far the fertility rate increase can be attributed to improvements in gender equality[101]. The meta-analysis of Matysiak and Vignoli (2008) based on more than 50 studies that address the link between gender equality in the labour market and fertility, highlights the large variation in the effects between the institutional settings. In particular, i) the link between gender equality and fertility appears to be relatively low in the social-democratic and liberal welfare regime; ii) in post-socialist regimes a positive influence

100 In most of the studies fertility intentions are measured by the question whether the respondent intended to have another child within the next three years or sometime in the future (European Social Survey, national surveys).

101 To have an idea of the variability of results find in the literature see Neyer et al (2013) pp. 248 and 249: "Some studies show that being in **employment** increases women's intentions to have a child in the next few years or at some unspecified time in the future. Yet, this may only apply to childless women, to women in specific countries or to full-time employed women (…). Others find no such effects or their results indicate that employed women tend to have lower fertility intentions than non-employed women, even if the same countries or parities are studied (…). Just as for employment, the **economic resources** available to a person have no uniform effect on fertility intentions either. Mills (2010) concludes from her study on the relationship between gender indexes and fertility intentions across European countries that economic security supports fertility intentions for women as well as for men. (…).By contrast, [other studies] find no effect, weak effects or inconsistent effects of financial resources or economic (in)security on childbearing intentions of women and of men. Greater gender equality in the division of **household work and care** is generally assumed to increase fertility intentions and childbearing, but research does not confirm this consistently (…). The results tend to depend on the country studied, on the burden of work put on women through employment or through the number of children, and on the share of fathers' involvement."

of women's employment on childbearing is detected as the result of a strong income effect; iii) the conflict between employment and family is stronger in conservative welfare regimes with respect to liberal ones; and (iv) it is even stronger in family-oriented welfare regimes[102].

In addition their study highlights how time and country specific institutional factors (like childcare subsidies, taxation policies and other forms of family support), structural factors (e.g. labour market rigidities or high uncertainty in the markets), socio-cultural factors (such as attitudes toward working mothers and perception of the gender roles), and the role of the partner's characteristics interact in the relationship between gender equality and fertility.

Using the scoring on the EIGE's gender equality index domains of work, money and time, we have clustered MS into three groups as detailed in Table 1.33.

This country grouping clusters countries according to the degree of scope for additional gender equality measure to influence fertility rates (countries with low gender equality scoring are assumed to have greater scope for increasing equality using these measures than countries that have already achieved high gender equality. However, there may be particular reasons for low equality in certain countries that may make further increase in equality difficult[103]).

- Group 1: Countries with a good level of gender equality already achieved in the work, money and time domains and where further measures are unlikely to have much influence because they already have high fertility rates and Eurostat projects a levelling-off.
- Group 2: Countries with generally western-liberal institutional settings, where gender equality measures are well developed and for which a moderate effect on fertility due to a further increase in gender equality is expected.
- Group 3: Countries with a low level of gender equality already achieved in the work, money and time domains and with the lowest fertility rates, where significantly higher rates are projected and which include post socialist and/or conservative/familalistic welfare regimes. For these countries a positive effect on fertility due to a further increase in gender equality is expected.

The clustering tends to reflect the influence of institutional settings and associated fertility rates. Countries scoring more highly on the Gender Equality Index tend to be western social democratic countries with higher fertility rates (Groups 1 and 2). Countries in Group 3 tend to be southern

Table 1.33 Classification of countries according to gender equality level in the work, money and time domains

Expected effect on fertility rates of additional gender equality measures	Gender Equality Index score in the work, money and time domains		
	High score (average[104] = 64.7)	**Medium score (average = 60.6)**	**Low score (average = 48.3)**
Low potential (Group 1)	Sweden, Finland, Denmark, Ireland, United Kingdom		
Medium potential (Group 2)		France, Belgium, Netherlands, Luxembourg, Austria, Germany	
High potential (Group 3)			Malta, Italy, Spain, Cyprus, Greece, Portugal, Latvia, Lithuania, Slovenia, Estonia, Bulgaria, Czech Republic, Romania, Croatia, Hungary, Slovakia, Poland

Source: Own analysis

102 The term familialistic indicates welfare systems where the family plays a key role acting as the main provider of care and welfare for children and dependent individuals.

103 This is reflected in producing a low and rapid progress scenarios, where in low progress scenario we assume lower increase in gender equality and thus fertility (see section 1.5.2 in for more detail).

104 Computed as weighted average of Gender Equality Index Scores in the work, money and time domains

Table 1.34 Estimates of the fertility rates in 2030 by Member State in different modelling scenarios

Member State	Fertility rates expected in 2030 in baseline (Eurostat –Main scenario projections)	Fertility rates expected by 2030 in	
		Slow progress scenario	Rapid progress scenario
Austria	1.53	1.54	1.55
Belgium	1.84	1.85	1.87
Bulgaria	1.67	1.71	1.74
Cyprus	1.50	1.56	1.60
Czech Republic	1.72	1.78	1.82
Germany	1.51	1.51	1.52
Denmark	1.81	1.81	1.81
Estonia	1.75	1.81	1.86
Greece	1.45	1.50	1.53
Spain	1.42	1.45	1.47
Finland	1.83	1.83	1.83
France	2.00	2.00	2.00
Croatia	1.59	1.63	1.66
Hungary	1.61	1.66	1.70
Ireland	2.00	2.00	2.00
Italy	1.51	1.55	1.58
Lithuania	1.71	1.73	1.75
Luxembourg	1.69	1.71	1.75
Latvia	1.68	1.69	1.70
Malta	1.67	1.75	1.80
Netherlands	1.75	1.75	1.76
Poland	1.47	1.52	1.55
Portugal	1.37	1.41	1.44
Romania	1.79	1.87	1.93
Sweden	1.93	1.93	1.93
Slovenia	1.67	1.70	1.72
Slovakia	1.38	1.38	1.39
United Kingdom	1.93	1.93	1.93

Source: Study calculations and Eurostat data

(conservative / familialistic) or post socialist countries with lower fertility rates.

1.4.5.2 Estimates of potential increase in fertility rates for individual Member States

The estimates of future changes in fertility rates by Member State, presented below are based on assumptions describing the possible increase in fertility by 2030 due to gender equality measures. The development of fertility rates is only considered up until 2030 because changes beyond that point are unlikely to affect the labour market by 2050, which is the modelling period used for this scenario.

Our starting point is the projection on fertility rates developed by Eurostat. Starting from Eurostat projections in their main fertility scenario, we have developed assumptions about potential further increase in fertility rates due to improved gender equality.

To acknowledge that increasing gender equality (and thus fertility) may be difficult to achieve in practice, we have produced two scenarios assuming additional improvements in gender equality compared to Eurostat projections:

- Rapid progress scenario – assume a high potential increase in fertility as a result of implementing higher number of additional gender equality measures
- Low progress scenario – assume a low potential increase in fertility as a result of implementing lower number of additional gender equality measures

They have been prepared for three groups based on the Member State clustering described in Table 1.33. In general, higher increases in fertility rates were assumed for countries with lower current gender equality. We assumed that low equality countries had greater scope for improvement than high equality ones - this was because in high equality countries, it is probably more difficult to achieve further improvements in equality and these improvements are likely to be smaller. However, no specific research was identified that could help to provide a robust underpinning for this assumption.

Specifically, we assume:

- For countries belonging to Group 1: no further increase above fertility rates projected by Eurostat in both rapid and low progress scenario
- For countries belonging to Group 2: potential increase of an additional 10% in the increase projected by Eurostat in the low progress scenario and of additional 30% in the projected increase in the rapid progress scenario
- For countries belonging to Group 3: potential increase of an additional 30% increase projected by Eurostat projections in the low progress scenario and of additional 50% in the increase in the rapid progress scenario

As discussed previously (see subsection1.4.5.1), it was not possible to derive straightforward assumptions about increases in fertility rates due to the implementation of gender equality measures. The hypotheses proposed are based on literature findings and on the progress made by Member States in terms of gender equality. These assumptions give reasonable values of future fertility rates as detailed in Table 1.34 and Figure 1.20. The modelling phase will provide some scope for sensitivity analysis and possibly some refinement in the proposed values.

Estimates of fertility rates in 2030 are presented in a table below for each Member State[105].

The following graphs highlights the effect on fertility rates of the different assumptions described above.

1.4.6 References

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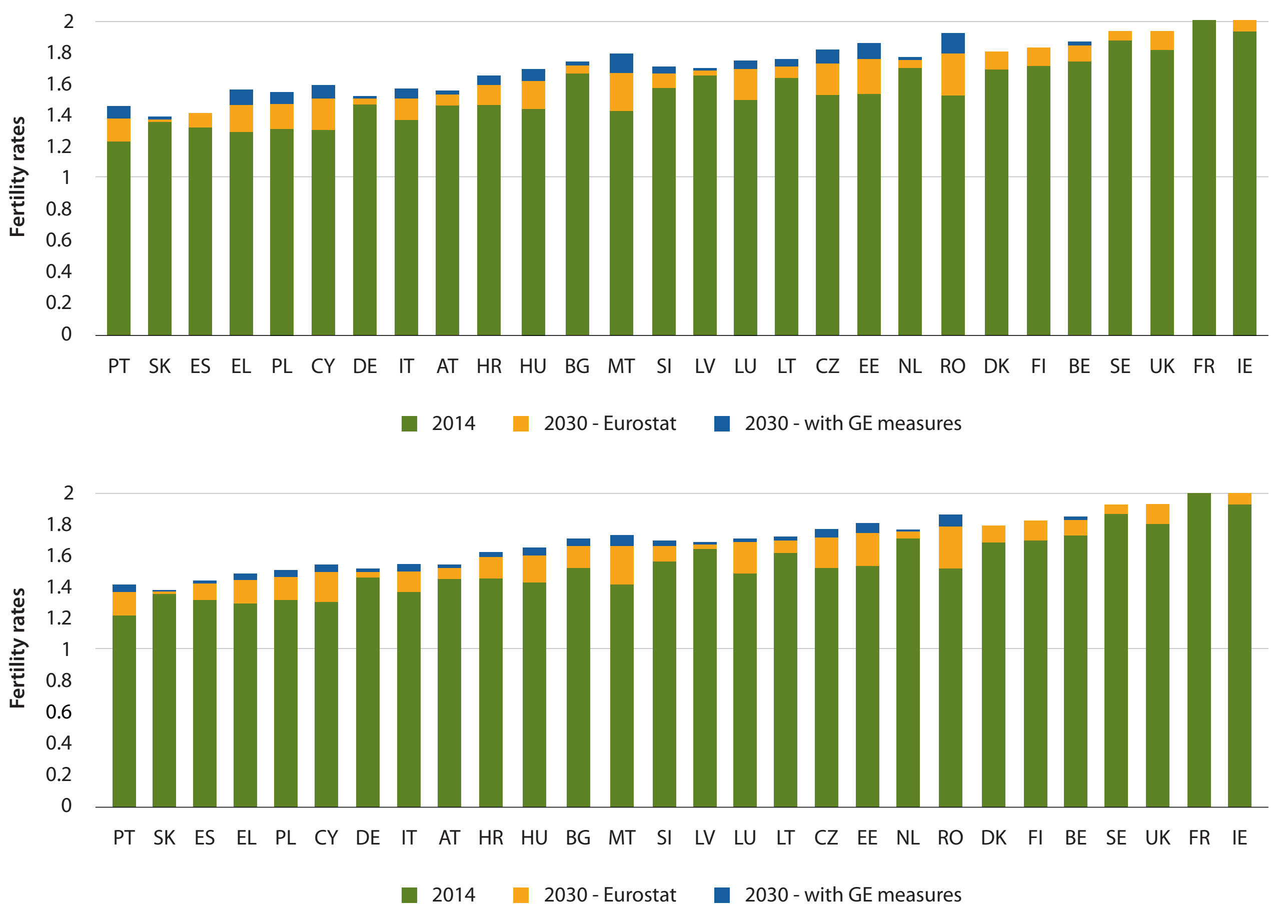
105 Please note that the effect of migration into European countries on Member State's future fertility rates are already included in the Eurostat projections

Figure 1.20 Fertility rates values in 2030 according to the different assumptions in EU MS



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2 Specification of E3ME equations

2.1 Introduction

This note outlines the specification of the gender-specific labour market equations in E3ME. It builds on the structure of the existing equations that is fully documented in the model manual[106].

The four sets of estimated equations are:

- Employment/labour demand (by sector and sex)
- Participation rates (by age group and sex)
- Wage rates (by sector and sex)
- Average working hours (by sector)

The figure below shows how the key labour market variables fit together in the model. These relationships are well established and it is not anticipated that they will change. The four econometric equations are marked in red. In order to avoid making the diagram overly complicated, feedbacks to the wider economy have not been included but several of the model variables in the diagram would clearly affect rates of economic activity (e.g. population, wage income from employment).

All equations are also disaggregated by Member State and solved annually over the period up to 2030. They are discussed in turn below.

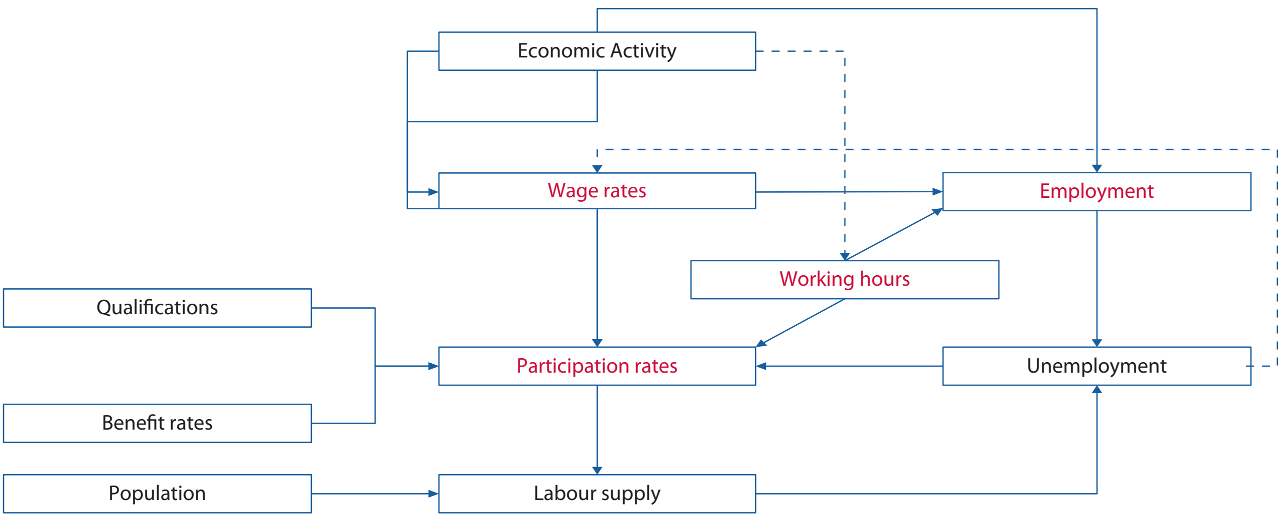
There are also several identity equations (e.g. labour supply, unemployment), which are outlined below as well. The main exogenous factors in the diagram are qualifications, benefit rates and population. The formal definitions of all the variables are given at the end.

In the existing version of E3ME, the only model variables in which sex is currently distinguished are population, participation rates and labour supply. This note outlines how the gender dimension can be better covered by the other model variables.

2.2 Employment

Employment is measured as a headcount in thousands of people. It will be solved in the model using a two-stage approach. First total employment demand is estimated in each sector (as in the existing model version), then it will be split by gender. The reasoning behind this is that the underlying demand for labour is 'gender blind' (which is why sex does not appear in the national accounts data) but then there may be gender-based factors in determining the types of workers that meet that demand. The second stage in the process is split into two parts, as outlined below.

Figure 2.1 E3ME model structure



106 The E3ME manual is available at: http://www.camecon.com/EnergyEnvironment/EnergyEnvironmentEurope/ModellingCapability/E3ME/E3MEManual.aspx

For the first stage:

EMPL = F (OUTPUT, REAL WAGE,
AVE HOURS, TECHNOLOGY) (1)

This is unchanged from the current E3ME specification, with employment dependent on rates of production (+ve), real wages (-ve), working hours (-ve) and technology (+ve or -ve).

For the second stage:

EMPL_M / EMPL = F (LABFOR_M / LABFOR,
REAL WAGE_M / REAL WAGE, HOURS_M / HOURS (2)

(nb in the above equation LABFOR and LABFOR_M are summed across the different age groups to give total labour force and total male labour force, similarly hours are summed across sectors)

The second stage estimates male employment, accounting for wage and working hour differentials, plus overall labour force shares. One obvious weakness here is that we are not able to include measures of relative productivity between male and female workers, as these data are not available. A work-around is needed for introducing productivity changes in the scenarios (see text box 2.1).

To generate female employment levels:

EMPL_F = EMPL – EMPL_M (3)

We could estimate either male or female employment shares rather than male shares, it does not really matter. The reason for choosing male shares is a larger sample size.

2.3 Participation rates, labour supply and unemployment

2.3.1 Participation rates

Participation rates are measured as a percentage of the workforce either in work or seeking work (i.e. unemployed). The current E3ME specification splits by sex and age group. It was developed during a previous study for CEDEFOP. Ideally the equations would take into account many additional factors but restrictions on data can become a major issue. Many of the explanatory factors that were tested turned out to be non-significant, again possibly due to data issues. However, it is clear that there are important factors in explaining participation rates that are missing from the specification below, hence the inclusion of a time trend. Possibilities for expanding the existing equation set are laid out in the text box 2.2 below.

Box 2.1 Changing productivity levels distinguished by gender

When modelling changes in qualification levels, it is necessary to infer an increase in the productivity of the workforce. But one key question in this study is how much female employment would increase in response to increases in female qualification rates. This is problematic as there are no data available that distinguish output or productivity by sex.

The issue is also important for the wage equations discussed further below, as there is a clear link from levels of education to productivity to wages.

In the absence of data with which to estimate an empirical link, we suggest making the following assumption:

- The change in wage rates in response to changes in productivity is the same for female workers as it is for male workers.

This is reflected implicitly in the wage equation specification outlined below.

However, there is still a question about how changes in the relative rates of male and female productivity affect male and female employment rates. Our approach is to replace the wage term in Equation 2 with a term cost per unit of production. Again, it is important to note that we do not have data on relative rates of production by male and female workers and so the regression must be performed on wages. In addition, given the assumption above, the ratio between male and female unit labour costs will not change.

However, when considering changes in levels of female qualifications, it is clear that both female wages and productivity levels will also change. We can estimate changes in wages based on the assumption above and, combined with the estimates of productivity changes, we can form a new unit costs estimate. Feeding the unit cost estimate into the employment equation allows us to estimate changes in female employment levels.

If additional data become available, then we can test this equation further. The current specification is:

P_RATE = F (OUTPUT, REAL WAGE, U RATE, BEN RATE, SER RATIO,

AVE HOURS, QUALIFICATIONS, TIME) (4)

Sectoral variables (wages, average working hours per week) are aggregated to macro totals in this equation.

The equation is estimated by sex and age group. The RHS variables are revised to include sex disaggregation so that wages and unemployment rates are taken into account by sex.

For age groups above 50 the benefit rate variable is replaced with pension rates.

Output and wage rates increase the likelihood to seek work, while higher unemployment rates and benefit rates reduce the likelihood to participate (as do higher working hours). A higher services ratio may encourage female participation and higher qualification levels typically lead to higher participation rates. A time trend is added to account for non-economic factors.

2.3.2 Labour force

The labour force is calculated by multiplying participation rate and population as indicated in (5):

LABFOR = P_RATE * POP (5)

It is disaggregated by sex and age group. The units are thousands of people.

2.3.3 Unemployment

Unemployment (as a rate) is defined as shown in (6):

U RATE = (LABFOR – EMPL) / LABFOR (6)

There are separate male and female rates, based on the gender-specific variables.

2.4 Wage rates

The units for wage rates are thousands of euros per worker per year. The initial suggestion was to build separate wage rate equations for male and female workers but it looks like the data do not support this approach due to two factors:

- The relative sparsity of figures in the LFS (and the low sample size supporting the figures)
- The lack of data on productivity, outlined above.

Our proposed approach is therefore to keep the existing E3ME wage equation for average sectoral wages and then estimate a separate gender differential.

WAGE = F (Other Wages, PROD, U RATE, BEN RATE, INFLATION, RET RATE) (7)

Wages in a sector/country in nominal terms are determined by wage rates in other sectors (+ve effect), average labour productivity (+ve), unemployment and benefit rates (both -ve), inflation rates (+ve) and the retention rate (share of untaxed wages, -ve).

The link from qualifications to wages is indirect, via changes in productivity. If qualification levels increase, we would

Box 2.2 Potential to adapt participation rate equations

The current list of explanatory factors in Equation 4 were found to be significant in previous work carried out for CEDEFOP. Other possibilities that were tested were found to be non-significant, although this may reflect the data available at the time.

The questions to ask when expanding the equation are:

- What other factors may affect participation in one or more age/gender groups?
- Which of these factors can be quantified?
- Which of these factors have available time-series data?

Examples of previous possibilities that have been considered include number of children and childcare costs – but there may be better data available now. In principle, any indicator that met the three criteria above positively could be tested.

expect productivity rates to increase, resulting in turn in higher wage rates.

As it is not possible to estimate gender-specific equations, we plan to model the wage differential rather than male and female wage rates separately. As much of the differential is determined mostly by things that lie outside the model's scope, it is given as exogenous, and we make exogenous changes for the scenarios under two conditions:

- If the female qualification mix changes, in which case we adjust wages in line with changes in productivity and the parameter for productivity estimated in the aggregate equation above.
- If the wage gap changes due to e.g. reduced discrimination, then wage rates are adjusted accordingly.

This implicitly assumes that male and female wage rates are determined equally by more general labour market factors. For example, a drop in the unemployment rate would have the same impact on both male and female wages – which seems fairly reasonable.

Changes in average wage rates due to sectoral composition will be provided by the model, based on employment results in each sector.

2.5 Data sources

Most data come from either the National Accounts (NA) branch of the Eurostat database, the AMECO database published by DG Ecfin or the European LFS published by Eurostat. Figures for employment, which are available in both the NA and the LFS, are taken from the National Accounts to maintain consistency with the economic data. However, it is often necessary to switch to LFS when incorporating a gender dimension.

The list of variable definitions below is colour-coded to show the data sources. Population is taken from the Eurostat database. The technology index is derived from Eurostat NA investment data combined with R&D data. The time trend is a synthetic variable.

Box 2.3 Potential to adapt participation rate equations

The Engle and Granger (1987) cointegration technique is a two-step procedure, which can be summarised as follows:

- The first step is to estimate the long-run equilibrium relationship by means of ordinary least squares (OLS). Then, the existence of cointegration among the variables is tested by checking the stationarity of the residuals produced by the long-run relationship. In doing so, the augmented Dickey-Fuller (Dickey and Fuller 1979, 1981) will be applied to examine whether the residuals are I(0). In the second step, the short-run dynamics are modelled by estimating a regression in differences, which also includes an error-correction term. The latter variable, which is built as the lagged residuals term of the cointegrating long-run relationship, shows the percentage of disequilibria eliminated between the short-run and the long-run model in each period.

For a better understanding of this technique, an example is provided as follows. Let us consider a simple model in which total employment, *E*, it is a function of real output, *Y*, real wage costs, *W*, average working hours, *H*, and technology, *T*. For the first stage, the model shown in (8) is estimated by means of OLS:

$$E_t = \beta_0 + \beta_1 {*} Y_t - \beta_2 {*} W_t + \beta_3 {*} H_t + \beta_4 {*} T_t + \varepsilon_t \qquad (8)$$

where the β_i represents the estimated parameters and ε_t is a random error term.

Then, the error-correction model that is shown in (9) is estimated. For this stage, OLS is also applied to produce the relevant parameters:

$$\Delta E_t = \theta_0 + \theta_1 {*} \Delta Y_t + \theta_2 {*} \Delta W_t + \theta_3 {*} \Delta H_t + \theta_4 {*} \Delta T_t + \theta_5 {*} \Delta Y_{t-1} + \theta_6 {*} \Delta W_{t-1} + \theta_7 {*} \Delta H_{t-1} + \theta_8 {*} \Delta T_{t-1} + \theta_9 {*} \Delta E_{t-1} + ECM_t + u_t \qquad (9)$$

where all the symbols have the same meaning as in expression (8), with the exception of *u*, which accounts for the residuals terms, and *ECM*, which accounts for the error-correction term and is calculated as $\theta_{10} {*} \varepsilon_{t-1}$ ($\theta_{10} < 0$).

NB Due to the large size of the E3ME model only one lag of each variable will be included in the error-correction model. The final specification of the error-correction model will be obtained by dropping from regression those terms which are not significant, as suggested by the 'general to specific' modelling strategy (Hendry and Richard, 1983).

Source: Cambridge Econometrics' elaboration based on Engle and Granger (1987).

2.6 Econometric specification

The E3ME equations are estimated by means of the Engle and Granger (1987) cointegration technique[107]. The value added of this approach is that cointegration techniques allows for the estimation of an equilibrium relationship that describes the behaviour of the variables in the long run, along with an error-correction model which explains the dynamics of the variables in the short run. Box 2.3 provides further explanations on the Engle and Granger (1987) cointegration technique.

The specification of the econometric relationships that compound E3ME is consistent with economic theory. In this sense, causality relationships among the relevant variables can be assumed confidently without the need of exploring all potential relationships.

2.7 Variable Definitions

A definition of the variables that have been mentioned above is provided below. The colour coding indicates the data source, with blue for LFS, green for National Accounts and red for the AMECO database.

AVE HOURS – average working hours per week, by sector

BEN RATE – Benefit rate, relative to wages

EMPL – Employment, by sector, headcount, 000s people (National Accounts basis)

EMPL_F – Employment, by sector, female headcount, 000s people (National Accounts basis)

EMPL_M – Employment, by sector, male headcount, 000s people (National Accounts basis)

HOURS_M – average working hours per week, male workers, by sector

HOURS_F – average working hours per week, female workers, by sector

INFLATION – Price index, 2005 = 1.0

LABFOR – Labour force, thousands of people

LABFOR_M – Labour force (male), thousands of people

OUTPUT – Production, by sector, m€ constant price basis

POP – Population, thousands of people, split by age group and sex

P_RATE – Participation rate, %, split by age group and sex

PROD – Labour productivity, output per worker

QUALIFICATIONS – Synthetic index based on attainment rates

REAL WAGE – Average annual wage, by sector, th€ deflated by total industry costs

REAL WAGE_F – Average annual wage for male workers, by sector, th€ deflated by total industry costs

REAL WAGE_M – Average annual wage for male workers, by sector, th€ deflated by total industry costs

RET RATE – Rate of wage retention, i.e. share of take-home pay

SER RATIO – Share of services in total production

TECHNOLOGY – Technology index, by sector (see E3ME manual for formal definition)

TIME – Time trend to account for non-economic factors

U RATE – Unemployment rate, % (LFS measure), by sex

WAGE – Average annual wage for all workers, by sector, th€ in nominal terms

107 The Engle and Granger (1987) cointegration technique requires that the time series involved in the econometric relationship are first-order integrated processes, i.e. the data must contain a unit root. A basic approach to check for the existence of a unit root in time series under consideration is the ADF test (Dickey and Fuller, 1979; 1981).

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The study on the 'economic benefits of gender equality' is unique in the EU context. It's the first of its kind to use a robust econometric model to estimate a broad range of macroeconomic benefits of gender equality in several broad areas such as education, labour market activity and wages.

The overall results of the study show that more gender equality would lead to:

- Between 6.3 million and 10.5 million additional jobs in 2050 with about 70% of these jobs taken by women
- Positive GDP impacts that grow over time
- An increase in GDP per capita of up to nearly 10% in 2050

The study used the E3ME macroeconomic model to estimate the economic impacts of improvements in gender equality. E3ME is an empirical macroeconomic model tailored specifically to model outcomes at EU and Member State level.

The outputs of the study on economic benefits of gender equality in the EU include 9 publications:

1) Literature review: existing evidence on the social and economic benefits of gender equality and methodological approaches
2) EU and EU Member States overviews
3) **Report on the empirical application of the model**
4) How the evidence was produced: briefing paper on the theoretical framework and model
5) How the evidence was produced: factsheet on the theoretical framework and model
6) Economic impacts of gender equality in the EU policy context: briefing paper
7) Economic impacts of gender equality: briefing paper
8) How gender equality in STEM education leads to economic growth: briefing paper
9) How closing the gender labour market activity and pay gaps leads to economic growth: briefing paper

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