

# **Updating of the Labour Market Model**

Final Report

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**European Commission** Directorate-General for Employment Social Affairs and Inclusion Directorate A



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# **Executive Summary**

Striving to improve their understanding of transmission mechanisms of labour market policies, the European Commission commissioned external experts to design and setup a *labour market model (LMM)* in the context of the project *Modelling of Labour Markets in the European Union* (Berger et al. (2009)). In the follow-up project *Development/Maintenance of the Labour Market Model* (Berger et al. (2012)), the model has been re-calibrated, further extended to include 14 Member States, and the documentation has been improved.

The current project is comprised of three different tasks. Task 1 involves a comprehensive update of the underlying data and the model calibration for eight Member States (Austria, Belgium, Czech Republic, France, Germany, Italy, Spain and Sweden) and a 'stripped-down' update for the six other countries in the model. Task 2 consists of a careful documentation of all steps taken. The simulation of an illustrative policy scenario and the analysis of the results are performed in Task 3.

The LMM complements existing models of the Commission such as the Quest model applied by DG ECFIN and is used to provide a basis for identifying the direction and intensity of the effects of labour market policies. LMM is a dynamic computable general equilibrium model with a detailed description of the labour market. It is based on an in-depth micro-foundation for the actors involved, namely households and firms. In particular, the model distinguishes eight different age groups (representing education, working age and retirement) and three different groups of educational attainment (low-, medium- and high-skilled). The model uses actual economic data to estimate how an economy might react to changes in labour market policies, other policy reforms or external factors. For example, such policies can comprise changes in direct and indirect taxation and social security contributions, active labour market policies, employment protection legislation, training subsidies, direct support to low-income employment and demographic developments. Simulation results provide the effects of policy scenarios on macroeconomic and labour-market specific variables (such as GDP, investment, private consumption, unemployment, employment or wages). Household-specific variables can either be presented in an aggregate manner or on a disaggregate level (such as age- and/or skill-specific unemployment rates).

The calibration of the LMM requires a considerable amount of data input from various sources. To the extent possible, use is made of harmonised Eurostat and OECD data. As the model differentiates several age- and skill-groups, there is a need for disaggregated individual and household data. Since most of the information is not available from published official statistics in sufficient detail, it is calculated directly from micro-data such as the EU Labour Force Survey (LFS) and the EU Statistics on Income and Living Conditions (EU-SILC). As the breakdown into several age and skill groups reduces the sample size, several years of data sets are used. The LFS is used, in particular, for the calibration of labour market variables (such as employment and unemployment rates, Life Long

Learning activities). The EU-SILC provides data on different types of income, such as labour income, unemployment benefits and social benefits.

Due care is taken to calibrate institutional details in the Member States. These institutions must be operationalised well to be included in the model. Information about these details is mostly taken from the MISSOC database, OECD publications such as Pensions at a Glance or Taxing Wages and national sources. The aggregate structure of taxes and social security contributions is based on the Revenue Statistics, whereas the detailed breakdown of income tax and social security contributions into age and skill groups is derived by combining OECD's Tax and Benefit model and income data from the EU-SILC. The strictness of Employment Protection Legislation (EPL) is calculated by using information from OECD's EPL index. Empirical research reported in the scientific literature provides estimates for the value of several parameters for behavioural equations in the LMM (e.g. elasticity of inter-temporal substitution, search elasticity, labour supply elasticities,...). The System of National Accounts (SNA) is used to calibrate major macroeconomic aggregates such as private and public consumption, the capital and labour income share, etc. An overview about main data sources for the calibration process is provided in the following table.

Parameters	Main Data Sources
Labour market data (e.g. (un-)employment rates, LLL intensity, dismissals)	LFS, EU-SILC
Various types of income	EU-SILC
Demographic structure	Eurostat
Institutional details	National experts, MISSOC, OECD publications, national sources
Revenue structure and tax rates	OECD (Revenue Statistics and Tax and Benefit Models), EU-SILC
Employment Protection Legislation	OECD EPL Index, LFS
Behavioural parameters (e.g. labour supply elasticities, production function, human capital formation)	Scientific empirical economic literature
Macroeconomic country data	System of National Accounts
Consumption profile	Eurostat

The steps performed during the calibration process are explained broadly, but not exhaustively, in this report. Additional information is provided to the European Commission in the files where the calculations have been performed. In particular, this includes Excel and Stata files (in which the

micro data is processed). We add relevant comments which should enable an understanding of the steps performed.

LMM's detailed representation of institutional settings and economic behaviour implies that the model requires numerous parameters and variables. To improve the clarity and transparency of the programme code and of the data processing procedure, the report includes a detailed list and description of variables. This should facilitate the work with the model for the staff of the European Commission.

This list of variables is complemented by the 'list of variables that need to be updated' in the Appendix. The latter provides information on those parameters and variables that need to be recalculated to perform an update of the LMM and, thus, can serve as a kind of check-list for future updates. It provides information to the reader how to perform the update of the calibration and should thus facilitate calibration procedures in the future. In contrast to that, the aim of the list of variables presented in the main part of the report is to support the interpretation of the different variables in the model (once the update of the model has been completed).

The annex includes the simulation and analysis of an illustrative policy scenario. The model is applied to analyse the labour market and economic impact of the migration of refugees to Germany in the years 2014-2016. This illustrative policy scenario serves two tasks. First, it illustrates short-, medium- and long-term characteristics of the LMM. Second, the analysis provides valuable insights into the potential impact of the migration of refugees, currently one of the most relevant topics in Europe.

Since 2014, the number of refugees has significantly increased. Even though several countries are considerably affected relative to their population size, Germany was the most important country of destination in absolute numbers. As a matter of fact, the analysis of this issue requires several assumptions. Indeed, as the future development in the current refugee crisis is particularly hard to project, the present simulations might be updated and refined at a later point in time when additional information is available. In the current policy scenario, we analyse the impact of an inflow of nearly 1.4 million, predominantly young, asylum applicants in the years 2014-2016. As Sweden had a pronounced migration in the last decade from the same region of origin, it is reasonable to assume a similar labour market integration (in terms of employment and unemployment rates and wages) for the refugees in Germany as in Sweden. There is a certain amount of uncertainty on the educational attainment of asylum seeker, even though some consensus has emerged that the average educational level is likely to be low. We take account for this uncertainty by performing a sensitivity analysis. In the first scenario, we assume the same educational structure for refugees as for the native population in Germany. The second scenario is

based on a distribution of educational attainment as in a survey of the German 'Bundesamt für Migration und Flüchtlinge'.

The simulation results indicate that, even in the case of the same educational structure, the increase of the number of refugees has an impact on the labour market. Based on the results for the native population, one can see that this effect is largely concentrated on refugees in this first scenario as a consequence of their less favourable labour market integration. In contrast to that, the second scenario illustrates displacement effects of low-skilled natives in terms of adverse employment and wage outcomes if educational attainment of refugees is below average.

As a result of the increased number of refugees, macroeconomic aggregates such as GDP, physical investment and private consumption rise in both scenarios. The impact is less pronounced, however, in the second scenario with the lower educational attainment of refugees. These results highlight the importance of educational attainment and the relevance of improving and adequately applying skills of refugees. In addition, it should be noted that the increase of GDP is less pronounced than the population increase so that GDP per capita declines in both scenarios compared to a baseline scenario.

The present Final Report is structured as follows. Following an Introduction in Section 1, Section 2 provides information on the calibration of the model and institutional details in the Member States modelled in LMM and concentrates on various different aspects of the calibration. A comprehensive List of Variables, including additional information about these variables, is presented in Section 3. Annex A presents the economic analysis of the current migration of refugees to Germany as an illustrative policy scenario. Annex B includes specific information for the modelling experts of the European Commission, a description of the parameters of the Mincer equation and the List of all the variables that have to be updated.

## Résumé

Afin de mieux comprendre les mécanismes de transmission des politiques du marché du travail, la Commission européenne a chargé des experts indépendants de concevoir et de mettre en œuvre un *modèle de marché du travail ou LMM (Labour market model)* dans le cadre du projet de *Modélisation des marchés du travail au niveau européen (Modelling of Labour Markets in the European Union,* Berger et al. (2009)). Dans le cadre du projet de *Développement / Maintenance du modèle de marché du travail (Development/Maintenance of the Labour Market Model*, Berger et al. (2012)) qui lui fait suite, le modèle initial a été recalibré et étendu afin d'inclure 14 États membres. La documentation a par ailleurs été améliorée.

Le projet actuel s'efforce de remplir trois objectifs. Le premier consiste à mettre à jour l'ensemble des données sous-jacentes, à calibrer le modèle pour huit États membres (l'Autriche, la Belgique, la République tchèque, la France, l'Allemagne, l'Italie, l'Espagne et la Suède) et à effectuer une mise à jour simplifiée pour les six autres. Le deuxième objectif est de documenter précisément les étapes suivies. La simulation d'un exemple de scénario de politique et l'analyse des résultats constituent le troisième objectif.

Le LMM vient compléter d'autres modèles existants de la Commission, tels que le modèle Quest de la Direction générale des affaires économiques et financières de la Commission européenne. Son rôle est de fournir une base pour analyser l'impact des politiques du marché du travail. Le LMM est un modèle d'équilibre général dynamique qui inclut une description détaillée du marché du travail. Il est basé sur des données micro approfondies sur les acteurs concernés, à savoir les ménages et les entreprises. En particulier, le modèle distingue huit groupes d'âges (représentant les étudiants, les personnes en âge de travailler et les retraités) et trois groupes de niveaux d'études (faible, moyen et élevé). Il utilise les données économiques actuelles pour estimer comment une économie réagirait à la modification des politiques du marché du travail et à d'autres réformes ou facteurs externes. Ces changements pourraient par exemple concerner l'imposition directe et/ou indirecte, les charges sociales, les politiques actives du marché du travail, la législation en matière de protection de l'emploi, les subventions pour la formation, le soutien direct aux travailleurs à faibles revenus et les développements démographiques. Les résultats de la simulation montrent les effets des scénarios de politiques sur les variables macroéconomiques et sur les variables propres au marché du travail (comme le PIB, l'investissement, la consommation des ménages, le chômage, l'emploi ou les salaires). Les variables propres aux ménages peuvent être présentées soit de manière agrégée soit de manière non agrégée (taux de chômage de certaines tranches d'âges et/ou catégories de niveaux d'études, par ex.).

Le calibrage du LMM nécessite d'importantes quantités de données issues de diverses sources. Dans la mesure du possible, des données Eurostat et des données de l'OCDE harmonisées sont utilisées.

Plusieurs groupes d'âge et niveaux d'études étant différenciés, le recours à des données non agrégées sur les ménages et individus est nécessaire. La plupart des informations n'étant pas disponibles à un niveau de détail suffisant dans les statistiques officielles, elles sont calculées directement à partir de données micro, notamment celles de l'Enquête sur les forces de travail (Labour Force Survey, LFS) et les statistiques de l'Union européenne sur le revenu et les conditions de vie (EU-SILC). La répartition en plusieurs groupes d'âge et niveaux d'études restreint la taille de l'échantillon. C'est pourquoi des données sur plusieurs années sont utilisées. Ces ensembles de données micro servent, en particulier, pour le calibrage des variables du marché du travail (taux de chômage et d'emploi, activités d'apprentissage tout au long de la vie, par ex.). L'EU-SILC fournit des données sur différents types de revenus, notamment les revenus du travail, les allocations chômage et les prestations sociales.

Les spécificités institutionnelles de chaque État membre sont soigneusement calibrées. Pour être intégrées au sein du modèle, ces caractéristiques institutionnelles doivent être précisément prises en compte. Pour l'essentiel, les informations relatives aux institutions sont tirées de la base de données des tableaux comparatifs MISSOC, des publications de l'OCDE, telles que le Panorama des pensions ou les Impôts sur les salaires, et de sources nationales. La structure agrégée des taxes et charges sociales est basée sur les statistiques sur les revenus. La répartition détaillée de l'impôt sur le revenu et des charges sociales par tranches d'âges et niveaux d'études, quant à elle, est obtenue en combinant le modèle impôts-prestations de l'OCDE aux données sur les revenus de l'EU-SILC. Le degré de protection de l'emploi est calculé à partir des informations des indicateurs de l'OCDE sur la protection de l'emploi. Les recherches empiriques menées dans les publications scientifiques fournissent des estimations sur la valeur de plusieurs paramètres pour les équations comportementales du LMM (par ex. élasticité de substitution intertemporelle, élasticité de la recherche, élasticité de l'offre de travail, etc.). Le Système des comptes nationaux est utilisé pour calibrer les principaux agrégats macroéconomiques tels que la consommation des ménages et des administrations publiques, la part des revenus du travail et du capital, etc. Le tableau ci-dessous fournit une vue d'ensemble des principales sources de données utilisées pour le calibrage.

Paramètres	Principales sources de données	
Données sur le marché du travail (ex. taux d'emploi/de chômage, intensité de l'apprentissage tout au long de la vie, licenciements)	LFS, EU-SILC	
Différents types de revenus	EU-SILC	
Structure démographique	Eurostat	
Données sur les institutions	Experts nationaux, MISSOC, publications de l'OCDE, sources nationales	
Structure des revenus et taux d'imposition	OCDE (statistiques sur les revenus et modèles impôts-prestations), EU-SILC	
Législation en matière de protection de l'emploi	Indice de la LPE de l'OCDE, LFS	
Paramètres comportementaux (ex. élasticité de l'offre de travail, fonction de production, formation du capital humain)	Littérature économique empirique scientifique	
Données macroéconomiques par pays	Système des comptes nationaux	
Profil de consommation	Eurostat	

Ce rapport trace dans les grandes lignes (et non de manière exhaustive) les différentes étapes du processus de calibrage. Les fichiers dans lesquels les calculs ont été effectués intègrent d'autres informations utiles pour la Commission européenne. Il s'agit notamment de fichiers Excel et Stata (dans lesquels sont traitées les données micro). Des commentaires pertinents pour comprendre les étapes successives, ainsi que les variables d'entrée et de sortie, ont également été ajoutés.

La représentation détaillée des paramètres institutionnels et des comportements économiques au sein du LMM implique que le modèle s'appuie sur de multiples paramètres et variables. Afin d'améliorer la clarté et la transparence du code de programmation et de la procédure de traitement des données, une liste détaillée et une description des variables complètent le rapport. Ces éléments visent à faciliter l'utilisation du modèle pour les équipes de la Commission européenne.

À la liste principale des variables s'ajoute en annexe une « liste des variables à mettre à jour ». Elle fournit des informations sur les paramètres et variables qui doivent être recalculés pour mettre à jour le LMM. Elle peut, de ce fait, servir de checklist pour les mises à jour suivantes. Elle décrit comment mettre à jour le calibrage en vue de faciliter les calibrages ultérieurs. La liste principale des variables présentée dans le corps du rapport sert quant à elle à soutenir l'interprétation des différentes variables du modèle (une fois mis à jour). L'annexe comprend la simulation et l'analyse d'un scénario de politique à des fins d'illustration. Le modèle est utilisé pour analyser l'impact sur l'économie et sur le marché du travail de la migration de réfugiés vers l'Allemagne dans les années 2014-2016. Cet exemple de scénario sert deux objectifs. Premièrement, il illustre les caractéristiques à court, moyen et long terme du LMM. Deuxièmement, l'analyse donne des informations précieuses sur l'impact potentiel de la migration de réfugiés, sujet fortement d'actualité en Europe aujourd'hui.

Depuis 2014, le nombre de réfugiés a sensiblement augmenté. Bien que plusieurs pays soient plus affectés que d'autres comparativement à la taille de leur population, l'Allemagne est le principal pays de destination en chiffres absolus. L'analyse menée dans le cadre du scénario prend en compte plusieurs hypothèses. S'il est particulièrement difficile d'anticiper les développements futurs de la crise actuelle des réfugiés, les présentes simulations pourront être mises à jour et affinées lorsque des informations supplémentaires seront disponibles. Le scénario actuel analyse l'impact d'un afflux de l'ordre de 1,4 million de demandeurs d'asile, principalement des jeunes, dans les années 2014-2016. La Suède ayant connu un important flux migratoire au cours de la dernière décennie, en provenance de la même région d'origine, on peut raisonnablement supposer une intégration des réfugiés sur le marché du travail allemand (en termes de taux d'emploi / de chômage et de salaires) comparable à celle de la Suède. Le niveau d'études des demandeurs d'asile demeure incertain, bien qu'un consensus relatif sur un niveau probablement faible émerge. Cette incertitude est prise en compte à travers une analyse de sensibilité. Le premier scénario part du principe que la structure éducative des réfugiés est la même que celle de la population allemande. Le second scénario se fonde sur une distribution des niveaux d'études, comme dans l'étude de l'office fédéral allemand pour la migration et les réfugiés (BAMF).

Les résultats de la simulation indiquent que, même dans le cas d'une structure éducative analogue, l'augmentation du nombre de réfugiés a un impact sur le marché du travail. Sur la base des résultats de la population native, le premier scénario montre que cet impact concerne majoritairement les réfugiés, du fait de leur intégration moins favorable sur le marché du travail. Par contraste, le second scénario révèle des effets sur les natifs peu qualifiés (répercussions défavorables sur l'emploi et les salaires) si le niveau d'études des réfugiés est au-dessous de la moyenne.

Face à la croissance du nombre de réfugiés, les agrégats macroéconomiques tels que PIB, investissement physique et consommation des ménages augmentent dans les deux cas. L'impact est toutefois moins prononcé dans le second scénario qui prend en compte un niveau d'études faible. Ces résultats mettent en évidence l'importance du niveau d'instruction et la nécessité d'améliorer et d'appliquer les compétences des réfugiés. En outre, il est à noter que la hausse du PIB étant moins forte que l'augmentation de la population, le PIB par habitant baisse dans les deux cas, comparativement à un scénario de base.

La structure du présent Rapport final est la suivante. Après une Introduction dans la Section 1, la Section 2, axée sur différents aspects du calibrage, fournit des informations sur le calibrage du modèle et les caractéristiques institutionnelles des États membres modélisés dans le LMM. Une Liste complète des variables, et des détails complémentaires les concernant, est présentée dans la Section 3. L'Annexe A contient l'analyse économique de la migration actuelle de réfugiés vers l'Allemagne sous forme d'exemple de scénario de politique. L'Annexe B regroupe des informations à l'intention des experts en modélisation de la Commission européenne, une description des paramètres de l'équation de Mincer et la liste de toutes les variables à mettre à jour.

## Zusammenfassung

Die Europäische Kommission hat im Rahmen des Projekts *Modelling of Labour Markets in the European Union* (Berger et al. (2009)) externe Experten damit beauftragt ein Arbeitsmarktmodell (Labour Market Model – LMM) zu entwickeln, um Transmissionsmechanismen von Arbeitsmarktreformen besser zu verstehen. Im Folgeprojekt *Development/maintenance of the Labour Market Model* (Berger et al. (2012)) wurde das Modell neu kalibriert, auf 14 Mitgliedstaaten erweitert und die Dokumentation verbessert.

Das vorliegende Projekt besteht aus drei Teilen. Der erste Teil beinhaltet ein umfassendes Update der zugrundeliegenden Daten und der Modellkalibrierung für acht Mitgliedstaaten (Österreich, Belgien, Tschechische Republik, Frankreich, Deutschland, Italien, Spanien und Schweden) und ein vereinfachtes Update für die anderen sechs im Modell inkludierten Länder. Teil zwei umfasst eine sorgfältige Dokumentierung aller vorgenommenen Schritte. Die Simulation eines illustrativen Szenarios und die Analyse der Ergebnisse werden im dritten Teil vorgenommen.

LMM stellt eine wichtige Ergänzung zu anderen Modellen der Europäischen Kommission dar, wie etwa dem Quest Modell der GD ECFIN. Es wird dafür verwendet, die Richtung und Intensität der Auswirkungen verschiedener Arbeitsmarktreformen zu analysieren. LMM ist ein allgemeines Gleichgewichtsmodell mit einer detaillierten Abbildung des Arbeitsmarkts. Es basiert auf einer eingehenden Mikrofundierung der beteiligten Akteure, nämlich der privaten Haushalte und der Unternehmen. Insbesondere unterscheidet das Modell acht verschiedene Altersgruppen (mit einem Lebenszyklus von Ausbildung, über Erwerbsleben bis zum Ruhestand) und drei verschiedene Ausbildungsgruppen (gering, mittel und hoch Qualifizierte). Unter Verwendung von Daten wird abgeschätzt, wie die Wirtschaft auf Arbeitsmarktreformen, andere Politikmaßnahmen oder eine Änderung externer Parameter reagieren wird. Dazu gehören unter anderem Reformen bei direkter und indirekter Besteuerung sowie Sozialversicherungsbeiträgen, aktiver Arbeitsmarktpolitik, Kündigungsschutzregelungen, Förderung von Weiterbildung, direkte Unterstützung für Beschäftigung mit geringem Einkommen und demographische Entwicklungen. Dabei können die Auswirkungen auf makroökonomische und arbeitsmarktspezifische Variablen (wie etwa BIP, Investitionen, privater Konsum, Arbeitslosigkeit, Beschäftigung und Löhne) untersucht werden. Die Variablen werden entweder in aggregierter oder disaggregierter Form (etwa alters- und/oder ausbildungsabhängige Arbeitslosenquoten) dargestellt.

Die Kalibrierung vom LMM erfordert einen großen Umfang von Daten aus verschiedenen Quellen. Soweit möglich wird dabei auf harmonisierte Daten der Eurostat oder der OECD Datenbank zurückgegriffen. Nachdem das Modell verschiedene Alters- und Ausbildungsgruppen unterscheidet, bedarf es zusätzlich disaggregierter Daten auf individueller bzw. haushaltsspezifischer Ebene. Da diese Informationen meist nicht in hinreichendem Detail auf den offiziellen Datenbanken publiziert werden, werden diese direkt aus den Mikrodatensätzen wie etwa dem EU Labour Force Survey (LFS) und der EU Statistics on Income and Living Conditions (EU-SILC) berechnet. Nachdem die Unterteilung in mehrere Alters- und Ausbildungsgruppen die Stichprobengröße reduziert, werden mehrere Jahre dieser Datensätze zusammengefasst. Der LFS wird insbesondere für die Kalibrierung von Arbeitsmarktdaten (wie etwa Beschäftigungs- und Arbeitslosenquoten und Life Long Learning Aktivitäten) verwendet. Der EU-SILC liefert Daten zu verschiedenen Einkommensformen, wie etwa Arbeitseinkommen, Arbeitslosenunterstützung und Sozialleistungen.

Besonderes Augenmerk wird auf die Kalibrierung der institutionellen Details in den Mitgliedstaaten gelegt. Informationen dazu werden größtenteils aus der MISSOC Datenbank, OECD Publikationen (wie etwa Pensions at a Glance oder Taxing Wages) und nationalen Quellen gewonnen. Die Abgabenstruktur basiert auf der Revenue Statistics, wohingegen die detaillierte Aufteilung von Einkommensteuer und Sozialversicherungsbeiträgen nach Alters- und Ausbildungsgruppen durch die Kombination des Tax und Benefit Modells der OECD und Einkommensdaten aus dem EU-SILC ermittelt wird. Kündigungsschutzregelungen werden auf Basis des EPL Index der OECD kalibriert. Empirische Forschung in der wissenschaftlichen Literatur liefert Abschätzungen für verschiedene Parameter der Verhaltensgleichungen im LMM (z.B. intertemporale Substitutionselastizität, Suchelastizitäten, Arbeitsangebotselastizitäten,...). Die Volkswirtschaftliche Gesamtrechnung (VGR) wird für die Kalibrierung der makroökonomischen Aggregate wie etwa privater und öffentlicher Konsum, Lohnquote usw. verwendet. Die folgende Tabelle gibt einen Überblick über die wichtigsten bei der Kalibrierung verwendeten Datenquellen.

Parameter	Wichtigste Datenquellen	
Arbeitsmarktdaten (z.B. Arbeitslosen- bzw. Beschäftigungsquoten, Weiterbildung, Kündigungen)	LFS, EU-SILC	
Verschiedene Formen von Einkommen	EU-SILC	
Demographische Struktur	Eurostat	
Institutionelle Details	nationale Experten, MISSOC, OECD Publikationen, nationale Quellen	
Abgabenstruktur und Steuersätze	OECD (Revenue Statistics und Tax und Benefit Modell), EU-SILC	
Kündigungsschutzregelungen	OECD EPL Index, LFS	
Verhaltensparameter (z.B. Arbeitsangebotselastizitäten, Produktionsfunktion, Humankapitalbildung)	Wissenschaftliche empirische ökonomische Literatur	
Makroökonomische Aggregate	VGR	
Konsumprofil	Eurostat	

Die bei der Kalibrierung vorgenommenen Schritte werden in diesem Endbericht im Überblick, aber nicht bis in das letzte Detail, dargestellt. Zusätzliche Informationen werden der Kommission in den Dateien zur Verfügung gestellt, in denen die Berechnungen durchgeführt wurden. Dies betrifft insbesondere Excel und Stata Dateien (in denen die Mikrodatensätze aufbereitet werden). In diesen Dateien sollen Kommentare das Verständnis der Berechnungsschritte verbessern.

Institutionelle Details und ökonomische Zusammenhänge sind im LMM detailliert abgebildet, wofür eine Vielzahl an Variablen und Parametern notwendig ist. Der vorliegende Bericht enthält eine umfangreiche Liste und Beschreibung der Variablen, um die Verständlichkeit und Transparenz des Programmcodes und der Datenaufbereitung zu verbessern. Diese Liste sollte den Mitarbeitern der Europäischen Kommission die Arbeit mit dem Modell erleichtern.

Diese Liste wird durch eine ,list of variables that need to be updated' im Appendix ergänzt. In dieser sind Informationen zu jenen Parametern und Variablen enthalten, die für ein Update von LMM neu berechnet werden müssen. Sie kann also als eine Art Checkliste bei zukünftigen Updates verwendet werden. Sie enthält Information darüber, wie Updates der Kalibrierung vorgenommen werden können. Im Gegensatz dazu soll die Variablenliste im Hauptteil des Berichts die Interpretation der verschiedenen Variablen im Modell unterstützen, sobald das Update fertiggestellt wurde.

Die Simulation und Analyse eines illustrativen Szenarios findet sich im Annex. Dabei wird das Modell für eine Analyse der Auswirkungen der Zuwanderung von Flüchtlingen der Jahre 2014-2016 auf den Arbeitsmarkt und die Wirtschaft für Deutschland verwendet. Dieses illustrative Szenario erfüllt zweierlei Ziele. Zum einen illustriert es die kurz-, mittel- und langfristigen Eigenschaften des LMM. Zum anderen liefert die Analyse Erkenntnisse über potentielle Effekte der Zuwanderung von Flüchtlingen, die derzeit eine der relevanten Herausforderungen in Europa ist.

Seit dem Jahr 2014 hat die Zahl der Flüchtlinge signifikant zugenommen. Auch wenn mehrere Länder im Verhältnis zu ihrer Bevölkerungsgröße stärker betroffen sind, erlebt Deutschland in absoluten Zahlen die kräftigste Zuwanderung. Naturgemäß ist eine Reihe von Annahmen notwendig, um diese Entwicklung zu analysieren. Da die Zukunft im Zusammenhang mit der aktuellen Flüchtlingskrise schwer vorherzusehen ist, kann die vorliegende Analyse zu einem späteren Zeitpunkt aktualisiert und verfeinert werden, alsbald bessere Informationen verfügbar sind. Im vorliegenden Szenario wird die Zuwanderung von knapp 1,4 Millionen, vorwiegend jungen, Flüchtlingen in den Jahren 2014-2016 analysiert. Da Schweden im letzten Jahrzehnt vergleichsweise starke Zuwanderung aus der betreffenden Herkunftsregion hatte, wird deren Arbeitsmarktintegration (in Bezug auf Beschäftigungs- und Arbeitslosenquoten sowie Lohneinkommen) auf Flüchtlinge in Deutschland übertragen. Darüber hinaus herrscht ein gewisses Maß an Ungewissheit über das Bildungsniveau der Flüchtlinge, selbst wenn sich ein gewisser Konsens darüber gebildet hat, dass das Bildungsniveau im Schnitt eher gering sein dürfte. Aus diesem Grund wird in dieser Studie eine Sensitivitätsanalyse vorgenommen. Im ersten Szenario wird vereinfachend angenommen, dass Flüchtlinge die gleiche Bildungsstruktur aufweisen wie die in Deutschland ansässige Bevölkerung. Das zweite Szenario basiert hingegen auf einer Verteilung der Bildungsabschlüsse gemäß einer Umfrage des deutschen "Bundesamt für Migration und Flüchtlinge".

Die Simulationsergebnisse lassen Auswirkungen des Zustroms an Flüchtlingen auf den Arbeitsmarkt erkennen, selbst wenn diese die gleiche Bildungsstruktur wie die einheimische Bevölkerung haben. Unter Berücksichtigung der Ergebnisse für die ansässige Bevölkerung wird aber deutlich, dass die Auswirkungen in diesem ersten Szenario vorwiegend auf die Flüchtlinge konzentriert sind, was insbesondere auf deren unterdurchschnittliche Arbeitsmarktintegration zurückzuführen ist. Im Unterschied dazu weist das zweite Szenario auch auf Verdrängungseffekte für geringqualifizierte einheimische Personen hin. Wenn also das Bildungsniveau der Flüchtlinge unterdurchschnittlich ist, zeigen sich auch nachteilige Auswirkungen auf Beschäftigung und Lohnentwicklung bei geringqualifizierten Einheimischen.

In beiden Szenarien steigen makroökonomische Größen wie BIP, Investitionen und privater Konsum aufgrund des Zustroms an Asylwerbern. Die Auswirkungen sind jedoch im zweiten Szenario als Folge der weniger qualifizierten Bildungsstruktur der Flüchtlinge weniger stark. Diese Ergebnisse verdeutlichen die Relevanz der Bildungsstruktur und die Bedeutung der Verbesserung und des adäquaten Einsatzes der Fähigkeiten der Flüchtlinge. Darüber hinaus muss man berücksichtigen, dass das BIP geringer wie die Bevölkerung zunimmt, sodass das BIP pro Kopf in beiden Szenarien schwächer ausfällt als im Szenario ohne Zustrom von Flüchtlingen.

Der vorliegende Endbericht ist folgendermaßen strukturiert. Nach einer Einleitung in Kapitel 1 liefert Kapitel 2 Informationen zur Modellkalibrierung und über institutionelle Details über die im Modell abgebildeten Mitgliedstaaten und fokussiert auf verschiedene Aspekte der Kalibrierung. Eine umfassend Variablenliste mit zusätzlichen Informationen zu diesen Variablen wird in Kapitel 3 dargestellt. Annex A bietet die ökonomische Analyse der aktuellen Zuwanderung von Flüchtlingen nach Deutschland als illustratives Szenario. Annex B enthält spezifische Informationen für die Modellexperten der Europäischen Kommission, eine Beschreibung der Parameter der Mincer Schätzung und die Liste aller Variablen, die bei einem Update angepasst werden müssen.

# 1. Introduction

The European Programme for Employment and Social Innovation "EaSI" 2014 is a financing instrument at EU level managed directly by the European Commission. It brings together three EU programmes managed separately between 2007 and 2013: PROGRESS, EURES and Progress Microfinance. The programme contributes to the implementation of the Europe 2020 strategy, by providing financial support for the Union's objectives in terms of promoting a high level of quality and sustainable employment, guaranteeing adequate and decent social protection, combating social exclusion and poverty and improving working conditions.

## 1.1. The Labour Market Model

The aim of the current study is to allow the Commission to update the calibration and further operationalize the existing Labour Market Model (LMM). This model has been set up by external experts in order to improve the European Commission's understanding of transmission mechanisms of labour market policies in the context of the European Employment Strategy.

It has first been developed in the project *Modelling of Labour Markets in the European Union* (see Berger et al. (2009) and tender of the European Commission under the procedure VT/2007/056). It has been further extended in the project *Development/Maintenance of the Labour Market Model* (Berger et al. (2012)) under the procedure VT/2010/010. This second project included the extension of the model coverage of 8 additional countries of the European Union (so that 14 Member States are covered in the model), a (re-)calibration and the provision of an exhaustive list of variables as well as a description of the variables. In addition, the model was applied to illustrate differences of the economic impact of policy scenarios.

LMM is a dynamic computable general equilibrium model with a detailed description of the labour market. The model is based on an in-depth micro-foundation for the actors involved, namely households and firms. Based on an Overlapping Generations approach (in the spirit of Samuelson (1958) and Diamond (1965) and refined by Gertler (1999) and Grafenhofer et al. (2007)), the model distinguishes eight different age groups. Four of those belong to the population of working age, three already reached the retirement age and are no longer available for the labour market. A so-called mixed age group includes people of working age who are already eligible to retire. Importantly, the model features three different skill groups (low-, medium- and high-skilled persons). **Households** maximize lifetime utility by deciding optimally on the *level of private consumption, labour supply along several margins* (number of hours worked if employed, search intensity if unemployed, participation on the labour market, retirement) and *investment in human capital* (education decision at beginning of their lifetime and LLL decision during their active life). **Firms** maximize the firm value by choosing the optimal amount of physical investment, the number of vacancies, the lay-off rate and the amount of investment in firm-sponsored training. The model

contains search unemployment based on the pioneering theory reviewed by Mortensen (1986), but applies a static search model as in Boone and Bovenberg (2002). The specific structure of the model allows for age- and skill-specific labour markets and unemployment rates. Based on the bargaining power of workers and firms, wages are the result of a bargaining process between these two. In addition, the model captures a detailed description of revenues and expenditures of the public sector as well as relevant institutions (like e.g. passive labour market policy or EPL) set by public authorities.

The LMM complements other existing models of the Commission such as the Quest III model applied by DG ECFIN. It is used to provide a theoretical and empirical basis for identifying the possible direction and intensity of the effects of labour market policies. The model uses actual economic data to estimate how an economy might react to changes in labour market policies or other policy reforms or external factors. For example, such policies can comprise changes in direct and indirect taxation, active labour market policies (ALMP), employment protection legislation (EPL), training subsidies, pension regimes, direct support to low-income employment and demographic shocks.

Simulation results provide the effects of reform scenarios on macroeconomic and labour-market specific variables (such as GDP, investment, private consumption, unemployment, employment and wages). Household-specific variables can either be presented in an aggregate manner or on a more disaggregated level such as age- and/or skill-dependent. Based on the model, inter- as well as intra-generational and inter-temporal effects of policy reforms can be analysed.

## 1.2. Subject of the Contract and Tasks To Be Carried Out

The current project is comprised of three different tasks. Task 1 involves the update of the underlying data and the model calibration for eight countries (Austria, Belgium, Czech Republic, France, Germany, Italy, Spain and Sweden).<sup>1</sup> In addition to the detailed update for these eight countries, we also perform a 'stripped-down' update for the six other countries in the model. Task 2 consists of a careful documentation of all steps taken. Simulations of an illustrative policy scenario and the analysis of the results are performed in Task 3. Subsequently, the contractor offers ongoing support for questions concerning the Commission's own first applications of the updated model and other issues.

<sup>&</sup>lt;sup>1</sup> In addition to the six countries (Belgium, Czech Republic, France, Italy, Spain and Sweden) requested in the tender specifications, we also perform a detailed updated for Austria and Germany.

# 2. Calibration and Institutional Details

# 2.1. Macroeconomic Data

In this section we discuss the different macro(economic) data which are used to calibrate the model. They are in general based on officially available harmonised data and can be updated easily.

## Output

In the model we differentiate output, gross value added (GVA) and gross domestic product (GDP). Given labour- and capital input, the production function determines the output ('y'). This function defines the maximum output possible given input factors. We apply several deductions, reflecting different types of costs, as stated below, to derive GVA. These costs can primarily be seen as time devoted to other tasks than production. These tasks are:

- Costs incurred by filling a vacancy (κ)
- Costs incurred by firm sponsored training ('firmskillcost')
- Costs incurred by managerial effort to keep workers ('probcost')
- Administrative firing costs  $(\tau^{c})$

GDP is derived by adding 'Taxes on Products' and deducting 'Subsidies on Products'. Taxes on products are taken from the OECD revenue statistics (see Section 2.7), subsidies on products from the annual national accounts.

Variable	Description	Formula
gva	Gross value added	$y - \kappa - firmskillcost - probcost - \tau^{C}$
gdp	Gross domestic product	gva + taxes on products – subsidies on products

The values for GDP, taxes on products, subsidies on products and GVA for the year 2014 can be found in Table 1. In the model, 'gva' is normalised to 100 in the calibration for all the countries. For this reason we define a parameter ('scalingfactor') to be able to derive values in billions of national currency. For example, multiplying 'gva' by 'scalingfactor' gives GVA in billions of national currency.

2014 / mio. national currency	GDP	Taxes on Products	Subsidies on products	GVA*
Belgium	400,643	44,216	1,985	358,412
Czech Republic	4,260,886	476,788	97,936	3,882,034
Denmark	1,942,584	296,371	16,394	1,662,607
Germany	2,915,650	298,519	6,670	2,623,801
Spain	1,041,160	102,813	7,889	946,236
France	2,132,449	238,334	18,039	1,912,154
Italy	1,613,859	191,569	24,862	1,447,152
Netherlands	662,770	75,127	3,174	590,817
Austria	329,296	39,038	712	290,969
Poland	1,719,097	199,113	2,617	1,522,601
Slovakia	75,561	8,141	362	67,781
Finland	205,178	29,697	770	176,251
Sweden	3,918,199	480,782	20,614	3,458,031
United Kingdom	1,816,439	196,346	7,485	1,627,578

Table 1: GDP, Taxes and Subsidies on Products and Gross Value Added (2014, in national currency)

\* this value will deviate from the value provided by the national accounts as we use OECD data for taxes on products and not the corresponding value of the national accounts. The difference is rather minor. Source: Eurostat: Annual sector accounts, own calculations.

## Required Rate of Return, Capital Stock, Investment Ratio and Capital Share

Production involves capital input and the required investment and provides compensation (capital compensation) to its owners, including the required rate of return, 'r', and compensation for deprecation of the capital stock. Therefore it is necessary to define some of these values whereas others are determined in the calibration procedure which implies that one has to define which of these parameters are set and which of them subsequently result from the calibration procedure. Capital compensation cannot be determined directly from the national accounts as gross operating surplus includes also mixed income which is the remuneration for the work carried out by the owner (or members of his family) of an unincorporated enterprise. However, there are ways to approximate the capital share. As this share has an impact on the simulation results and cross-country differences it is important to implement a rather accurate value.

We suggest the following calibration procedure. Information is available for the capital stock, the capital share, the investment ratio and the corporate tax rate. Using this information leaves the depreciation rate, the required rate of return and taxes on capital available to replicate these variables. Referring to the steady state investment equation, the depreciation rate can be derived by the level of investment and the capital stock.<sup>2</sup> In addition, the following optimality relationship has to be fulfilled in the steady state (for more information see Modelling of Labour Markets in the

<sup>&</sup>lt;sup>2</sup> Neglecting the exogenous growth trend 'g'.

European Union – Final Report Part II, p. 37), where 'K' is used to determine the marginal productivity of capital,  $F_K^{Y}$ :

$$F_K^Y = \frac{(1 - t^{prof} sub^i)(r + \delta^K) - t^{prof} \delta^K}{(1 - t^{prof})} - t^{cap}$$

One has to take into account that the capital stock cannot be observed directly and is determined in an indirect way. Calculated values are only approximations such that adjustments can be justified. The required rate of return is usually set to the same value in all countries.<sup>3</sup> In this project we deviate from a common interest rate in some countries, the three New Member States, Italy and UK. The difference amounts to the interest rate differential of long-term government bonds compared with Germany in the years before the crises started. This deviation is necessary to replicate the capital share.<sup>4</sup> In some cases we also deviate for other variables (capital stock and tax rate on capital  $t^{cap}$ )<sup>5</sup> from data sources. This is necessary to be able to replicate the derived capital share.

Information about the adjusted<sup>6</sup> labour share (capital share = 1-labour share) can be received from the AMECO database<sup>7</sup>. In addition, we also derive a second measure for the labour share, by adding compensation of employees (Source: System of National Accounts) and payroll taxes (if there are any) and multiply this value by a factor to reflect labour input of self-employed persons. The factor is derived in the following way:

$$factor = \frac{No. of \ employee * AW_e + No. of \ selfemployed * AW_s}{No. of \ employee * AW_e}$$

where  $AW_e$  reflects average working hours of employees and  $AW_s$  average working hours of selfemployed persons. The capital share according to these two sources is presented in Table 2. The third column shows the value used in the model. In most cases the capital share in the model lies within the range of the two sources or very close to it. Deviations are large for Poland and Slovakia. This can be justified by a strong decrease of investment in Slovakia in the years after the crises and the comparable modest capital stock in Poland (compared to Slovakia and the Czech Republic, see below).

<sup>&</sup>lt;sup>3</sup> See for example the Quest model. In the previous calibration of the model (see Berger et al. 2012) we set the real interest rate to 3% in all countries. In this project we used 2.5% as this fits better to replicate the capital stock and the capital share. A common interest rate can be justified by assuming perfect mobility of capital.

<sup>&</sup>lt;sup>4</sup> Especially in the New Member States the capital share is extraordinarily high.

<sup>&</sup>lt;sup>5</sup> In general the tax rate on capital is set to zero. Subsidies (a negative tax) are granted in a lump-sum fashion in the calibration, such that changes in the level of investment have no feedback effect on public subsidies in general. If necessary we also use the tax rate on capital (a negative value) to replicate the capital share and decrease the lump-sum subsidy accordingly.

<sup>&</sup>lt;sup>6</sup> Adjusted means that labour input of self-employed individuals is taken into account.

<sup>&</sup>lt;sup>7</sup> We add payroll taxes which are not considered in the compensation of employees in AMECO.

	Capital share AMECO database	Calculations via System of National Accounts	Model
Belgium	31.6%	29.6%	32.1%
Czech Republic	47.9%	45.3%	44.4%
Denmark	34.0%	30.5%	34.0%
Germany	37.0%	35.3%	35.3%
Spain	39.9%	34.8%	34.8%
France	32.7%	29.2%	34.9%
Italy	38.9%	37.8%	37.8%
Netherlands	32.9%	30.9%	30.9%
Austria	33.7%	32.4%	34.0%
Poland	46.0%	46.3%	43.0%
Slovakia	50.6%	49.3%	44.5%
Finland	34.5%	31.9%	34.5%
Sweden	37.6%	32.6%	37.6%
United Kingdom	37.2%	35.1%	34.0%

Table 2: Capital share based on AMECO, System of National Accounts and Model

Source: AMECO database, System of National Accounts, own calculations.

	Capital stock as percent of GVA (average 2011-2014) AMECO database	Capital stock as percent of GVA (average 2011-2014) System of National Accounts	Model
Belgium	298%	333%	262%
Czech Republic	332%	Capital Stock as percent of GVA (average 2011-2014) System of National Accounts Model   3333% 262%   472% 472%   376% 292%   363% 385%   - 270%   735% 341%   397% 397%   347% 2290%   447% 290%	
Denmark	292%	376%	292%
Germany	324%	363%	385%
Spain	404%	-	270%
France	341%	735%	341%
Italy	372%	397%	397%
Netherlands	323%	347%	323%
Austria	396%	447%	290%
Poland	221%	166%	390%
Slovakia	194%	501%	501%
Finland	348%	370%	348%
Sweden	415%	350%	415%
United Kingdom	284%	266%	315%

Table 3: Capital Stock in Percent of GVA (Average 20011-2014)

Source: AMECO database, System of National Accounts, own calculations.

Data about the capital stock in the economy in the calibrated countries is based on the AMECO database and the system of national accounts. Both provide information about the net capital stock for the total economy for a longer time horizon for all considered countries, except of Spain. The

average ratio of capital stock to GVA for the countries can be found in Table 3. The third column provides information about the capital stock used in the model. In most countries the chosen value is within the range of the two data sources or very close to it. Larger deviations only arise in Spain, Austria and Poland. For Spain we assume a lower capital stock given the large overinvestment in the years before the crises. With respect to Poland, given the large capital share as well as the high capital stock in the other two New Member States we assumed a higher capital stock. For Austria the lower capital stock is necessary to calibrate the capital share derived.

The investment ratio is calculated as the level of investment as percent of GDP. The information is based on national accounts. We use the average investment ratio of the period 2011 up to 2014. The average level for the different countries can be found in Table 4. The rather low capital stock in the UK is also reflected in the comparably low investment ratio. On the contrary, the capital stock according to AMECO is the lowest of the considered countries in Slovakia, the investment ratio ranges in the middle of these countries. There is no direct relationship between the investment ratio and level of the capital stock as the depreciation rate can vary widely as a matter of the different composition of the capital stock (buildings, machinery etc.). The depreciation rate in the modelled countries is derived in the calibration procedure and does not need to be set.

	Investment ratio (2011-2014)
Belgium	23.1%
Czech Republic	25.8%
Denmark	19.6%
Germany	19.8%
Spain	20.3%
France	22.6%
Italy	17.9%
Netherlands	18.9%
Austria	23.6%
Poland	20.7%
Slovakia	22.0%
Finland	22.1%
Sweden	23.2%
United Kingdom	16.7%

Table 4: Average Investment	Ratio (2011	1 <i>-2014,</i> in %	of GDP)
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Source: Eurostat, own calculations.

### Subsidies on Production

Subsidies are not only paid on products but also in production. The annual national accounts contain data about this type of subsidy, which is labelled by d.39. In the model, subsidies on production are assumed to be transfers to firms. From an economic point of view, the higher the subsidies on production the less capital in production needs to earn to yield the required rate of

return on capital which is determined on the capital markets. The share of subsidies on gross value added ranges from 0.3 percent in the UK to 3.4 percent in Belgium (see Table 5).

	Subsidies on production
Belgium	3.4%
Czech Republic	1.4%
Denmark	2.1%
Germany	1.0%
Spain	1.1%
France	1.6%
Italy	0.7%
Netherlands	1.1%
Austria	1.9%
Poland	1.4%
Slovakia	1.1%
Finland	1.6%
Sweden	1.6%
United Kingdom	0.3%

Table 5: Subsidies on Production in Percent of GVA (Average 2011-2014)

Source: Eurostat: Annual sector accounts, own calculations.

### External balance of goods and services

Produced goods and services can either be consumed (private or public consumption), invested or exported to other countries. Consumption and investment consists of home produced goods and imported goods from abroad. The difference between exported and imported goods results in the external balance of goods and services. Data for the external balance is based on the System of National Accounts provided by Eurostat. The external balance is used for the calibration of the model. The average external balance of the years 2011 to 2014 as percent of GVA is provided in Table 6.

able 6. External balance in percent of dvn (nverage 2011-2				
	External balance (2011-2014)			
Belgium	0.9%			
Czech Republic	5.9%			
Denmark	6.8%			
Germany	6.6%			
Spain	1.9%			
France	-2.3%			
Italy	1.3%			
Netherlands	11.3%			
Austria	3.4%			
Poland	0.2%			
Slovakia	3.0%			
Finland	-1.1%			
Sweden	5.1%			
United Kingdom	-2.1%			

Table 6: External balance in percent of GVA (Average 2011-2014)

Source: Eurostat, own calculations.

### Government Debt

Private savings can either be held in domestic firm assets, government debt and in assets in foreign countries. Foreigners in turn can hold assets from the modelled countries. This can be firm assets as well as government debt. The external balance of financial assets is defined by the external balance of goods and services. The model does not distinguish which of the assets in the home country are held by households in the home country and which are held by foreigners. Data on the capital stock is already provided above, the value of government debt in 2014 in percent of GVA can be found in Table 7.

	Gross government debt 2014
Belgium	119.3%
Czech Republic	46.9%
Denmark	52.7%
Germany	83.2%
Spain	109.3%
France	106.6%
Italy	147.5%
Netherlands	76.5%
Austria	95.3%
Poland	56.9%
Slovakia	59.6%
Finland	69.0%
Sweden	50.9%
United Kingdom	98.4%

Table 7: Gross government debt 2014 in percent of GVA

Source: Eurostat, own calculations.

## 2.2. Demography and Educational Attainment

The model includes a detailed breakdown of the population with respect to age and educational attainment, so that we can analyse both age- and skill-dependent impacts of policy reforms, as also indicated in the illustrative reform scenario, see Annex A. LMM distinguishes three different educational attainment groups. The low-skilled group includes individuals with pre-primary, primary and lower secondary education (ISCED 0-2), individuals with completed tertiary education (ISCED 5-6 according to the ISCED classification 1997)<sup>8</sup> are high-skilled and medium-skilled individuals have an upper secondary (and post-secondary non-tertiary) level of education (ISCED 3-4). The distribution of the 25 to 64 years old population according to the highest level of education attainment is based on Eurostat data and is shown in Table 8. In 2013, the share of low-skilled individuals ranges from less than 10 % in the Czech Republic, the Slovak Republic and Poland to more than 40 % in Spain and Italy. On the other hand, the share of high-skilled individuals ranges from 16 % in Italy to around 40 % in Finland and the UK.

	Low	Medium	High
	ISCED 0-2	ISCED 3-4	ISCED 5-6
Belgium	27.2%	37.2%	35.5%
Czech Republic	7.2%	72.4%	20.5%
Denmark	21.7%	42.8%	35.4%
Germany	13.3%	58.1%	28.6%
Spain	44.5%	21.7%	33.7%
France	25.0%	43.0%	32.1%
Italy	41.8%	41.8%	16.4%
Netherlands	24.2%	41.9%	33.9%
Austria	17.0%	62.4%	20.6%
Poland	9.9%	64.4%	25.8%
Slovakia	8.1%	72.0%	19.9%
Finland	14.1%	45.3%	40.5%
Sweden	16.8%	46.2%	37.0%
United Kingdom	21.7%	38.7%	39.6%

Table 8: Distribution of Educational Groups (25-64 years old), 2013

Source: Eurostat, own calculations. ISCED 1997 classifications.

The model is calibrated to an initial steady state that also assumes a stationary demographic structure which implies that the demographic structure of the population in the model deviates from the actual demographic structure. Our approach is that we take current mortality rates for each one-year-cohort from Eurostat and derive average mortality rates for our age groups. Table 9 compares the actual demographic structure with the initial demographic structure that results in the model. We overestimate the group of older individuals in all countries. However, given that we

<sup>&</sup>lt;sup>8</sup> For the used (micro-)data, information on the educational attainment according to the new ISCED classification 2011 is only available from 2014. As we are using data for several years, we remain with the old ISCED classification 1997 in this update of the calibration in order to avoid inconsistencies.

adjust the flat pension in order to derive actual pension expenditures in the countries (see Section 2.11), this is probably the best way to deal with this issue.

		15-39	40-64	65+
Polgium	Model	37.9	35.9	26.2
Deigium	Data	38.0	40.9	21.2
Czoch Popublic	Model	39.5	36.4	24.0
Czech Republic	Data	40.6	39.7	19.7
Donmark	Model	38.2	35.3	26.5
Dennark	Data	37.6	40.8	21.6
Cormany	Model	37.9	36.3	25.9
Germany	Data	33.4	42.8	23.9
Spain	Model	36.6	35.0	28.4
Spain	Data	38.5	40.6	20.8
Franco	Model	36.9	35.1	28.0
rrance	Data	37.6	40.8	21.6
Italy	Model	36.7	35.2	28.1
Italy	Data	33.8	41.6	24.6
Netherlands	Model	37.5	35.7	26.7
	Data	36.8	42.9	20.3
Austria	Model	37.6	35.8	26.6
Ausula	Data	37.0	41.9	21.1
Deland	Model	40.1	37.4	22.5
Totanu	Data	43.1	40.0	16.9
Slovakia	Model	40.5	37.7	21.8
SIOVAKIA	Data	44.5	40.0	15.5
Finland	Model	37.7	35.5	26.8
rinanu	Data	37.0	40.6	22.5
Sweden	Model	37.2	34.9	27.9
Sweden	Data	38.4	38.6	23.0
United Kingdom	Model	37.7	35.3	27.0
United Kingdom	Data	39.6	39.5	20.9

Table 9: Demographic Distribution (in Percent of Individuals Aged 15 and Older), 2013

Source: LFS, Eurostat, own calculations.

## 2.3. Earnings profiles

To reflect differences in earnings (productivity) between skill-groups and over the life-cycle we estimate an earnings profile. This provides information about the returns to education and experience in the countries. The theoretical framework was developed by Mincer (1974). We estimate the following simple earnings equation:

$$\log w_i = \alpha + rs_i + \delta x_i + \gamma x_i^2 + u_i,$$

where  $w_i$  is a measure of hourly earnings of individual *i*,  $s_i$  represents a measure of schooling and  $x_i$  the labour market experience of the individual.<sup>9</sup> The experience is also included in a quadratic form to allow for a concave life-cycle wage profile. In the estimation we distinguish schooling between low-, medium and high-skilled and not the number of years of schooling.<sup>10</sup> Experience is derived as age minus 15 for low-skilled (minus 20 for medium- and 25 for high-skilled persons). The estimated coefficients r,  $\delta$  and  $\gamma$  represent the private returns to schooling. In addition, if the distinction between natives and foreign born persons is important, additional dummy variables for schooling are introduced.<sup>11</sup> In the calculations we focus on employees, self-employed are not taken into account, as self-employed income also includes capital income to some extent and not only labour income. Gross hourly wage is derived by dividing yearly employee cash or near cash income (EU-SILC variable PY010G) by the number of months spent in full- or part-time work as employee (PL073 and PL074) and dividing the result by the number of hours usually worked<sup>12</sup> in the main (PL060) and further jobs (PL100).

Wage gap foreigner to natives	Low	Medium	High
AT	13.8%	21.2%	20.8%
BE	10.2%	8.2%	1.5%
CZ	7.2%	-1.8%	-9.9%
DE	-13.5%	1.7%	12.4%
DK	3.9%	3.1%	4.8%
ES	20.1%	30.3%	28.2%
FI	-	7.6%	13.9%
FR	2.3%	2.6%	11.6%
IT	15.4%	31.1%	32.3%
NL	8.3%	9.8%	9.8%
PL	25.5%	9.2%	-16.1%
SE	22.7%	12.5%	10.2%
SK	6.5%	14.5%	0.8%
UK	8.1%	5.2%	4.0%

<i>Table 10: Wage gap</i>	of	foreign born	to	natives of	f the sam	e skill-	arou	р
	- / /							-

Source: EU-SILC, own calculations.

Results for the wage gap between foreign born and natives with same educational attainment are shown in Table 10. A positive number stands for lower wages of foreign born compared to natives, a negative number for higher wages of foreigners. In general the wage gap is positive such that wages

<sup>&</sup>lt;sup>9</sup> Other variables affecting hourly wages, like sex or the industrial sector are ignored as we do not distinguish them in the model.

<sup>&</sup>lt;sup>10</sup> For this reason we use the dummy variables for medium- and high-skilled persons.

<sup>&</sup>lt;sup>11</sup> The number of dummy variables in this case is five instead of two, i.e. medium-skilled natives, high-skilled natives, low-skilled foreign born, medium-skilled foreign born, and high-skilled foreign born.

 $<sup>^{12}</sup>$  As PL060 and PL100 reflect hours per week the number is multiplied by 4.36 (=30.5/7) to derive the number of hours worked per month.

of foreigners are lower than wages of natives. However, there are large differences in the wage gap between the countries. This is to some extent a result of different regions of origins of migrants. According to the data, high wage gaps can be found in Austria, Spain, Italy, Poland, and Sweden. Germany is the only country with a negative gap for low-skilled individuals.<sup>13</sup>

## 2.4. Consumption Profile

The consumption and savings decisions of individuals, in which individuals decide what level to consume now or save, determine an optimal marginal propensity to consume ('mpc') out of expected total lifetime wealth (consisting of financial wealth and the present value of future labour and pension income and transfers). As described in equation (42) of the model documentation, the 'mpc' is age-dependent and determined by different parameters such as preference parameters (e.g. the subjective discount factor and the intertemporal elasticity of substitution), policy parameters such as the consumption tax rate and future mortality rates. The elasticity of intertemporal substitution describes the intertemporal response of consumption to changes in the 'real interest rate'. In the model, this 'real interest rate' is compounded of the interest rate, the probability of ageing, the discount factor and price changes, i.e. changes in the consumption tax rates in two periods. Thus, combined with the stream of income and transfers, the 'mpc' determines an intertemporal consumption profile of individuals in economic models. However, this consumption profile can deviate from the profile actually observed in reality. The model therefore incorporates inter-vivo transfers between households. We calibrate these transfers such that the consumption profile observed in reality results from optimal household behaviour in the model.<sup>14</sup> Data on private consumption expenditures per adult equivalent for different age groups are taken from Eurostat. The dataset contains few data on very young and very old households.<sup>15</sup> Therefore, we estimate quadratic consumption profiles for each of the countries. As can be seen in Table 11, an ordinary least squares estimation shows the expected hump-shaped consumption profile for all countries.

<sup>&</sup>lt;sup>13</sup> One explanation could be that foreigners predominantly work in western provinces, in which the wages are higher than in eastern provinces.

<sup>&</sup>lt;sup>14</sup> Given calibrated values for income and transfers and the consumption profile, the asset profile is endogenously determined as a result of the intertemporal budget constraint of private households.

<sup>&</sup>lt;sup>15</sup> Furthermore, the detailed breakdown according to the age was not available for the Netherlands.

	15-19	20-24	25-39	40-54	55-69	70-79	80-84	85+
Belgium	0.88	1.00	1.13	1.23	1.24	1.18	1.10	1.03
Czech Republic	0.83	1.00	1.18	1.31	1.26	1.10	0.94	0.80
Denmark	0.80	1.00	1.22	1.40	1.39	1.25	1.11	0.97
Germany	0.79	1.00	1.24	1.47	1.55	1.49	1.39	1.30
Spain	0.79	1.00	1.23	1.41	1.40	1.25	1.09	0.95
France	0.76	1.00	1.26	1.48	1.49	1.34	1.19	1.04
Italy	0.90	1.00	1.10	1.17	1.13	1.02	0.91	0.81
Netherlands	0.96	1.00	1.05	1.09	1.10	1.08	1.05	1.03
Austria	0.82	1.00	1.19	1.33	1.29	1.13	0.97	0.82
Poland	0.94	1.00	1.06	1.09	1.06	0.99	0.93	0.88
Slovakia	0.90	1.00	1.09	1.15	1.11	0.99	0.89	0.79
Finland	0.79	1.00	1.21	1.35	1.27	1.04	0.83	0.64
Sweden	0.76	1.00	1.25	1.44	1.40	1.20	0.99	0.81
United Kingdom	0.93	1.00	1.05	1.06	0.97	0.82	0.70	0.59

### Table 11: Consumption Profile

Source: Eurostat, own calculations.

## 2.5. Effective Corporate Tax Rates

The calibration of corporate tax rates is based on results of a ZEW (2014) research report for DG TAXUD of the European Commission. Among other indicators, this report provides calculations of the effective marginal corporate tax rate (EMTR) for the different countries based on the method by Devereux and Griffith (2003) which computes EMTRs for a 'mean company'. The EMTRs for the relevant countries are presented in Table 12. There is a wide range in the 14 countries modelled, ranging from 7 % in Belgium to 36 % in France.

Country	EMTR	Country	EMTR
Belgium	6.9%	Netherlands	16.9%
Czech Republic	10.6%	Austria	18.4%
Denmark	16.9%	Poland	13.8%
Germany	22.5%	Slovakia	13.0%
Spain	34.1%	Finland	14.4%
France	35.8%	Sweden	14.5%
Italy	24%*	United Kingdom	25.3%

Table 12: Effective Marginal Corporate Tax Rates (EMTR), 2014

\*EATR to replicate the capital share in the economy, see chapter 2.1. Source: ZEW (2014).

## 2.6. Public Health Expenditures

Information on public health expenditures is taken from the OECD Health Database. Expenditures (including current expenditure and capital formation) range from around 5 percent of gross value added in Poland to more than 10 percent of value added in Denmark, Netherlands and Sweden.

Country		Country	
Belgium	9.2	Netherlands	10.5
Czech Republic	6.7	Austria	9.2
Denmark	10.8	Poland	5.3
Germany	9.4	Slovakia	6.2
Spain	7.3	Finland	7.8
France	9.9	Sweden	10.8
Italy	7.9	United Kingdom	8.5

Table 13: Public Health Expenditures as a Share of GVA (average 2011-2013)

Source: OECD Health Data, own calculations.

## 2.7. Public Revenues from Taxes and Social Security Contributions

Public revenues from taxes and social security contributions in the different countries are derived by using detailed data from OECD's database on Revenue Statistics (see e.g. OECD (2015b)). We group the detailed items according to their economic function in five categories: Income, Capital Gains, Corporates, Social Security Contributions and Consumption.

Results are presented in Figure 1. It must be noted, that the data shown may deviate sharply from the officially published OECD Revenue Statistics because some items (such as occupational pension schemes) are included in the LMM but not in the Revenue Statistics. Background information on these adjustments that may be relevant for the modelling experts of the European Commission is provided in Annex B (Section B.1.1).

The share of 'total revenues as in the LMM' (including revenues from taxation and social security contributions and the additional items mentioned above) on gross value added ranges from 34 percent in Slovakia to more than 60 percent in Denmark. The share of income taxes and social security contributions varies strongly for the Member States.
Figure 1: Revenues as in the LMM According to Economic Function, as Share of Gross Value Added, Average 2011-2014



\* data available until 2013.

Numbers shown in the figure may deviate strongly from revenues published in the OECD revenue statistics as some items (such as occupational pension systems) are included in the LMM but are not included in the Revenue Statistics. Source: OECD Database, own calculations.

These 'Model Revenues' in the five different categories are used to calibrate LMM's tax rates. Some tax rates (tax on consumption and capital gains tax) are calculated directly by relating revenues to the assessment base (i.e. private consumption or capital gains). For instance, the consumption tax rate is equal to revenues from taxes on consumption divided by the assessment base for consumption tax, consisting of total private consumption and a share of public consumption (intermediate consumption and consumption of fixed capital). Income tax rates and social security contribution rates of employers and employees according to education and age are derived via the method described in Section 9.2.3 of the second part of the Final Report of 'Modelling of Labour Markets in the European Union'. Simply speaking, we derive age- and skill specific tax and social security contribution rates using OECD'S Tax-Benefit model and the EU-SILC. These rates are subsequently adjusted for all groups so that we get appropriate revenues (only minor adjustments are necessary for all countries). For corporate taxation, a different method is applied and we use the calculations of the ZEW (2014), see Section 2.5 for effective corporate tax rates. In a second step, we calibrate the necessary deductions of the tax base so that revenues in our model fit to revenues based on OECD data.

# 2.8. Income Taxation and Social Security Contributions

The model's detailed breakdown of households according to age and skill groups allows for a different taxation of different (income) groups to consider, for example, progressive income tax systems, maximum thresholds for social security contributions or earned income tax credits. The drawback of this detailed representation is the considerable calibration effort. As described in the Final Report of 'Modelling of Labour Markets in the European Union', the calibration relies on a sophisticated (and rather time-consuming) application of OECD's Tax-Benefit model (using institutional details based on the year 2013) on EU-SILC data. In contrast to that, in models with only one representative household, tax rates can be calibrated rather easily by using aggregate revenue data. However, once the calculation method is completed, tax and social security reforms can be replicated rather easily and in profound detail.

This chapter gives a very brief overview on institutional settings of personal income taxes and social security contributions in the different countries. The information is mainly drawn from editions of Taxing Wages (OECD), Benefits and Wages (OECD), the MISSOC database and, if necessary, national sources. The Appendix provides some specific information that might be relevant for modelling experts of the European Commission.

# Austria

Income taxation is on an individual basis in Austria, but some of the tax reliefs and tax credits (e.g. sole earner's or sole parent's tax credits) depend on household characteristics. Standard tax reliefs include for instance work related expenses, child care allowances and, most importantly, employee's social security contributions. Social security (which includes, for example, pension, health and unemployment insurance) is primarily financed by employee's and employer's contributions. In addition, payroll taxes on employers include the contributions to the Family Burden Equalisation Fund (at a rate of 4.5 %) and the Community Tax (3 %). Pension payments are subject to the same personal income tax schedule, social security contributions on pension benefits only include health insurance. Unemployment insurance benefits and unemployment assistance are defined proportional to net income and are thus not taxable.

### Belgium

Spouses are taxed separately in Belgium. However, a notional amount of income can be transferred between spouses if one of them earns no more than 30 percent of the couple's combined income.<sup>16</sup> Individuals can deduct some work-related expenses and social security contributions. The model also considers the local government tax. Employees and employers contribute to several items of

<sup>&</sup>lt;sup>16</sup> This system is called the non-earning spouse allowance or 'quotient conjugal'.

social insurance (unemployment, health insurance, health care, pensions, etc.). A reduction of employer's and employee's social security contributions as well as tax credits are also taken into account in the model. Unemployment and pension benefits are subject to income taxation and to social security contributions amounting to 6.5 percent resp. 3.55 percent (above a certain threshold).

#### Czech Republic

Spouses are taxed separately in the Czech Republic, but some tax credits are dependent on household characteristics. Non-standard tax reliefs include, for instance, supplementary pension scheme contributions and private life insurance premiums. It is important to note that taxable income is comprised of gross earnings, *augmented by employers'* social security contributions (in contrast to that, taxable income is comprised of gross earnings minus employees' social security contributions in most other countries). Employees and employers both contribute to health and social insurance, but the overall contribution rate is much higher for employers (34 %) than for employees (11 %). Unemployment benefits are not taxable and exempted from social security contributions (they are already based on previous net labour income). Pension benefits, however, are subject to income taxation but exempted from social security contributions.

#### France

In France, the tax unit is aggregate family income, but children over 18 are included only if their parents claim them as dependents.<sup>17</sup> The 'family quotient' system takes into account the household situation by dividing net taxable income by a certain amount of shares.<sup>18</sup> In the French income tax system, there are several standard reliefs such as for work-related expenses, the employment premium ('PPE') or tax credits for low earning households. The universal social contribution ('CSG') and the reimbursement of social debt ('CRDS') are assigned to the personal income tax system (and are not seen as social security contributions) in the OECD publications. There are several different types of employees' and employers' social security contributions.

Pension and invalidity benefits are subject to income taxation, to CSG and CRDS and to reduced social security contributions. Unemployment benefits are subject to income taxation and partially social security contributions, unemployment assistance only to income taxation.

<sup>&</sup>lt;sup>17</sup> From 2004 on, the law also allows for joint taxation of partners in a French civil union ('PACS').

<sup>&</sup>lt;sup>18</sup> E.g. one share for singles, two shares for couples, and half a share for each dependent child.

#### Germany

Spouses are generally assessed jointly in Germany, but they also have the option of being assessed separately. We calculate the income tax liability by applying the splitting method: the income tax is calculated on basis of one-half of the joint taxable income, the resulting amount is doubled to obtain the joint tax liability. Essentially, even if two partners have a different income, they share the same tax rate determined by their joint income. This system exclusively applies to married couples and does not include other forms of partnership. Tax reliefs include reliefs for children, for lone parents, for work-related expenses and for special expenses. Social security contributions and other expenses for financial security (e.g. life insurance) are deductible up to specific ceilings. A solidarity surcharge (initially meant to raise money for the German reunification) is additionally levied on the income tax liability. Employers and employees contribute to sickness, pension, unemployment and care insurance.

The gradual transition of the income tax system to deferred taxation of pension benefits instead of pension contributions implies several changes. First, a gradually increasing share of the contributions of workers can be deducted from their income tax base. Second, the share of pension benefits taxed gradually increases over time for each new retiree cohort (starting from 50 percent of the benefits in the year 2005 to 80 percent in 2020 and to 100 percent until 2040). Retirees pay social security contributions for sickness and care. Unemployment insurance and assistance are not taxable.

### Italy

Spouses are taxed separately in Italy, but certain reliefs are dependent on household characteristics. Social security contributions due by law can be deducted from taxable income. Apart from standard tax credits, there are also tax credits for family dependents (spouse and child tax credit). Tax credits for children have to be equally shared between the parents. There are also regional and local surcharges to the income tax. In accordance with the OECD Tax Benefit model, we apply the tax rate paid in the capital Rome in our model. Employees and employers contribute to the social security system. Pension and unemployment benefits are subject to taxation and there are no special reliefs for these benefits. Pensions are subject to the very low social security contributions for the National Institution for Italian Pensioners, unemployment benefits are not subject to social security contributions.

## Spain

As a general rule, individuals are taxed separately in Spain, but families also have the option of being taxed as married couples or as heads of households. Taxpayers can claim several standard reliefs such as a basic relief and tax credits depending on household characteristics and several nonstandard reliefs (like investment in own-housing). Social security contributions are fully deductible. In addition to the central government income tax there are also substantial regional surcharges. Employers' social security contribution rates (29.9%) are substantially higher than that of employees (6.35%). Pension benefits are subject to income taxation, but no social security contributions arise. According to OECD's Benefits and Wages, unemployment benefits are taxable and social security contributions have to be paid at lower contribution rates.

#### Sweden

Spouses are taxed separately in Sweden. In the Swedish system, there is a basic allowance that varies with income and there are several non-standard reliefs. Employees are granted a tax credit equal to 100 % of compulsory employees' social security contributions. In addition, there is an Earned Income Tax Credit (EITC) worth up to SEK 22,300 (and higher for employees aged 65 or more). Apart from the central government income tax, Sweden also has a local government tax (with the same tax base and an average rate of 31.7 % in 2013). Employees and employers pay social security contributions and the rate is reduced for people aged less than 26 or more than 65. Pension benefits, unemployment insurance and assistance benefits are taxable, but no social security contributions are levied.

# 2.9. Employment Protection Legislation (EPL)

A literature review on both theoretical and empirical research on EPL can be found in the first part of the final report of the base project, a more detailed description of the calibration in the second part (Berger et al. (2009)). In the model, the elasticity of the layoff rate w.r.t. EPL is based on estimates of the OECD (2004). Based on a cross-country GLS estimation, this study finds that the flow into unemployment decreases by 0.165 percentage points if the OECD EPL index increases by 1 point. This result is used for the calibration of the sensitivity of the layoff decision of firms.

	Modified EPL Index	Share of Severance Pay
Belgium	2.95	28.1%
Czech Republic	2.61	19.5%
Denmark	2.28	19.9%
Germany	2.70	27.1%
Spain	2.55	31.0%
France	2.97	34.2%
Italy	2.87	26.6%
Netherlands	2.59	32.7%
Austria	2.42	24.1%
Poland	2.38	19.4%
Slovakia	2.27	17.3%
Finland	2.12	32.2%
Sweden	2.29	25.9%
United Kingdom	1.53	17.1%

Table 14: Modified EPL Index and Share of Severance Pay Costs among Total Firing Costs (2013)

Source: OECD EPL Index (OECD database), own calculations.

We implement the relative strictness of EPL in the different countries by calculating a *Modified EPL Index* for the labour market model by using version 3 of the EPL Index of the OECD<sup>19</sup> and by weighing the sub-indices for regular and temporary workers by their respective share in the labour market (taken from Eurostat). This modified index is provided in Table 14. Of the countries modelled, Belgium and France feature the highest modified EPL indicator, whereas the value is the lowest for the UK. The labour market model includes both severance payments and administrative firing costs. We calculate the share of severance payments on total firing costs by classifying the costs for the different items of the EPL index according to whether they are associated with severance payments or with administrative costs.

As we have more detailed information on firing costs for Germany based on Grund (2003) and Goerke and Pannenberg (2005), the calibration of firing costs in all countries is implemented relative to these values according to their relative modified EPL index. Using these estimates and the average tenure for each age- and skill-group from the LFS, we derive average severance payments for the different groups. Thereafter, we derive administrative costs as a multiple of severance payments by using the share in Table 14. For sure, this method can only be an approximation, but we think that it is plausible.

<sup>&</sup>lt;sup>19</sup> Compared to version 2, version 3 (which is available from 2008) comprises three additional items related to employment protection.

# 2.10. Unemployment Benefits

The unemployment system is an important part of the public social system, which influences the behaviour of economic agents. According to economic theory, higher unemployment benefits imply positive incentives to participate on the labour market, but negative incentives to search for a job if a person is unemployed. Furthermore unemployment benefits also influence the wage bargaining process between workers and firms as wages in general will rise as a consequence of higher reservation wages if the replacement rate in the unemployment system increases. Unemployment regulations differ among countries to a wide extent. In this chapter we discuss the system country by country, where the information is mainly drawn from the OECD Benefits and Wages publication and the MISSOC database. We focus on the regulations of January 2014. For the calibration of the model, we rely on EU-SILC data as it is not possible to translate institutional regulations one by one into the model. This is due to the fact that institutional regulations alone do not provide information whether a person is eligible for unemployment payments and about the replacement rate as the rate often depends on the length of the unemployment spell or other important aspects.

Furthermore, this chapter provides information on how the variables which reflect the unemployment system in the model are calibrated. These variables are 'xi1', 'brepl' and 'b00'. 'xi1' reflects the share of unemployed persons receiving benefits which depend on labour income before unemployment ('earnings-related benefits'). The other individuals either receive no public unemployment benefits or benefits which do not depend on labour income, like social assistance in most countries. 'brepl' reflects the gross replacement rate in the public or private mandatory unemployment insurance and/or assistance system. If unemployment insurance benefits as well as unemployment assistance benefits depend of prior labour income then 'brepl' reflects both of them and the generosity depends on the shares of persons eligible for unemployment insurance and unemployment assistance (if eligibility differs between these two types, which is usually the case). In general, 'brepl' and 'xi1' are based on EU-SILC data. However, if unemployment insurance is dependent on labour income but unemployment assistance is not, then more information is needed to derive 'xi1' and 'brepl'. This is the case in five of the eight calibrated countries, namely Belgium, Germany, Spain, France and Sweden. Social assistance benefits reflected in 'b00' are not discussed in this chapter and are therefore not included in the values for 'b00' in the following tables. For this reason the values for 'b00' here will differ from the ones which will be found in the 'DataInputXX.xls' files. However, the sources of 'b00' are shown in the 'DataInputXX.xls' files.

To derive the rate of eligibility and the replacement rate we refer to the variable *unemployment benefits PY090G* in the EU-SILC, where *G* stands for gross income. This variable contains the yearly income of a person received from several sources, like full and partial unemployment benefits, early retirement benefits, vocational training allowances, mobility or resettlement benefits, severance payments and other, but excludes family allowances. This income category is broader than required, but no better sources are available. As the income variable represents income received during the

whole year we divide it by the number of months spent in unemployment represented by the variable *PL080* to calculate monthly income. To get rid of very low and very high benefits (which might, for example, be a result of high severance payments), we set very low benefits equal to zero and high benefits to an upper bound. The upper bound is set by visual inspection of the data<sup>20</sup>. Eligibility for unemployment compensation is derived as the number of persons with months spent in unemployment and receiving positive unemployment benefits in relation to the number of persons with months spent in unemployment. The second type of persons includes therefore individuals with no unemployment benefit receipts.

The average monthly unemployment benefit payments and the average monthly income for the different age- and skill-groups allow determining average gross replacement rates for the unemployment period. To derive monthly employee cash or near cash income we divide the income variable *PY010G* by the number of months spent in full- or part-time work (*PL073*, *PL074*).

Subsequently, the unemployment systems in the considered countries are discussed. The rate of eligibility for unemployment payments (total of unemployment insurance and unemployment assistance) as well as the gross replacement rate (weighted average of unemployment insurance benefits and assistance benefits as percent of average gross labour income of the respective ageand skill-group) will be presented in each of the country's sections. The latter are compared to important parameters of the system to check for plausibility.

# Austria

The Austrian public unemployment system is a compulsory insurance scheme for all employees with a monthly earning of more than the so-called 'Geringfügigkeitsgrenze' (monthly minimum income limit) which amounts to EUR 395.31 (2014). For high-income workers, the upper ceiling taken into account is amounting to EUR 4,200. Self-employed persons can insure themselves voluntarily, no such insurance exists for civil servants. To qualify for unemployment benefits, a person must have been in dependent contributory employment for at least one year in the last two years, or 28 weeks in a row in case of a repeated unemployment period. For persons aged below 25, only 26 weeks of employment are necessary to qualify for benefit payments. The duration of eligibility depends on work length and the age of the unemployed persons. It starts from 20 weeks and can be extended to 52 weeks if the unemployed person is aged 50 or more and was employed for at least 468 weeks in the previous 15 years<sup>21</sup>. For specific active labour market programs even longer periods are possible. After the exhaustion of the eligibility for unemployment insurance

<sup>&</sup>lt;sup>20</sup> The lower bound is set to 100 Euro per month in most countries. Lower values are only used for new EU Member States.

<sup>&</sup>lt;sup>21</sup> Since 2011 the duration may be extended to 78 weeks if the unemployed person participates in measures of rehabilitation.

benefits, a person qualifies for unemployment assistance if this person is in need, unemployment assistance is granted for 52 weeks, but can be extended for 52 weeks repeatedly.

Unemployment insurance benefits are based on the average net income in the year before the unemployment spell and amount to 55 percent of this reference income. For low income persons the replacement rate is raised to 60 percent (80 percent in households with dependents) if 55 percent of the reference income is below the supplementary pension amount ('Ausgleichszulagenrichtsatz'). In addition, for each dependent person an extra daily amount of EUR 0.97 is paid. Beneficiaries are allowed to receive work related earnings up to the monthly minimum income limit ('Geringfügigkeitsgrenze') without any consequences for the qualification for unemployment benefits. Unemployment assistance benefits, which are paid after the exhaustion of unemployment insurance benefits, amount to 92 percent of the basic unemployment insurance benefits, or 95 percent for low income groups. Family supplements are also available in the unemployment assistance scheme. Eligibility for unemployment assistance requires that earnings of the spouse do not exceed EUR 624 per month (plus additional EUR 271 for each child).<sup>22</sup> Unemployment insurance as well as unemployment assistance benefits are exempted from income taxation and social security contributions.

In the following, the data from the EU-SILC are presented in Table 15. They show that across all ageand skill-groups eligibility is rather high, so that most of the unemployed persons receive payments. Only for the young low-skilled persons the eligibility rate is lower, which reflects the presence of the required minimum contribution period. The replacement rate seems to be rather moderate, however one has to keep in mind, that no taxes and social security contributions are levied on unemployment benefits as well as on unemployment assistance payments. The much lower rate for older, medium and for high-skilled individuals is also a fact of the tax exemption as well as the upper ceiling in the unemployment insurance.

	Eligibility				Replacement rate			
	Low skilled	Medium Skilled	High Skilled		Low skilled	Medium Skilled	High Skilled	
15-19	50.3%	-	-	15-19	52.8%	-	-	
20-24	70.3%	75.0%	-	20-24	48.2%	35.2%	-	
25-39	81.3%	79.7%	70.1%	25-39	42.4%	36.9%	29.1%	
40-54	83.9%	86.8%	86.3%	40-54	39.8%	30.3%	21.9%	
55-69	88.5%	79.3%	70.9%	55-69	36.7%	25.7%	15.0%	

Table 15: Unemployment Benefit Eligibility and Replacement Rate in Austria

Source: EU-SILC, own calculations.

<sup>&</sup>lt;sup>22</sup> For persons aged 50 (55) these limits are twice (three times) as high.

### Belgium

Unemployment insurance in Belgium is compulsory and pays earnings related benefits (lump-sum benefits for young persons), dependent on the family status. The qualifying period depends on the age of the insured persons and is between 312 working days within the last 21 months and 624 working days within the previous 42 months. The duration of eligibility for unemployment benefits is unlimited as long as an unemployed person provides sufficient search effort for a new job. Accumulation with work-income is possible to a certain extent as long as the activity is *subordinate*. Other income from work reduces benefits proportionally to the number of days worked.

The unemployment system in Belgium distinguishes 3 periods. The first period covers the first year of unemployment. The second period lasts two months extended by additional two months for each year of previous employment. The maximum duration in the second period is 36 months. In the third period, unemployed persons receive a flat unemployment benefit.

In the first, period the replacement rate equals 65 percent of last income in the first 3 months and 60 percent afterwards. Upper and lower ceilings for unemployment benefits are defined. The lower ceiling for cohabitants with dependents amounts to average daily earnings of EUR 43.65, the upper ceiling to EUR 61.66. For single persons and cohabitants without dependents the lower ceiling amounts to EUR 36.66 and EUR 27.49, respectively. The upper ceiling decreases stepwise and amounts to EUR 53.05 after six months of unemployment. In the second period the replacement rate still amounts to 60 percent for cohabitants with dependents, but decreases to 55 percent for single persons (40 percent for cohabitants without dependents). The upper and lower ceilings decrease further stepwise. The flat benefit in the third period amounts to EUR 43.65 for cohabitants with dependents, EUR 36.66 for single persons and EUR 19.37 for cohabitants without dependents.

For young individuals, lump-sum daily benefits are defined, for older workers there exist age supplements. Unemployment benefits are subject to taxation. Social security contributions are 6.5 percent for unemployment benefits above EUR 1,359.10 (2014, 1,637.06 for persons with dependents).

The third period benefit requires to separate unemployment benefits into income dependent benefits ('xi1', 'brepl') and flat benefits ('b00'). We distinguish these two types by the duration of unemployment. Persons searching for a job for more than two years are assigned to the third period, other unemployed persons to the first two periods.

The reason for the division of these types of benefits is the different impact on the incentives of unemployed persons. If replacement income depends on previous labour income, higher wages will induce a higher replacement income, which is not the case for a fixed flat replacement income. For this reason, unemployment benefits are divided into the income dependent unemployment insurance and the income independent unemployment assistance in the model. The same happens for other countries, Germany, Spain, France, and Sweden.

The share of persons receiving unemployment insurance benefits in percent of all unemployed persons is reflected in the policy parameter 'xi1'. The variable 'b00' reflects the income of the other unemployed, including those without benefits eligibility and those who receive unemployment assistance. The policy parameter 'brepl', which stands for benefit replacement, captures the gross replacement rate in the unemployment insurance. These inputs are necessary for countries with an income independent unemployment replacement income. For the other countries only values for 'xi1' and 'brepl' are needed as unemployment insurance as well as unemployment assistance are income dependent.

		xi1				brepl	
	Low skilled	Medium Skilled	High Skilled		Low skilled	Medium Skilled	High Skilled
15-19	17.4%	-	-	15-19	40.2%	-	-
20-24	46.5%	40.3%	-	20-24	33.3%	39.1%	-
25-39	49.9%	61.1%	57.5%	25-39	36.4%	34.7%	34.1%
40-54	49.8%	53.3%	60.4%	40-54	41.2%	38.4%	29.8%
55-69	43.0%	45.4%	43.9%	55-69	45.9%	45.7%	38.1%
	<b>b00 (as</b> )	percent of gross	income)				
	Low skilled	Medium Skilled	High Skilled				
15-19	5.7%	-	-				
20-24	10.7%	6.7%	-				
25-39	19.9%	23.9%	13.1%				

17.9%

18.7%

Table 16: Unemployment Benefit Eligibility and Replacement Rate in Belgium

36.0% Source: EU-SILC, LFS, own calculations.

26.4%

24.6%

29.9%

40-54

55-69

In Table 16, one can find eligibility for income-dependent unemployment benefits ('xi1') and the corresponding replacement rate ('brepl') in Belgium. The replacement rate is lower than the above mentioned 50 to 60 percent, which may be the consequence of the rather small difference between lower and higher ceiling. The increase of the replacement rate for older workers can be the effect of the age supplements. Given that we assign persons searching for a job for more than two years to the third period and that this share on unemployed persons is rather high, 'b00', the flat rate unemployment benefits, are also very important in Belgium as shown in Table 16.

### Czech Republic

In the Czech Republic, persons qualify for unemployment insurance benefits not only in the case of previous employment but also for example in case of rehabilitation. The necessary period of contributions to the unemployment scheme amounts to twelve months within the last two years. The entitlement for unemployment benefits ends after five months as long as the beneficiaries' age is below 50. For persons older than 50 (55) years, the maximum duration raises to eight (eleven) months.

The benefit ratio amounts to 65 percent of previous net earnings (net of tax and social security contributions) in the first two months, 50 percent in the following two months and 45 percent in the remaining months. During retraining of disabled persons the recipient of benefit receives 60 percent of the last net earnings. The maximum benefit equals 58 percent of the national average wage or 65 percent in case of retraining. In case of termination of the last job by the employee or by agreement without valid reason the unemployment benefit shall be set to 45 percent of previous income for the entire support period. Benefits received are not taxable as well as exempted from social security contributions.

Eligibility and the replacement rate for the different age- and skill-groups are presented in Table 17. The eligibility rate is rather low which can be explained by the short benefit duration in comparison to other countries. The replacement rate also seems to be rather low, but one has to keep in mind that the unemployment benefits are not taxable and exempted from social security contributions, which implies a low replacement rate as benefits are related to gross labour income. Compared to net income the rate is considerably higher.

		Fligihility			Renlacement rate		
	Eligibility			Replacement l'ate			
	Low skilled	Medium Skilled	High Skilled		Low skilled	Medium Skilled	High Skilled
15-19	1.0%	-	-	15-19	22.7%	-	-
20-24	14.0%	19.0%	-	20-24	32.3%	30.1%	-
25-39	16.8%	46.5%	30.1%	25-39	25.1%	22.3%	21.3%
40-54	23.3%	42.9%	56.1%	40-54	32.1%	24.6%	16.6%
55-69	37.3%	52.8%	52.2%	55-69	36.0%	30.1%	20.3%

Table 17: Unemployment Benefit Eligibility and Replacement Rate in Czech Republic

Source: EU-SILC, own calculations.

### Germany

In Germany, two types of unemployment benefits are available, unemployment insurance and unemployment benefits II. Unemployment insurance is compulsory and entitlement for benefits lasts between six to 24 months depending on the duration of the contribution period as well as the age of the beneficiary. For eligibility at least twelve months of contribution to the public unemployment system during the last two years before unemployment are necessary. The ceiling for the reference income differs between the new and old Länder, amounting to EUR 5,950 for the new and EUR 5,000 for the old Länder in 2014. If a person receives unemployment insurance benefits, income from part-time work (at most 15 hours per week) reduces entitlement to unemployment benefits. An amount of EUR 165 is not taken into account. After the expiration of the unemployment benefits, unemployed are eligible for unemployment benefit II. This benefit is a

combination of unemployment assistance and social assistance with the aim to increase labour force. Furthermore, unemployment benefit II is needs-based and means-tested.

The replacement rate in the unemployment insurance is 60 percent of previous net earnings, or 67 percent for unemployed with at least one dependent child. Unemployment benefits II is a flat rate, independent of former labour income, but dependent on the number of persons in the household and other social factors. It consists of a standard benefit to secure livelihood, additional needs allowances (e.g. for expectant mothers from the 13<sup>th</sup> week of pregnancy), housing and heating allowance, one-off benefits and insurance contributions. For support of school attendance an additional benefit is paid. The lump-sum standard benefit for a single person amounts to EUR 391 (2014) and between 60 and 90 percent of this value for other household members. Unemployment insurance and unemployment benefits II are exempted from taxation and social security contributions.

		xi1			brepl		
	Low skilled	Medium Skilled	High Skilled		Low skilled	Medium Skilled	High Skilled
15-19	7.3%	-	-	15-19	60.2%	-	-
20-24	21.3%	42.4%	-	20-24	61.3%	60.8%	-
25-39	14.3%	28.9%	42.4%	25-39	63.1%	62.8%	62.1%
40-54	14.8%	27.9%	50.3%	40-54	63.4%	62.5%	62.9%
55-69	27.7%	44.2%	64.4%	55-69	61.8%	61.3%	61.2%
	b00 (as	percent of gross	income)				
	Low skilled	Medium Skilled	High Skilled				
15-19	30.0%	-	-				
20-24	38.3%	15.8%	-				
25-39	32.0%	18.1%	6.5%				
40-54	27.6%	15.9%	6.8%				
55-69	21.2%	10.6%	3.7%				

Table 18: Unemployment Benefit Eligibility and Replacement Rate in Germany

Source: Bundesagentur für Arbeit (Federal Employment Agency), EU-SILC, LFS, MISSOC, OECD, own calculations.

Table 18 provides the calculated values for eligibility for unemployment insurance in Germany for different age and skill-groups, the replacement rate in the unemployment insurance and the average replacement income of persons not eligible for unemployment insurance benefits. The division of unemployed persons into those who receive unemployment insurance and those who receive unemployment assistance or nothing is based on data of the 'Bundesagentur für Arbeit' (Federal Employment Agency), which provides information about unemployment insurance and unemployment assistance for different age groups and educational levels in the annual reports.

The share of unemployed persons receiving unemployment insurance benefits is comparably low, especially for low-skilled persons, for high-skilled unemployed it is markedly higher. In contrast, across the age-groups within the educational groups the difference is rather small. Long-term

unemployment plays an important role in all groups. The replacement rate in the unemployment insurance 'brepl' is calculated by using information about dependents of unemployed persons which can be derived from LFS-data. Using this information 'brepl' is derived as weighted average of 60 percent (for persons with no dependent children) and 67 percent (for persons with dependent children). In the aggregate across the age- and skill-groups the difference is rather minor.

Fixed payments from the unemployment assistance are calculated by using information on dependent children living in the household. Information concerning the amount of unemployment benefits II is drawn from MISSOC and OECD Benefits and Wages and relevant information about other social benefits is provided by the Federal Employment Agency. The corresponding nominal values are then related to the average gross labour income in the age- and skill-groups.

### Spain

The unemployment system in Spain can be characterised as being a system of two types of support, unemployment insurance and unemployment assistance, where the unemployment assistance is granted subsequently to unemployment insurance. In Spain, persons who voluntarily quit their employment do not qualify for unemployment benefits. Eligibility criteria are a minimum of 360 working days in the six years preceding unemployment. Unemployment insurance benefits are paid at most for 720 days, where the duration depends on the number of days contributed to the system within the last six years. The minimum duration amounts to 120 days, subsequently an unemployed person may qualify for unemployment assistance, this benefit is income-tested. To be eligible other earnings in the household must be below 75 percent of the interprofessional minimum wage. The benefit duration for unemployment assistance is between six and 18 months in most cases. Special regulations exist for certain groups and regions.

The unemployment insurance benefit amounts to 70 percent of the reference earnings (average gross earnings over the last 180 days) for the first 180 days and 50 percent afterwards. In addition, there exist minimum and maximum benefits, which are defined as percentage of a defined reference income IPREM.<sup>23</sup> For unemployed persons with no dependent child the minimum amounts to 80 percent, the maximum to 175 percent of the reference income IPREM. For example, two or more children raise the minimum and maximum to 107 and 225 percent. Unemployment assistance amounts to 80 percent of IPREM, but is excluding bonus payment of one sixth for unemployed aged over 55. Unemployment insurance benefits are taxable and social security contributions amount to 4.7 percent (contributions for pension/sickness and invalidity insurance). Unemployment assistance benefits are also taxable, social security contributions do not arise.

<sup>&</sup>lt;sup>23</sup> For 2014 the reference income was set to EUR 532.51 per month.

Table 19 provides the results of the calibration of the Spanish unemployment system. Compared to other countries, eligibility for benefits is rather low, but increases significantly with age. The qualifying restrictions, especially the requirement of involuntary job separation can explain these differences. A relatively large share of all beneficiaries receives unemployment assistance.<sup>24</sup> The replacement rate in the unemployment insurance system 'brepl' is rather constant across age and skill-groups. Only for older unemployed persons it decreases as a result of the maximum benefit like in most other countries. The amount of unemployment assistance income is comparable to other countries, but is an important income especially for older workers as a result of the large share of eligibility.

		XII			DI epi		
	Low skilled	Medium Skilled	High Skilled		Low skilled	Medium Skilled	High Skilled
15-19	0.8%	-	-	15-19	44.3%	-	-
20-24	15.9%	14.0%	-	20-24	44.3%	54.4%	-
25-39	33.5%	32.1%	33.9%	25-39	47.8%	55.5%	50.9%
40-54	30.0%	28.7%	27.7%	40-54	46.6%	52.6%	44.1%
55-69	19.4%	18.6%	16.7%	55-69	37.2%	43.8%	33.2%
	b00 (as	percent of gross i	income)				
	Low skilled	Medium Skilled	High Skilled				
15-19	1.6%	-	-				
20-24	7.5%	6.9%	-				
25-39	11.5%	9.9%	7.6%				
40-54	13.6%	10.1%	6.2%				
55-69	20.4%	14.8%	7.6%	1			

Table 19: Unemployment Benefit Eligibility and Replacement Rate in Spain

Source: EU-SILC, own calculations.

### France

Unemployment benefits in France consist of unemployment insurance and an unemployment assistance, which is paid subsequently. Eligibility for unemployment insurance requires either an involuntary separation from the last job or a quit for good cause. Unemployment insurance benefits are based on previous labour income, whereas unemployment assistance benefits are flat. The qualifying period for unemployment insurance is six months of employment during the last 28 months. For unemployment assistance five years of activity during the last ten years preceding unemployment are necessary. Unemployment insurance benefits are not means-tested. The duration for which unemployment insurance benefits are paid corresponds to the duration of contribution to the system with a minimum of at least four months and a maximum of 24 months (36 months for persons aged 50 and over). Unemployment assistance consists of two different types of payment, the allowance of specific solidarity or the temporary waiting period allowance.

<sup>&</sup>lt;sup>24</sup> Nearly 50 percent in the age group 25 to 54 and more than 70 percent for older workers.

The latter is granted at most twelve months, the former six months, both are renewable such that a much longer duration is possible. Benefits are subject to taxation with no special relief scheme. In addition, social security contributions have to be paid, consisting of 6.2 percent for the generalised social contribution, 0.5 percent for the contribution for the repayment of social debt and 3 percent for complementary pension contributions. In case of unemployment assistance these contributions do not arise.

The unemployment insurance benefits are the maximum of 40.4 percent of the reference daily wages with additional EUR 11.64 per day (at most 75 percent of the daily wage) and 57.4 percent of the reference daily wage. Additional the minimum daily benefit amounts to EUR 28.38 per day. The unemployment assistance pays a maximum of EUR 16.11 per day (30 days per month) in case of eligibility for the allowance of specific solidarity or EUR 11.35 per day in case of the temporary waiting period allowance.

		xi1				brepl		
	Low skilled	Medium Skilled	High Skilled		Low skilled	Medium Skilled	High Skilled	
15-19	8.6%	-	-	15-19	48.8%	-	-	
20-24	24.5%	37.8%	-	20-24	66.6%	53.6%	-	
25-39	34.9%	46.2%	46.5%	25-39	59.2%	65.8%	51.2%	
40-54	39.1%	44.6%	51.0%	40-54	58.0%	63.7%	42.7%	
55-69	43.4%	51.8%	48.2%	55-69	51.6%	55.5%	34.1%	
	<b>b00 (as</b> )	percent of gross :	income)					
	Low skilled	Medium Skilled	High Skilled					
15-19	1.8%	-	-					
20-24	4.7%	7.6%	-					
25-39	10.7%	12.5%	8.3%					
40-54	11.5%	10.2%	7.1%					
55-69	13.3%	11.9%	5.4%					

Table 20: Unemployment Benefit Eligibility and Replacement Rate in France

Source: EU-SILC, LFS, own calculations.

France is among the group of countries with a non-income dependent unemployment assistance scheme which requires the calculation of 'b00'. To proxy the share of persons receiving unemployment assistance benefits of all persons receiving benefits we use the share of long-term unemployed on all unemployed persons, defined as being unemployed for more than one year. Using EUR 16.11 per day or EUR 483.3 per month as basis for unemployment assistance benefits this allows to calculate 'b00' by taking into account the share of unemployed without any unemployment claims on all unemployed individuals. The relatively low level of 'b00' across all age-and skill-groups is also a matter of the comparable low share of unemployed persons with unemployment benefit claims. The policy parameter 'xi1' is derived by using EU-SILC information about eligibility and the share of short time (less than one year) unemployed persons. The replacement rate in the unemployment insurance 'brepl' is calculated by using the average replacement rate of all persons receiving unemployment benefits, 'b00' and the according shares for

unemployment insurance and unemployment assistance. The replacement rate fits very well to the statutory replacement rate of at least 57.4 percent and is similar across age and skill-groups. The values are presented in Table 20.

# Italy

In Italy, unemployment insurance is a compulsory scheme, unemployment assistance does not exist. There are two types of unemployment benefits, which are not means-tested: i) employment social allowance (Assegno Sociale per l'Impiego – ASpI)<sup>25</sup> and ii) mobility benefits. The benefit is available for persons being involuntary unemployed and having matured at least two years of insurance contributions (13 weeks during the 12 months before dismissal in case of Mini ASpI and 12 months in case of mobility benefits). The benefit (AspI) is granted for 8 months for persons under 50, 12 months for 50 to 54 years old and 14 months for persons aged 55 and over. Mini ASpI is granted for half the number of weeks of contributions paid during the last year and the mobility benefits for 12 months for unemployed aged under 40 years, 24 months for unemployed aged between 40 and 50 years and 36 months for older unemployed persons.

Benefits are calculated on basis of average remuneration during the last two years before unemployment with a monthly ceiling of EUR 1,180. The replacement rate in the ASpI amounts to 75 percent of monthly reference earnings below the ceiling and 25 percent above the ceiling. The maximum payable amount is EUR 1,152.90. After six months the replacement rate is reduced to 60 percent and 45 percent after twelve months. The mobility allowance is 5.84 percent lower than the ASpI benefit. All benefits are taxable but not subject to social security contributions.

Eligibility for unemployment benefits and the replacement rates for the different age- and skillgroups in Italy can be found in Table 21. Eligibility for unemployment benefits is low compared to other countries and increasing with age (with the exception of the last age group). Given the maximum benefit criteria the replacement rate is considerably lower than the statutory replacement rate of 75 percent (60 percent after 6 months).

	Eligibility				Replacement rate		
	Low skilled	Medium Skilled	High Skilled		Low skilled	Medium Skilled	High Skilled
15-19	2.9%	-	-	15-19	49.1%	-	-
20-24	17.7%	13.5%	-	20-24	42.6%	39.4%	-
25-39	28.8%	33.3%	22.7%	25-39	40.7%	40.2%	33.8%
40-54	39.8%	37.5%	39.8%	40-54	40.9%	37.6%	29.6%
55-69	33.7%	24.7%	35.5%	55-69	43.5%	25.3%	26.0%

Table 21: Unemployment Benefit Eligibility and Replacement Rate in Italy

Source: EU-SILC, own calculations.

 $^{\rm 25}$  We also include the Mini ASpI in this category.

### Sweden

The unemployment system in Sweden is based on an income related and voluntary unemployment insurance scheme and a flat-rate unemployment assistance, covering those not voluntarily insured. For unemployment insurance a beneficiary must have worked at least 6 months (with at least 80 hours per month) or 480 hours during a continuous period of 6 months (with at least 50 hours each month). In addition, an insured person (employee or self-employed) must be a member of the 'Unemployment Insurance Society' for at least 12 months. The duration of benefits is a maximum of 300 days (450 for persons with dependent children). After the expiration of the benefit, an unemployed person can take part in the *active labour market programme* or in the *job and development guarantee* for additional 450 days.

The gross replacement rate in the unemployment insurance amounts to 80 percent of previous earnings for the first 200 days and 70 percent afterwards. There is also a maximum daily benefit of SEK 680 and a minimum benefit of SEK 320. The benefit is reduced proportionally if the person worked part-time before unemployment. The job and development guarantee pays 65 percent of previous earnings with the same limits. Benefits in the unemployment assistance correspond to a daily flat-rate benefit of SEK 320, the minimum payment in the unemployment insurance scheme. For part-time workers the benefit is reduced proportionally. Unemployment insurance and assistance benefits are taxable, but no social security contributions are deducted.

Although unemployment insurance is voluntary, eligibility for this type of benefit is rather high and increasing with age. Information about membership according to age can be found at the database of the Swedish unemployment insurance board (IAF). This is also mirrored in 'xi1' in Table 22. For younger persons the eligibility is markedly lower. Similar to eligibility, the replacement rate 'brepl' is constant for unemployed aged 25 and above and lower for younger low-skilled persons. The decrease in the replacement rate with respect to the level of education as well as age can be attributed to the maximum benefit level.

The level of the fixed unemployed assistance is calculated by dividing the monthly replacement income of SEK 6,930 by average gross labour income in the different age- and skill-groups. In this calculation also the average number of hours worked in the different groups is taken into account as unemployment assistance depends on the number of hours worked before unemployment. In addition, as also unemployed individuals without any benefits are considered in this calculation as well with a replacement income of zero, 'b00' is very low.

		xi1				brepl	
	Low skilled	Medium Skilled	High Skilled		Low skilled	Medium Skilled	High Skilled
15-19	0.0%	-	-	15-19	67.7%	-	-
20-24	7.3%	9.8%	-	20-24	63.2%	58.0%	-
25-39	32.9%	39.0%	26.2%	25-39	41.6%	45.6%	33.5%
40-54	50.6%	58.3%	46.9%	40-54	38.1%	42.9%	29.7%
55-69	60.5%	68.9%	76.5%	55-69	52.8%	44.5%	35.6%
	<b>b00 (as</b>	percent of gross	income)				
	Low skilled	Medium Skilled	High Skilled				
15-19	0.0%	-	-	1			
20-24	2.2%	2.5%	-				
25-39	2.5%	3.1%	1.6%				
40-54	2.1%	2.5%	1.2%	1			
55-69	1.4%	1.9%	2.1%	1			

Table 22: Unemployment Benefit Eligibility and Replacement Rate in Sweden

Source: EU-SILC, LFS, MISSOC, OECD Benefits and Wages (hyperlink), own calculations.

# 2.11. Pension benefits

Pension systems play a major role in providing social security in the Member States. The systems in the various countries differ significantly, not only with respect to their generosity, but also in the breakdown between public and private pension provision and other institutional details. In many European countries, the pension system is basically a public PAYG system, but several countries also have pension benefits financed by tax revenues, a funded pillar that is often managed privately or occupational pension systems. Many countries are characterized by a mix between these different pillars. One should keep in mind, however, that even if a pension system is managed privately to a large extent, governments still play an important role by setting a regulatory framework or by subsidizing private saving.

This short overview of pension systems in the calibrated countries is primarily based on OECD's 'Pensions at a Glance' (2015a), which provides information on country-specific settings for the year 2014, and the MISSOC database of the European Commission. We do not intend to give a complete picture of pension schemes. Instead, we will provide a basic overview of the systems and present information which is important for setting parameters in the model.

Many countries have reformed their systems in recent years, often intended to improve sustainability of pension systems. These reforms are accompanied by transition periods between the 'old' and the 'new' system. As a basic rule, we model the new system which is in place after the period of transition has ended. In our view, this approach ensures an adequate illustration of labour market incentives for those individuals currently participating on the labour market. In order to reflect higher current expenditures of the government and household income, we top up these pension benefits by flat (non earnings-related) pension benefits.

Given some standard assumptions that we also apply in the model (such as perfect foresight and perfect capital markets), funded pension systems could be seen as perfect substitutes to private savings. Under these assumptions, private households will reduce private savings one-by-one if contributions in the funded system increase. In addition, as for example shown in Keuschnigg (2005), a funded system does not distort labour market incentives under these conditions. One could therefore neglect modelling funded pension systems. Nevertheless, our approach is to include mandatory funded pension systems in the model as the government treats pensions quite differently than private savings in some of the countries.

# Austria

Austria runs a compulsory pension scheme providing earnings-related pension benefits, to a large part financed by contributions of employees and employers, with a means-tested top-up for low income retirees. Statutory pension age is 65 for men and 60 for women, but the pension age for women will gradually increase to 65 until 2033. 180 months of insurance within the last 30 years or 300 months during the entire lifetime are necessary to qualify for a pension benefit. Alternatively, 180 months of contributions actually paid are sufficient.

Benefits are determined by the amount of income, the duration of insurance and the age of application. The pension benefit currently accrues at 1.78 % of the calculation base (gross income), more generous older arrangements are transferred to the new system as a start value to the so-called pension account. Contributions are payable up to a ceiling of a yearly income of EUR 63,420 (2014). Past earnings are revalued according to wage growth. Periods in which an individual receives unemployment benefits or assistance are treated as number of pensionable years and entitlements are based on 70 % of the last gross labour income before unemployment (64 % in case of receiving unemployment assistance). In principle, the law envisages that pension payments are indexed to inflation.

In general, early retirement is currently possible three years before the statutory retirement age, under the condition of 37.5 years of contributions and credits ('Korridorpension'). For each year of retirement before the regular pension age, benefits are (under certain circumstances) reduced by 5.1 %. An incremental factor of 4.2 % applies to deferred retirement per year between 65 and 68, but there is no additional increment thereafter. In addition, certain groups benefit from other, more beneficial, types of early retirement.

Disability pensions play an important role in Austria. The benefit is mainly dependent on previous labour income. Recently, the disability pension scheme has been reformed on the basis of the philosophy 'Rehabilitation and Prevention before Pension'.

### Belgium

Belgium has an earnings-related public pension scheme with a minimum pension and a meanstested safety net. The statutory retirement age is 65, both for men and women. Drawing a full pension requires a full career of 45 years. The mandatory public system is complemented by voluntary private pension schemes.

Earnings-related pension benefits are based on lifetime income. The annual accrual rate depends on the family status. It is 0.6/45 for a single or a married person without dependent spouse, whereas it is 0.75/45 for a married person with dependent spouse (in case that applying the single accrual rate for both spouses is less advantageous). The ceiling of yearly pensionable earnings was EUR 52,973 in 2014. Basically, earlier years' earnings are revalued in line with prices.

Under certain conditions, non-contributory periods, such as certain periods of career interruption or maternity leave are also credited. Periods of unemployment with eligibility for insurance benefits are also credited. These credits are initially based on earnings prior to the period of unemployment but subsequently (starting with the so-called '3<sup>rd</sup> period') based on the 'minimum annual credit'. According to the OECD, pensions in payment are indexed to a consumer price index (which excludes some goods), but some discretionary adjustments have been made recently.

From 2016, early retirement with the age of 62 will be possible if 40 years of contributions have been reached. There is no actuarial reduction of pension benefits but they may be lower due to incompleteness of insurance years. According to the OECD, deferment of retirement after the normal retirement age is possible and can be used to close career gaps and to obtain higher pension benefits. Disability pensions cover workers who, as a result of sickness or infirmity, cannot earn more than one third of the normal earnings of a worker in the same category. The benefit is dependent on the family situation and foregone earnings.

#### Czech Republic

The public pension system in the Czech Republic has a basic element and an earnings-related part and is complemented by voluntary private pensions. Statutory retirement ages of men and women are gradually increasing over time. As the pension age of women is increasing faster, it will be unified with that of men in 2019. Minimum requirement for the eligibility of pension benefits will gradually increase to 35 years (or 30 years without non-contributory periods) but under certain conditions individuals can receive pension benefits with lower contributory periods five years later than the statutory retirement age.

The basic pension benefit was CZK 28,080 (EUR 1,020) per year in 2014. The assessment base for the earnings-related benefit is starting from the calendar year after reaching the age of 18. In principle, the accrual rate in the earnings-related part is 1.5 percent. However, not all earnings are

included in the assessment base. Income is incorporated by 100 percent up to monthly earnings of CZK 11,415 (EUR 415) and by much lower values above that figure. Earlier years' earnings are revalued by the growth of economy-wide average earnings.

Several non-contributory periods, such as child care, education or invalidity are taken into account for the calculation of benefits. Periods of earnings-related unemployment insurance benefits as well as unemployment spells without entitlements (for a certain period) are credited. According to the OECD, the unemployment period credited is reduced to 80 percent of the actual spell of unemployment. Pension benefits in payment (the two types) are indexed to prices plus one third of real wage growth.

Under certain conditions, it is possible to retire three years before the statutory retirement age. The actuarial adjustment for early retirement is 3.6 accrual points per year in the first 360 days of early retirement, 4.8 points in the next 360 days and 6 points thereafter. Deferment of pension claims is credited by an actuarial adjustment of pension benefits of 6 points per year. In the pension system, disability is handled within three different degrees of invalidity. Disability benefits consist of two elements: a basic amount and an earnings-related part based on average earnings and the years of insurance.

# France

The French pension system for private sector employees has two tiers: a defined benefit public pension scheme and mandatory occupational schemes. Additionally, the public system features two kinds of minimum pensions. The minimum legal pension age for the earnings-related pension is currently increasing to 62 years.

The public pension targets a replacement rate of 50 % after a full career, each missing quarter of a year of contributions reduces the pension pro rata. Benefits are calculated on the basis of the 25 years of highest earnings, where earlier years' earnings are valorised in line with price inflation. In 2014, the ceiling for eligible earnings was EUR 37,548. Periods of unemployment are credited for the state pension if unemployment benefits are received, but these periods will not be part of the 25 years of highest earnings. There are also credits for the first period of unemployment without unemployment payments. Benefits in payment are indexed to price inflation.

There are different occupational schemes in place. In line with the OECD, we focus on the ARRCO scheme here, which covers the majority of private-sector employees. Below the social security ceiling (EUR 37,548), claims accumulate for 6 % of earnings, whereas they accumulate for 16 % of earnings between the ceiling and three times the ceiling. The number of points earned per year is determined by the value of these contributions and the costs of a point (EUR 15.2589 in 2014). At retirement, the accumulated points are converted into benefits by multiplying them with the value of a pension point (EUR 1.25 in 2014). Uprating of the costs and the value is agreed between the

social partners. Following the approach of the OECD, we assume that this implies an increase of the costs of a point in line with earnings and of the value in line with prices. This uprating policy affects both indexation of pensions in payment and uprating of earlier years' earnings. Periods of unemployment entitle to pension benefits in the occupational system if the person had contributed to one of the plans prior to the unemployment period.

Early retirement is possible under certain conditions in the public scheme. In the occupational schemes, early retirement is possible as well, subject to deductions depending on the age and/or the years of contributions. If individuals retire later, they continue to increase pension benefits. According to MISSOC, disability benefits are provided to persons who, as a results of sickness or infirmity, can no longer earn more than one third of the normal earnings of a worker in the same 'category, training and region'. The benefit is dependent on the salary during the ten years with the highest income and the amount of incapacity.

### Germany

The pension system in Germany is an earnings related PAYG-system with a social-assistance safety net for low-income pensioners. Pension eligibility requires at least five years of contributions. The statutory retirement age is gradually increasing to 67 in the next decades. There is a complementary voluntary private pension system ('Riester-Rente').

The valuation of individual contributions is dependent on personal income relative to average earnings: if a worker earns average income, she earns one point in the public pension system. In 2014, employees contribute up to a ceiling of EUR 71,400 of gross yearly wage earnings (resp. EUR 60,000 in the new Länder). At retirement age, accumulated points are multiplied by the value of a point. In January 2015, the yearly value of one point was EUR 343.32 (resp. EUR 316.68 in the new Länder).

During the first period of unemployment, entitlements are earned on the basis of 80 % of previous gross earnings. If unemployment benefit II ('Arbeitslosengeld II') is paid, there are no financial contributions to the pension scheme, but the time period is accounted for ('Anrechnungszeiten'). In principle, pension payments are indexed to gross wages. However, there are additional factors that usually result in lower indexation.

Early retirement is possible from an age of 63 (this requires 35 years of contributions). In this case, deductions of 3.6 percent per year of earlier retirement are applied. In addition, there are several other possibilities to retire earlier without penalties. Each year of deferred pension benefit after the statutory retirement age leads to an increment of six percent. Disability pensions are paid in case of reduced earnings capacity. This pension is paid until an age of 65, normal old-age pension being paid afterwards.

### Italy

The new Italian pension system is based on notional accounts and applies in full to labour market entrants from 1996 onwards. The legal retirement age will increase in line with life expectancy at 65. Currently (in 2015), it ranges from less than 64 years to more than 66 years, depending on gender and occupation.

The contribution-based regime is financed by a rate of 33 percent, of which around one-third is paid by the employee and two-thirds by the employer. The yearly salary ceiling was EUR 100,123 in 2014. The pension benefit is calculated as a product of lifelong contributions (past contributions are valorised with the nominal GDP growth rate) and a transformation coefficient. The transformation coefficient is available for the age of 57 to 70, but workers are not allowed to retire if they have not reached eligibility. The coefficient is mainly determined by the probability of death, by the probability of leaving a widow or widower and the expected number of years that a benefit will be withdrawn. It is possible to defer pension benefits after age 65 and a higher transformation coefficient ensures that benefits increase to achieve actuarial adjustment.

Non-contributory periods of illness, maternity, military service, unemployment and the receipt of redundancy pay are credited in the public pension system. Unemployment spells give rise to credited contributions that are based on previous earnings. The indexation of pension payments is rather complex. Benefits below a threshold have full price indexation, higher pensions are only partly indexed to a so-called 'cost-of-life' index.

Invalidity allowances cover workers whose earning abilities are permanently reduced to at least two thirds as a result of sickness or infirmity. Incapacity pensions are payable to persons who are absolutely and permanently incapable of any occupational activity. Benefits are determined by reference earnings and the number of insurance years.

### Spain

The public pension system in Spain consists of an earnings-related benefit (with a means-tested minimum pension) and a non-contribution means-tested benefit. Statutory retirement age will gradually increase from currently 65 years both for men and women to 67 years in 2027, unless an individual has at least 38.5 years of contributions. In order to qualify for a contribution-level pension benefit, 15 years of contributions are necessary.

The earnings base for the calculation of the pension benefit will be average earnings over the last 25 years (currently, it is 17 years) with earnings valorised with prices (apart from the last two years). The contribution ceiling was EUR 43,164 in 2014. Benefits accrue according to a schedule so that maximal accrual of 100 % is reached after 37 years of contributions, a rate of 50 % is valid after 15 years (and in between, each additional month of contributions increases the accrual).

Several non-contributory periods such as parental leave or leave to take care of relatives are credited. During periods of receipt of unemployment benefits, the government takes over the employer's contributions and the worker pays employee's contributions to the pension insurance scheme. Contributions are based on previous earnings. Periods of unemployment assistance are not credited except for individuals aged 55 years or older. Pension benefits in payment are indexed according to a new adjustment index calculated according to a number of different factors.

Early retirement is possible in Spain, the conditions depending on whether unemployment is involuntary or voluntary. Actuarial reductions of pension benefits vary from 6 % to 8 % per year depending on the length of contributions. There's also partial retirement. Deferred retirement is also possible but the increase of the benefit is less pronounced. Disability pensions are dependent on the degree of incapacity and previous earnings.

#### Sweden

The Swedish public pension system consists of an earnings-related part based on notional accounts and a smaller mandatory defined-contribution funded pension system. There is also an income-tested top-up, the 'guarantee pension'. Furthermore, quasi-mandatory occupational pension plans cover almost 90 % of employees.

Contributions of 18.5 % of pensionable earnings (which corresponds to an effective contribution rate of 17.21 % of gross earnings) are credited on the accounts. Whereas 14.88 % of earnings are devoted to the notional-accounts system, 2.33 % are paid to the funded pension scheme. Contributions are levied up to a ceiling of pensionable income of SEK 424,500 in 2014.<sup>26</sup> In the *earnings-related part*, earlier years' contributions are uprated with a three-year moving average of average earnings. The earnings-related pension benefits are calculated by dividing the total amount of accrued pension rights of the earnings-related part by an annuity factor. For the *defined contribution system*, individuals can choose between an annuity to avoid investment risk and a variable annuity where funds continue to be invested. In the labour market model, we assume that funds are paid as annuities indexed to price inflation.

In addition, there are four major *occupational schemes* in Sweden that are estimated to cover almost 90 % of employees. We follow the OECD by modelling ITP1, a defined-contribution plan. The contribution rate is 4.5 % of salary for an income up to 7.5 *income base amounts* (~ SEK 425,000 for 2014) and 30 % of additional income above that value.

<sup>&</sup>lt;sup>26</sup> Employer contributions are also only paid up to the ceiling, but there is an additional tax on earnings above the ceiling which has exactly the same tax rate.

Several non-contributory periods are also credited for pension entitlements. Unemployment benefits (and training allowances to unemployed individuals) are also pensionable income, in which case the government takes over the employer's contribution. Earnings-related pension benefits in payment are indexed with average earnings growth less an imputed interest rate of 1.6 %.

There is no fixed retirement age in the public pension scheme. Retirement is possible from 61 and there is no upper age limit. The pension system includes an automatic actuarial reduction of benefits for early retirement. The income-tested guarantee pension, however, cannot be claimed before the age of 65. Disability pensions are dependent on the three highest gross annual incomes during a certain period before the time of disability and on the degree of incapacity. For persons with low pension income, there is also a guaranteed compensation.

### Aggregate Pension Expenditures as in the LMM

Aggregate pension expenditures as in the LMM are shown in Table 23. It must be noted, that these numbers can deviate strongly from expenditures published by the OECD as we include some expenditure items (such as occupational pension systems) that are in force in the LMM but are not included in OECD pension expenditures (see also the description above and the Appendix B.1.2). Pension expenditures in LMM vary widely among the modelled countries. They range from 8 percent of GVA in the UK to nearly 20 percent of GVA in Denmark.

Country		Country	
Belgium	13.8	Netherlands	14.6
Czech Republic	10.8	Austria	16.4
Denmark	19.5	Poland	13.9
Germany	12.3	Slovakia	9.5
Spain	11.9	Finland	14.3
France	18.6	Sweden	12.1
Italy	16.9	United Kingdom	7.9

Table 23: Pension Expenditures as in the LMM in Percent of GVA, 2011.

Numbers shown here may deviate strongly from expenditures published by the OECD as we include expenditure items (in particular occupational pension systems) as in force in the LMM but not included in OECD pension expenditures. Source: OECD Database, own calculations.

# 2.12. Other social benefits

In addition to public unemployment and pension insurance, other social benefits are available for private households in the modelled countries. The main database used for the division of benefits in different age- and skill-groups is EU-SILC. Given the availability of data the following cash transfers are reflected:

- Education allowances
- Sickness benefits
- Family allowances
- Social exclusion
- Housing allowances

Some of them are defined on an individual level (education allowances, sickness benefits), whereas the others are defined on a household level. Benefits which are only available on a household level are divided upon the household members for the calibration of the model in the following way. Each person in the household aged 25 or older and each person of a lower age whose mother and father are not members of the household, receive the same share of the total household benefit. This means that these benefits are divided equally upon this group of persons in the household. The level of aggregate expenditures is largely based on information of the OECD *Social Expenditure Statistics*.

Data of the EU-SILC about education allowances needs to be modified for the model as education is ongoing for younger age-groups. Without adjustment the share of allowances granted would be too high for low- and medium-skilled persons whereas high-skilled persons would only receive grants with a finished tertiary education. For this reason we divide education allowances for 15 to 19 years old persons according to the population share in the model between medium- and high-skilled persons. For 20 to 39 years old persons we assign all benefits to high-skilled persons. For older age-groups we use the data directly without any corrections.

Sickness benefits are assigned only to employed persons or persons receiving unemployment benefits. In addition we assume that the amount paid to employed and unemployed persons is the same. Sickness benefits are reflected in the model in the variables 'zw' and 'zu' as well as 'b00', which reflect fixed transfers if a person is employed or unemployed. 'zu' includes sickness benefits for unemployed persons receiving income-dependent unemployment benefits, 'b00' includes sickness benefits of unemployed persons receiving wage-independent benefits.

Benefits for social exclusion are divided between three groups of persons, namely persons in retirement, persons not participating on the labour market<sup>27</sup> and persons in unemployment. This division is based on EU-SILC data by using information about how many months a person spent in these states. Only persons spending the entire year in one of these states and with positive social exclusion benefits are considered for the model. This may distort the result to some extent but will, in our opinion, lead to a more trustworthy result than dividing income arbitrarily by counting all persons receiving social assistance. Social exclusion benefits for retired persons enter the model as

<sup>&</sup>lt;sup>27</sup> Reflected by months spent disabled or/and unfit to work (PL086), studying (PL087), fulfilling domestic tasks and care responsibilities (PL089) or in other activity (PL090).

lump-sum payments to private households. Benefits for inactive persons are included in 'ynonpar0' and benefits for social exclusion for unemployed persons are included in 'b00'.

Information about the age- and skill structure of social expenditures is based on the EU-SILC. Total expenditures for the different social expenditure categories are provided by the OECD Social Expenditure Dataset and are used to scale benefits derived from the EU-SILC. Although EU-SILC also provides information about total expenditures by aggregating individual or household data, small sample sizes may lead to an imprecise approximation of total expenditures. However, education allowances are directly taken from EU-SILC as the OECD Social Expenditure Dataset does not provide any information about this type of allowance. Total expenditures for educational allowances in percent of GVA for the modelled countries are shown in Table 24. There are significant differences in total expenditures. In the Northern countries, the values are significantly higher than in the other countries.

	Education allowances
Belgium	0.06%
Czech Republic	0.02%
Denmark	1.21%
Germany	0.17%
Spain	0.11%
France	0.06%
Italy	0.09%
Netherlands	0.44%
Austria	0.12%
Poland	0.05%
Slovakia	0.06%
Finland	0.44%
Sweden	0.94%
United Kingdom	0.17%

Table 24: Total Expenditures for Education Allowances in Percent of Gross Value Added

Source: EU-SILC, Eurostat, own calculations

For the other categories of social expenditures, aggregate public expenditures are based mainly on information provided by the OECD.<sup>28</sup> An overview about total public expenditures in percent of GVA is presented in Table 25. These numbers include cash transfers as well as in-kind benefits. We deviate from the OECD aggregates for some countries. In Denmark public expenditures for income maintenance according to the OECD amount to 1.18 percent of GVA, whereas EU-SILC data do not contain any income of the households from this source. As discussed below in the country section,

<sup>&</sup>lt;sup>28</sup> Detailed tables are available up to 2011.

eligibility for income maintenance in Denmark requires persons to be eligible for the labour market. For this reason, this type of household income may be captured in the unemployment income instead of social exclusion income.<sup>29</sup> Therefore, we set total public expenditures for income maintenance equal to zero. For Italy and UK, the OECD database does not report expenditures for income maintenance. For this reason we use expenditures provided by the EU-SILC. For the UK, we deduct these expenditures from housing assistance assuming a different classification in the OECD data. After deduction, expenditures for housing assistance according to the OECD and the EU-SILC fit very well.

	Daid sick loavo	Family	Housing	Income
	Falu SICK leave	allowances	assistance	maintenance
Belgium	0.70%	2.06%	0.26%	0.75%
Czech Republic	0.50%	1.14%	0.16%	0.13%
Denmark	0.99%	1.97%	0.86%	0.00%
Germany	0.37%	1.40%	0.73%	0.17%
Spain	0.97%	0.57%	0.24%	0.12%
France	0.57%	1.76%	0.93%	0.55%
Italy	0.20%	0.78%	0.02%	0.06%
Netherlands	0.99%	0.79%	0.42%	1.28%
Austria	0.25%	2.37%	0.11%	0.27%
Poland	0.85%	0.91%	0.07%	0.06%
Slovakia	0.47%	1.89%	0.00%	0.46%
Finland	0.56%	1.84%	0.60%	0.56%
Sweden	0.82%	1.72%	0.52%	0.65%
United Kingdom	0.17%	3.10%	1.35%	0.46%

Table 25: Total Public Expenditures in the Model for Different Social Events in Percent of GVA

Source: OECD.Stat, own calculations.

In the following we describe the different systems for family allowances, housing allowances and social exclusions in the modelled countries.

### Austria

In Austria, two types of social assistance exist, the needs-oriented guaranteed minimum resource (bedarfsorientierte Mindestsicherung) and the supplementary pension (Ausgleichszulage). The latter one is paid to retirees or persons incapable of working to guarantee a minimum income. The needs-oriented guaranteed minimum resource is granted at the regional level and differs between regions. The transfer in Vienna amounts to EUR 794.91 (2013) per month for a single person, EUR

<sup>&</sup>lt;sup>29</sup> This seems to be confirmed by the fact that eligibility for unemployment benefits differs significantly between information based on the LFS and the EU-SILC. Eligibility according to the EU-SILC is much higher than according to the LFS.

1,192.36 for a couple and 214.63 for a child. The amount also contains a 25 percent share for the housing rent. Persons receiving the benefit have to be available for taking up a job. General assistance entitlement depends on household resources, i.e. it is means- and income-tested. The benefit is not taxable and not subject to social security contributions.

The system of housing benefits is rather complex in Austria. The amount of benefit depends on the region. In Vienna, for example, there exist three types of housing benefits, the 'Mindestsicherung-Mietbeihilfe', the 'Wohnbeihilfe', and 'Mietzinsbeihilfe'. The rent allowance ('Mietbeihilfe') is provided to persons with means-tested minimum income and persons with low pension benefits. The maximum rent allowance for 1 or 2 persons in a household amounts to EUR 297.09 (2013) per month up to EUR 347.46 for seven or more persons in a household. 'Wohnbeihilfe' subsidizes housing costs to the amount of the difference between countable housing expenditures and reasonable housing expenditures. Benefits are not taxable.

The main family benefits are the child benefit ('Familienbeihilfe') and the child-raising allowance ('Kinderbetreuungsgeld'). The child benefit is paid for families with dependent children and is differentiated with respect to age and the number of children. The benefit amounts to EUR 105.40 per month for a child below the age of three, EUR 112.70 for a child up to the age of ten, EUR 130.90 up to the age of 19 and EUR 152.70 up to the age of 24 (in general). If there is more than one child, a supplement is paid, amounting to EUR 12.80 for the second child, EUR 47.80 for the third child and EUR 50 for the fourth and further children. In addition, for three or more children an additional increase of EUR 20 per month and child is granted. In September, EUR 100 are granted for children between 6 and 15 to cover schooling costs. Family benefits are not taxable and are not meanstested. In combination with the child benefit a payable tax credit amounting to EUR 58.40 per month and child is granted.

Besides the child benefit also childcare is granted. From 2009 on, expenditures for childcare are taxdeductible up to an amount of EUR 2,300 per year. Additionally, parents can claim a childcare allowance ('Kinderbetreuungsgeld'), which is granted for child-raising reasons. Five options are available differing by the length of payment and whether the benefit is income-dependent or not. The longest option pays benefits up to 30 months, the middle options between 15 and 20 months and the shortest option for 12 months.<sup>30</sup> The benefits for these versions vary between EUR 14.53 daily and EUR 33 daily. The income-dependent variant requires employment prior to benefit eligibility. There exists a ceiling for additional yearly earnings amounting to EUR 16,200. The childcare allowance is not taxable. Lone parents and married couples on low income can apply for a supplementary allowance amounting to EUR 6.06 per day.

<sup>&</sup>lt;sup>30</sup> If the other parent also engages in child-care activities, the length is increased by a fifth.

### Belgium

Social assistance in Belgium, called integration income, is an individual right and paid to persons who prove willingness to work. Eligibility requires an age of 18 (different rules for special cases). The amount of the integration income depends on the family situation and is means-tested. A person living alone receives EUR 817.36, a single parent or couple EUR 1089.82 and a cohabitant EUR 544.91. Family benefits are granted in addition to the minimum. Benefits are not taxable and not subject to social security contributions. For persons aged 65 or above, there exists the 'Guarantee of Income', which is means-tested. It amounts to EUR 1011.70 for a single person per month and EUR 1348.92 for a two-person household.

Direct housing benefits are not available, but there exist schemes to assist the access to property as well as measures providing social housing dependent on income. The child benefit is granted to the active population (also including persons receiving integration income) with an age limit of the child of 18 years (25 years in case of vocational training or further education). The monthly amount for the first child is EUR 90.28, for the second EUR 167.05 and for the third and subsequent children EUR 249.41. For single parents whose professional or replacement income is below EUR 2,230.74, a supplement of EUR 45.96 for the first child is paid, decreasing to EUR 22.97 for the third and subsequent children. In addition, a monthly age supplement (ranging from EUR 15.73 to EUR 27.60) and a yearly age supplement (ranging from EUR 27.60 to EUR 110.42) are paid, depending on the age of the child.

Parental leave benefits are paid to persons leaving the labour market for child-raising reasons (maximum four months in case of interrupting a full-time job, 8 months in case of a half-time job). To be eligible a person has to be on leave from the time of childbirth on and before the child reaches the age of twelve. The benefit amounts to EUR 771.33 (EUR 654.17 in case of half-time interruption) in case of a previous full-time job and a total interruption. For persons in previous part-time employment the amount is reduced proportionally. In addition, birth and adoption grants can be claimed. For the first birth EUR 1,223.11 are paid and EUR 920.25 for all subsequent births. Family allowance and birth grant are not subject to taxation, but parental leave benefits are taxable (but no social security contributions).

#### Czech Republic

The social assistance or living allowance provides support for citizens who are in need for assistance (means-tested) and the overall social and economic situation prevents a person or family from increasing income from work. It includes social services and cash benefits. In case of unemployment, the person has to be registered with the public employment service. A supplement for housing is granted for persons or families not being capable to cover housing costs. To be eligible for the housing supplement the family must either be entitled to the living- or to the housing allowance (see below). The amount of the housing supplement is determined by how much

the difference of income and living minimum covers reasonable housing costs, which include rent, services related to housing and energy costs. The living minimum amounts to CZK 3,410 for a single person, CZK 3,140 for the first person in a household and CZK 2,830 for the second and further adults in the household. The minimum for a dependent child lies between CZK 1,740 (under 6 years) and CZK 2,450 (15 to 26 years old). The subsistence minimum is available for persons who are out of work for more than 6 months and amounts to CZK 2,200. Social assistance benefits are not taxable.

The housing allowance supports low-income households to cover housing expenditures. Eligibility requires that 30 percent of the household income is not sufficient to cover housing costs and that 30 percent of the household income is lower than the *prescriptive* housing costs. The allowance does not cover total housing costs. It is derived as the difference between the prescriptive housing costs and 30 percent of the relevant household income. If actual housing costs are lower than the prescriptive housing costs, the actual costs are used for the calculation.

Family benefits consist of the child allowance, the parental allowance and a birth grant. The child allowance is provided to children up to the age of 15 and longer if a child invests in full-time education up to an age of 26. Entitlement requires that family income is below 2.4 times the family's living minimum. The child allowance amounts to CZK 500 per month for a child below the age of six, CZK 610 between six and 15 years and CZK 700 for an older child. The parental allowance is granted to a parent who provides full-time and regular care for the youngest child. The allowance is provided until the total amount of CZK 220,000 is drawn or the child reaches the age of four. A parent may choose the monthly amount within limits and therefore the length of the allowance if at least one parent in the family is insured against sickness. Otherwise it amounts to CZK 7,600 for the first 10 months and CZK 3,800 afterwards.

The birth grant is related to the first born child and only to families whose income does not exceed 2.4 times the family living minimum. The amount of the birth grant is CZK 13,000. A higher amount is paid to families in case of multiple births. All three benefits are not taxable.

#### Germany

Social assistance (Arbeitslosengeld II) in Germany is discussed in chapter 2.10. Housing benefits are disposable for persons with low income and high rent. Persons receiving 'Arbeitslosengeld II' or a needs-based pension supplement in case of old age are not eligible for housing benefits as the benefits already include a benefit for housing costs. The housing allowance is determined by the size of the household, eligible income and housing costs by using a rather complicated formula. Eligible income is linked to taxable income expanded by several non-taxable income components to reflect net disposable income of the household.

Family benefits consist of the family tax credit ('Kindergeld'), the parental allowance ('Elterngeld'), the child care allowance ('Betreuungsgeld') and the supplementary child allowance. The family tax credit is granted to children up to the age of 18 (21 in case of unemployment) or 25 in case of education. The tax credit is independent of the income and rewarded as negative tax if the tax liability of the person who cares for the children is lower than the credit. The credit amounts to EUR 184 per month for the first and the second child, EUR 190 for the third and EUR 215 for the fourth and subsequent children. The parental allowance is granted to persons who take care for their children and work at most part-time. It amounts to 67 percent of net labour income between EUR 1,000 and EUR 1,200 before the birth of the child. For higher income it decreases to 65 percent. The allowance is granted at most for the first 14 months after birth of the child. If only one parent applies for the grant then it is paid for 12 months. The child care allowance is granted to mothers or fathers, who are not claiming early childhood education, care in a day-care institution or day nursery. It is independent of the labour market status of the parents. Entitlement exists from the day the child turns 14 months old until it reaches the age of 36 months. The allowance amounts to EUR 150 per month. For several children fulfilling the requirements a multiple entitlement is possible. The supplement child allowance is available for persons being able to finance their own living costs, but who do not have sufficient resources available for their children. The allowance depends on the income of the family, the rent and additional needs and will be at most EUR 140 per month and child. Benefits are tax exempted and no social security contributions are obliged. The parental allowance is subject to progression.

### Spain

The social assistance scheme 'Ingreso Minimo/Renta Minima de Insercion' (MII) is implemented on the regional level, following the principle to alleviate poverty by cash benefits. On average, the basic amount of MII is EUR 420.55 per month, the amount for the second and further persons is considerably lower (e.g. in Madrid the supplement for the second earner is set to EUR 112.67 and EUR 75.11 for the third person). The claimant must actively search for a job. Eligibility requires a minimum age of 25 (less in certain regions) and a maximum age of 64. Older persons receive an oldage pension. If a person participates in social and labour measures an income supplement is paid. Qualifying households will have to pass an income-test. The benefit is taxable.

Housing benefits are granted at a regional level, if there is a grant at all. A tax credit for housing expenses exists at the national level. Child benefits are available for dependent children (under an age of 18, or older if disabled) and for multiple birth or adoption (one-off lump-sum payments). The child benefit is granted if yearly income is below EUR 11,519.16 (higher amounts for large families). The economic allowance amounts to EUR 24.25 per month and child. Benefits for disabled children depend on the degree of handicap (EUR 83.33 for a degree of 33 percent or more for children below 18, EUR 365.90 for a child above 18 and a degree of handicap of 65 percent or more, and EUR 548.90 for a degree of 75 percent and more). The multiple birth grant for a birth or adoption

amounts to EUR 2,581.20 for 2 children and raises to EUR 7,743.60 for four and more children. In addition, large families, lone parent families or disabled mothers receive an additional amount of EUR 1,000. Family benefits are not taxable.

### France

Social assistance in France is an individual right, taking into account the family situation, implying that a differential amount is paid. Persons are eligible if they are at least 25 years old (younger if a child is supported or the person is pregnant). There is also a connection to the labour market, as the person must be willing to perform training, integration or employment activities. The Guaranteed Minimum Resources (RMI) is determined at the national level. The income-test includes earnings from activities, interest from property and so on. RMI amounts to EUR 499.31 for a single person (single parent family with 1 child EUR 854.89, couple with two children EUR 1,048.55). The amount includes family benefits. Special schemes exist for elderly and disabled persons. The benefits are taxable.

The housing allowance is available for families who receive one of the various forms of family allowances (see below). For the calculation of the allowance the rent (upper limit) and the family situation as well as the resources of the family are taken into account. It can be higher for beneficiaries with low income.

Several family benefits exist in France. The Child benefit is granted for children up to the age of 20 as long as the income of the child is less than 55 percent of the minimum wage and it is paid only if there are two or more children. The benefit amounts to EUR 129.21 for two children per month and rises up to EUR 791.42 for six children. Each further child is granted with EUR 165.55. There is no income-test for this benefit. For children over 14 years, a supplement of EUR 64.61 can be claimed and a flat rate allowance of EUR 81.70 for one year for large families is granted.

The Infant Welcome Benefit consists of two parts. One part of the benefit is granted for a birth or adoption and a second for the child education choice or child care choice. The Birth or Adoption Grant amounts to EUR 927.71 from the seventh month of pregnancy or EUR 1,855.42 for the adoption. The benefit is means-tested. In addition, the Basic Allowance of EUR 185.54 is paid for the first three years after birth or adoption. The second type of benefit is granted for child-raising or child-care. The child-raising allowance is not means-tested but previous labour market activity is necessary. Beneficiaries must have at least one child under the age of three. The amount of the benefit is EUR 575.68 (partial amounts for part-time activity). For the third child a shorter period (12 months) could be chosen and the benefit amounts to EUR 823.25 per month in case of complete suspension of activity. The child care allowance is a partial payment of care costs for children younger than six years and requires a professional activity generating a minimum income. The benefit is decreased to 50 percent for a child between the age of three to six. Social contributions of

a hired maternal assistant are paid entirely and to 50 percent if a person, who takes care of the child at home, is hired. For single parents a Single Parent allowance is granted (income-tested on a differential basis) to guarantee minimum income. The monthly amount is EUR 854.89 for a single parent with one child, EUR 1068.61 with two children and EUR 213.72 for each subsequent child. The New School Year allowance is paid for children aged between six and 18. It is a one-off payment and means-tested. The amount depends on the age of the child (EUR 362.28 for a child between six and ten years up to EUR 395.51 for a child between 15 and 18 years). Family benefits are not subject to taxation but are subject to the 0.5 percent contribution for the repayment of the social debt (single parents receiving single parent allowance are exempted).

### Italy

In Italy, no universal support scheme exists with the exception of 'Assegno sociale' covering persons aged 65 and older. At the local level different schemes for people in need are available. The 'Assegno sociale' amounts to EUR 442.30 per month, 13 months per year, for income not exceeding EUR 5,749.90 for a non-married person and twice this amount for a married couple. The benefit is paid on a differential basis and tax exempted.

Housing benefits are available for those who buy a residence as well as persons who rent it. Buyers are subsidized by a tax allowance for mortgage loan interests (up to EUR 4,000), rebates on the property transfer tax and low interest rates for loans. The rent allowance could either be a meanstested tax relief or rent subsidies for low income households. Rent subsidies are granted if taxable income of the household is below twice of the statutory minimum pension, i.e. EUR 12,882 and the rent exceeds 14 percent of the income. The tax allowance is available for different reasons (mainly housing). In all these cases no credit is granted if income is higher than EUR 30,987.41. The tax credit decreases with income and ranges between EUR 247.90 and EUR 991.60. The highest allowance is available for persons between 20 and 30 years old, the lowest allowance in general cases. Eligibility conditions for and the level of the rent subsidy are determined at the regional level. The subsidy is not taxable.

There are three types of family benefits, a family allowance, a maternity allowance, and an allowance to households with at least three children. The family allowance is not only granted to households with children but also to low-income couples with no children, as long as they are not self-employed or former self-employed retirees. The transfer covers different household types and varies also with respect to the level of income of the household. For an annual income up to EUR 14,198.48, the monthly benefit amounts to EUR 258.33, for an income above EUR 76,330.97 no benefit is granted. The average benefit amounts to EUR 139.49. The maternity allowance amounts to EUR 334.53 per month for five months and is granted to a lone parent whose wealth lies below a certain threshold or who is without income. Another scheme is granted at the national level and available for mothers who resigned their job during pregnancy and paid contributions for at least

three months before resigning. Mothers receiving this benefit are not eligible for the maternity allowance on the local level. The allowance for households with at least three children below the age of 18 amounts to EUR 135.43 (2013) per month. The last two allowances are paid on a differential basis if means are too high to receive the full amount. All three allowances are tax exempt.

The system in Italy also grants vouchers to families. One voucher is granted for child-care activities with a monthly amount of EUR 300 for six months. The other voucher, the social card, supports people aged 65 or older and persons with a dependent child less than three years. It amounts to EUR 40 per month and can be used in groceries or to pay energy bills.

## Sweden

Social assistance in Sweden is locally administered, means-tested and the beneficiary is required to actively search for a job. About 5.7 percent of households have claimed social assistance for one or more months (2011)<sup>31</sup>. The norm for social assistance is calculated annually and has an individual part (marital status, age of the child) and a household part (size of the household). The individual rate is SEK 2,950 for a single person and EUR 5,320 for a married couple. For each child the rate depends on the age and increases with the age, from SEK 1,740 for a child younger than one year to SEK 3,280 for a child between an age of 19 and 20. The household rate increases with the number of persons in the household, from SEK 930 to SEK 2,120 for a household with 7 persons. The benefit is tax free.

Housing benefits for rented accommodations consist of the income-tested housing allowance, a supplement for social assistance claimants and an income-tested housing supplement for pensioners. The condition for receipt of the housing allowance is low-income and varies with the number of children. Most recipients are single parents. The housing benefit depends on age and the family status as well as the housing costs. The housing benefit is not taxable.

For each child below an age of 16, or until compulsory education is finished, a child benefit is paid. The benefit is neither means- nor income-tested and amounts to SEK 1,050 per month and child. Supplements are paid if the parents have more than one child. The supplement is SEK 150 for the second child, SEK 454 for the third child, SEK 1,010 for the fourth and SEK 1,250 for the fifth and all subsequent children. The benefit is not taxable. In addition, at the municipal level a childcare allowance is granted. At the maximum the benefit amounts to SEK 3,000 per child and per month and the municipalities have the right to reduce the allowance if the child attends a publicly funded pre-school establishment.

<sup>&</sup>lt;sup>31</sup> See OECD Benefits and Wages (hyperlink).
# 3. List of Variables

LMM's detailed representation of institutional settings and economic behaviour implies that it features numerous parameters and variables. This large number of parameters and variables reduces transparency. Thus, the following list and description of variables is intended to improve the clarity of the programme code and of the data processing procedure and to facilitate the work with the model for the staff of the Commission and help them to perform future calibration procedures on their own.

This list of variables is complemented by the 'list of all the variables that need to be updated' in the Appendix. The latter provides information on the parameters and variables that need to be recalculated to perform an update of the LMM and is focussed on providing information on how to perform the update of the calibration. In contrast to that, the list of variables presented in this section deals with the interpretation of the different variables in the model (once the update of the model has been completed).

A list of variables and a description of variables have already been provided in Part II, Section 8.2., of the Final Report of the original project. An improved list of variables is shown in Table 26 of this report, which is also provided as an Excel-file. This list of variables can be complemented by a pdf-file providing a correspondence between the parameter or variable in the code and the same variable in the technical model documentation.<sup>32</sup>

For all of the variables listed, we provide i) a short description of the function of the variable, ii) the type of the parameter or variable, iii) its dimension, iv) the dimension/unit and v) the source for the code. The column 'Type' deals with the issue that variables can be distinguished according to whether they are determined endogenously in the model or exogenously outside the code. Exogenous parameters are grouped further: they can either be assigned to institutional/policy parameters, and thus can be changed in a policy reform scenario. Alternatively, they can represent completely exogenous parameters such as preference parameters or the depreciation rate of the capital stock. Nevertheless, even though these parameters are no policy parameters in a narrow sense, they can also be modified in a simulation, e.g. to simulate how a change of the depreciation rate might impact the economy. Furthermore, the model includes some 'technical terms' which simply help to improve the application of the model.

The column 'Dimension' specifies whether the variable is (in one particular time period) a scalar or a matrix. The latter indicates that the value of the variable varies (potentially) for different age and

<sup>&</sup>lt;sup>32</sup> Excel does not allow for the formula notation that would be necessary to provide this correspondence in a sufficient manner in a combined Excel table.

skill groups.<sup>33</sup> The column 'Dimension/Unit' provides information on how to interpret the values in the model. Basically, we distinguish 'nominal values' and 'factors/rates'. When interpreting nominal values, one must keep in mind the normalization of the model. For each of the individual countries, we normalize two variables. First, population is normalized to 100 in calib. Second, gross value added (GVA) is normalized to 100 in calib. Subsequently, this implies that GVA per capita is normalized to 1 in calib. Thus, all the nominal values must be interpreted relative to this normalization. This holds true for aggregate values (such as public revenues, trade balance,...), which should be interpreted relative to GVA (which is 100 in calib) or GDP, as well as for individual values (such as labour income, social benefits,...) which should be interpreted relative to GVA per capita (which is 1 in calib).

The column 'Source for Code' describes the way in which the variable is initially set/calibrated. Basically, this can happen in four different ways in the model. First, the file 'param' contains parameters currently being the same for all countries, for example labour supply elasticities or the elasticity of intertemporal substitution. Second, the Excel-files 'DataInputXX.xls' contain country specific data, for example the participation rate, the average number of hours worked or institutional parameters.<sup>34</sup> Simulations require setting the country code for which the simulation is performed in 'Imm.g'. Depending on the country code, the programme imports the country specific input data from the relevant 'DataInputXX.xls' file. In addition to these two files, other variables are initially determined in the programme *code* calib as they can be derived from model equations (given the data input provided in param and 'DataInputXX.xls'). Finally, the categorization Root indicates a special way of the *code* categorization. It implies that the variable is derived as a root of the calibration procedure. For instance, the subjective discount factor beta is derived in a way so that, for a given interest rate, asset markets clear, i.e. aggregate supply of assets by private households equals aggregate demand of assets (consisting of public debt, foreign assets and assets invested in firms).<sup>35</sup> Sometimes, the categorisation is mixed, i.e. in the term 'DataInput+Root' or 'DataInput+Code'. This indicates that the variable is initialised in the 'DataInputXX.xls' file, but is subsequently adjusted during the calibration procedure (in the 'calib' file). For instance, the ageand skill-specific structure of the income tax rate 'tw' is set in the 'DataInputXX.xls' file. Adjacently, these tax rates are adjusted in the 'calib' file in order to replicate public revenues from this tax. Thus, this variable is categorized as 'DataInput+Root').

<sup>&</sup>lt;sup>33</sup> For some variables, we include additional information in brackets. For instance, the entry for human wealth (hwv) is 8x3 (5x3). This means that the variable is a 8x3-matrix in the programme code but that only 5x3 entries are different from zero (as human wealth is zero for retirees).

<sup>&</sup>lt;sup>34</sup> These variables are listed in the 'list of variables that have to be updated' in the Appendix.

<sup>&</sup>lt;sup>35</sup> This 'root' categorization is complemented by information, which condition/equation is solved via the adjustment of the variable.

# Table 26: List of Variables

General Economic Parameters								
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code			
gx	exogenous real (trend) growth rate	exogenous parameter	scalar	factor/rate	DataInput			
r	exogenous real interest rate	exogenous parameter	scalar	factor/rate	DataInput			
rr	interest factor (1+r)	exogenous parameter	scalar	factor/rate	Code			
rrtau	interest factor net of capital income taxes (1+(1-t <sup>cg</sup> )*r)	exogenous parameter	scalar	factor/rate	Code			
delta	depreciation rate of capital	exogenous parameter	scalar	factor/rate	Root (so that capital stock matches value in DataInput)			
Production								
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code			
у	production	endogenous variable	scalar	nominal value	Code			
gva	gross value added	endogenous variable	scalar	nominal value	normalized to 100 in Calib			
gdp	gross domestic product	endogenous variable	scalar	nominal value	Code			
tb	trade balance	endogenous variable	scalar	nominal value	DataInput			
k	capital stock	endogenous variable	scalar	nominal value	DataInput			
ld	effective employment	endogenous variable	5x3	nominal value	Code			
lsk	effective employment (aggregate for skill)	endogenous variable	1x3	nominal value	Code			
L	effective employment (aggregate)	endogenous variable	scalar	nominal value	Code			
mpl	marginal labour productivity (of each skill)	endogenous variable	1x3	nominal value	Code			
mpk	marginal productivity of capital	endogenous variable	scalar	nominal value	Code			
lam_k	Tobin's marginal q	endogenous variable	scalar	factor/rate	Code			
i	physical investment	endogenous variable	scalar	nominal value	Code			
j	investment installation costs function	endogenous variable	scalar	nominal value	Code (but normalized to 0 in Calib and Steady State)			
psi	scaling factor of investm. installation costs function	exogenous parameter	scalar	factor/rate	param <sup>1)</sup>			
firmskillcost	costs for firm-sponsored training	endogenous variable	5x3	nominal value	Code (but normalized to 0 in Calib)			
div	dividend payments	endogenous variable	scalar	nominal value	Code			
firmrent	firm rents	endogenous variable	scalar	nominal value	Code			
vk	firm value due to the capital stock	endogenous variable	scalar	nominal value	Code			
ve	firm value due to rents	endogenous variable	scalar	nominal value	Code			
vf	firm value (vk+ve)	endogenous variable	scalar	nominal value	Code			

<sup>1)</sup> set so that speed of adjustment of capital stock is in line with empirical estimates

Preferences					
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code
beta	subjective discount factor	exogenous parameter	scalar	factor/rate	Root <sup>1)</sup>
sig	elasticity of intertemporal substitution	exogenous parameter	1x3	exponent	param
трс	marginal prospensity to consume	endogenous variable	8x3	factor/rate	Code
oomv	factor considering the MRS across age groups	endogenous variable	8x3	factor/rate	Code
effcost	disutility of number of hours worked or spent in training	endogenous variable	5x3	nominal value	Code
searchcost	disutility of search effort if unemployed	endogenous variable	5x3	nominal value	Code (but normalized to 0 in Calib)
delparcost	disutility of participation	endogenous variable	5x3	nominal value	Code (but normalized to 0 in Calib)
phibarcost	'total' labour market disutility of households	endogenous variable	5x3	nominal value	Code
homeu	value of home production of an unemployed person	exogenous parameter	5x3	nominal value	Root <sup>2)</sup>
homepar	value of home production of an inactive individual	exogenous parameter	5x3	nominal value	Root (set identical to homeu)
Stock, Wealth and Co	nsumption Variables of Households				
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code
av	asset stock	endogenous variable	8x3	nominal value	Code
р	amount of claims to the pension system	endogenous variable	8x3	nominal value	Code
SV	pension wealth	endogenous variable	8x3	nominal value	Code
theta	average productivity per age-skill-group (theta=thetaind*thetafirm)	endogenous variable	5x3	factor/rate	Code (set to match Mincer equations)
thetaind	average individual productivity per age-skill-group	endogenous variable	5x3	factor/rate	Code <sup>3)</sup>
thetafirm	productivity resulting from firm-sponsored training	endogenous variable	5x3	factor/rate	Code
hefffirm	amount of firm-sponsored training	endogenous variable	5x3	relative amount	DataInput (normalized to 1 for young low-skilled)
hwv	human wealth (pres. value of labour related income)	endogenous variable	8x3 (5x3)	nominal value	Code
trans	transfer wealth	endogenous variable	8x3	nominal value	Code
cv	private consumption	endogenous variable	8x3	nominal value	Code (but reflects age-profile of consumption)
qv	effort-adjusted private consumption	endogenous variable	8x3	nominal value	Code
Shadow Prices					
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code
lam_til	shadow price of pension claims (relative to shad. pr. of assets)	endogenous variable	8x3	factor/rate	Code
chi_til	shadow price of labour prod. (relative to shad. pr. of assets)	endogenous variable	8x3	factor/rate	Code

<sup>1</sup>) set so that asset demand and supply match in calib; <sup>2</sup>) residual to match wage bargaining power; <sup>3</sup>) set so that theta = thetaind\*thetafirm in calib

Income Variables					
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code
yv	total labour related income net of taxes	endogenous variable	8x3	nominal value	Code
wdv	effort-adjusted labour related income net of taxes	endogenous variable	8x3	nominal value	Code
wagev	gross wage rate (per productivity unit)	endogenous variable	5x3	nominal value	Code
wv	gross wage rate (wagev*theta)	endogenous variable	5x3	nominal value	Code (theta is set to match Mincer equations)
inc_gross	gross labour income (wv*eff)	endogenous variable	5x3	nominal value	Code
inc_net	labour income net of taxes	endogenous variable	5x3	nominal value	Code
ba	unemployment benefits	endogenous variable	5x3	nominal value	Code
lump	lump sum transfers to households	policy parameter	8x3	nominal value	DataInput+Code 1)
ZW	social assistance paid to workers	policy parameter	5x3	nominal value	DataInput (adjusted relative to avg. labour costs in calib)
zu	social assistance paid to unemployed individual	policy parameter	5x3	nominal value	DataInput (adjusted relative to avg. labour costs in calib)
ynonpar	social assistance for inactive individual	policy parameter	4x3	nominal value	DataInput+Code 1)
sev	severance payments	policy par./end. var.	5x3	factor/rate	Code
factau	factor to correct the assessment base for severance payments	policy parameter	5x3	factor/rate	param
р	average earnings-related gross pension (=stock of pension claims)	endogenous variable	8x3	nominal value	Code
p00	flat pension payments	policy parameter	8x3 (4x3)	nominal value	DataInput+Root (adjusted relative to avg. labour costs in calib) <sup>2)</sup>
ee	pension benefit net of taxes	endogenous variable	8x3 (4x3)	nominal value	Code
рр	gross pension benefit	endogenous variable	8x3 (4x3)	nominal value	Code
ppearly	disability pension benefit	endogenous variable	5x3	nominal value	Code
p00early	flat disability pension benefit	policy parameter	8x3 (5x3)	nominal value	DataInput (adjusted relative to avg. labour costs in calib)
transhouse	inter-vivo transfers to households	endogenous variable	8x3	nominal value	Root <sup>3)</sup>
ivtrans	inter-vivo transfers from households	endogenous variable	8x3	nominal value	Root <sup>3)</sup>
ytil	technical income term simplifying notation	technical term	5x3	factor/rate	Code
sbar	technical income term simplifying notation	technical term	5x3	factor/rate	Code

<sup>1)</sup> adjusted to match aggregate expenditures in calib; <sup>2)</sup> adjusted to match aggregate pension expenditures in calib; <sup>3)</sup> set so that consumption profile matches data

Labour Market Variab	our Market Variables of Households									
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code					
eff	number of hours spent working	endogenous variable	5x3	relative value 1)	DataInput					
heff	number of hours spent training	endogenous variable	5x3	relative value 1)	DataInput					
effagg	total number of hours spent working or training	endogenous variable	5x3	relative value 1)	Code					
deltapar	participation rate (conditional on not being disabled)	endogenous variable	5x3	factor/rate	DataInput (set to match participation rate)					
deltabar	share of individuals not disabled	exogenous variable	8x3	factor/rate	DataInput					
part	participation rate (=deltapar*deltabar)	endogenous variable	5x3	factor/rate	DataInput					
empl	probability of having a job without searching	exogenous variable	5x3	factor/rate	Code					
search	individual search intensity for a job	endogenous variable	5x3	relative value 2)	normalized to 1 in Calib					
find	probability of finding a job per unit of search intensity	endogenous variable	5x3	factor/rate	Code					
hir	probability of being employed (before firing decision)	endogenous variable	5x3	factor/rate	Code					
u	unemployment rate	endogenous variable	5x3	factor/rate	DataInput					
hheff	argument of the human capital production function	endogenous variable	5x3	factor/rate	Code					
hinv	'production' function of human capital	endogenous variable	5x3	factor/rate	Code					
deltah	depreciation rate of human capital	exogenous parameter	5x3	factor/rate	Code (set so that theta matches Mincer)					
Matching Variables										
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code					
reswagefirm	outside option of the firm in wage bargaining	endogenous variable	5x3	nominal value	Code					
reswagework	outside option of the worker in wage bargaining	endogenous variable	5x3	nominal value	Code					
barg	bargaining power of the firm	exogenous parameter	1x3	factor/rate	param					
aggsearch	aggregate search units per age-skill-group	endogenous variable	5x3	nominal value	Code					
vac	number of vacancies	endogenous variable	5x3	nominal value	Code					
kappa	vacancy costs	endogenous variable	5x3	nominal value	Code					
fill	probability of filling a vacancy	endogenous variable	5x3	factor/rate	Code					
muv	labour market tightness	endogenous variable	5x3	factor/rate	Code					
matching	number of matches	endogenous variable	5x3	nominal value	Code					
lh	number of workers that have a job before firing	endogenous variable	5x3	nominal value	Code					
prob	probability of keeping a worker	endogenous variable	5x3	factor/rate	Code					
probcost	managerial effort costs to keep a worker	endogenous variable	5x3	nominal value	Code (but normalized to 0 in Calib)					

<sup>1)</sup> relative to eff of youngest low-skilled group; <sup>2)</sup> search effort is normalized to 1 in calib for all groups

Public Sector					
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code
cg	public consumption (per capita)	policy parameter	scalar	nominal value	Code (determined by budget constraint in calib)
factctotcg	share of public consumption taxed by consumption taxes	policy parameter	scalar	factor/rate	DataInput
trssc	public transfer to the public social security system	endogenous variable	scalar	nominal value	Code
expenu	total unemployment payments paid to individuals	endogenous variable	scalar	nominal value	Code
expenpens	total pension payments to individuals	endogenous variable	scalar	nominal value	DataInput (p00 is adjusted in calib to match aggr. expenditures)
dg	government debt	endogenous variable	scalar	nominal value	DataInput
prim_bal	primary balance of the general budget	endogenous variable	scalar	nominal value	Code (determined by budget constraint in calib)
reven	total revenues of the general budget	endogenous variable	scalar	nominal value	Code
expen	total expenditures of the general budget	endogenous variable	scalar	nominal value	Code (determined by budget constraint in calib)
taxfirm	total tax payments of firms (excl. firing taxes and employers' ssc)	endogenous variable	scalar	nominal value	Code (but allowance adjusted to match aggregate revenues)
reventindiv	revenues from taxes on capital gains	endogenous variable	scalar	nominal value	Code 1)
revenfiring	revenues from firing taxes	endogenous variable	scalar	nominal value	Code
revenssc	aggregate social security contributions	endogenous variable	scalar	nominal value	Code 1)
reventax	income tax revenues	endogenous variable	scalar	nominal value	Code 1)
revencons	consumption tax revenues	endogenous variable	scalar	nominal value	Code 1)
expenz	public expenditures lump sum transfers and social assistance	endogenous variable	scalar	nominal value	Code
ch	public health expenditures	policy parameter	scalar	nominal value	DataInput
Institutional Variable	S				
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code
pinc	indexation of pension claims	policy parameter	8x3	factor/rate	DataInput
mp	pension accrual rate of labour income	policy parameter	5x3	(accrual) rate	DataInput
m1	pension accrual independent of labour income	policy parameter	5x3	nominal value	DataInput
b1	pension accrual for unemployment periods	policy parameter	5x3	(accrual) rate	DataInput
pensinv0	'imputation' for public disability pensions	policy parameter	5x3	nominal value	Code
sigpens	Gruber-Wise discounts and surcharges of pension claims	policy parameter	1x3	factor/rate	DataInput
corrp	statutory retirement age	policy parameter	1x3	factor/rate	DataInput
vabzug	adjustment factor for public pension payments	technical term	8x3	factor/rate	Code
va1, va2	adjustment factor in old age / disability pension system	technical term	8x3	factor/rate	DataInput
brepl	unemployment replacement rate of earnings-related benefits	policy parameter	5x3	factor/rate	DataInput
b0	unemployment payment not indexed to previous earnings	policy parameter	5x3	nominal value	DataInput
xi1	share of unempl. payments indexed to previous earnings	policy parameter	5x3	factor/rate	DataInput

<sup>1)</sup> tax/ssc rate adjusted to match aggregate revenues in calib

Statutory Taxes of Households								
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code			
twp	average income tax rate for pension benefits	policy parameter	4x3	tax rate	DataInput+Root <sup>1)</sup>			
ttotp	average retiree's social security contribution rate	policy parameter	4x3	ssc rate	DataInput+Root <sup>1)</sup>			
1-taxp	average tax wedge for pension benefits	policy parameter	4x3	tax/ssc rate	Code			
xtaxp	share of ssc of retirees deductible from income tax	policy parameter	4x3	rate	DataInput			
twearly	average income tax rate for disability benefits	policy parameter	5x3	tax rate	DataInput+Root 1)			
ttotearly	average ssc rate for disability pension benefits	policy parameter	5x3	ssc rate	DataInput+Root 1)			
1-taxearly	average tax wedge for disability pension benefits	policy parameter	5x3	tax/ssc rate	Code			
taxtau_s	average income tax rate for severance payments	policy parameter	5x3	tax rate	DataInput			
tw	average income tax rate for workers	policy parameter	5x3	tax rate	DataInput+Root <sup>1)</sup>			
twsocass	average 'social assistance tax rate' for workers	policy parameter	5x3	tax rate	DataInput			
twtot	tw+twsocass	policy parameter	5x3	tax rate	Code			
ttotw	average employee's social security contribution rate	policy parameter	5x3	ssc rate	DataInput+Root 1)			
1-taxw	average tax wedge of worker	policy parameter	5x3	tax/ssc rate	Code			
xtaxw, xtaxearly	share of ssc of workers/disabled deductible from income tax	policy parameter	5x3	rate	DataInput			
tu	average income tax rate of unemployed	policy parameter	5x3	tax rate	DataInput+Root 1)			
ttotu	average social security contribution rate of unemployed	policy parameter	5x3	ssc rate	DataInput+Root 1)			
1-taxu	average tax wedge of unemployed	policy parameter	5x3	tax/ssc rate	Code			
рс	price index of priv. consumption (including cons. tax)	policy parameter	8x3	tax rate	Root <sup>2)</sup>			
tindiv	capital gains tax rate	policy parameter	scalar	tax rate	Root <sup>2)</sup>			

<sup>1)</sup> structure from DataInput is adjusted in Calib to match aggregate revenues; <sup>2)</sup> set to match aggregate revenues in calib

Effective and Implicit Tax Rates									
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code				
gainu	effective gain in unemployment insurance	technical term	5x3	factor/rate	Code				
gainp	effective gain in pension insurance	technical term	5x3	factor/rate	Code				
gainu	effective gain in severance payments	technical term	5x3	factor/rate	Code				
1-taxhat	effective average tax wedge	technical term	5x3	factor/rate	Code				
gamtax	technical 'tax' term in search F.O.C.	technical term	5x3	factor/rate	Code				
taxpart	implicit tax rate on participation/retirement	technical term	5x3	factor/rate	Code				
Taxes of Firms									
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code				
tau_s	tax rate for severance payment	policy parameter	5x3	factor/rate	Code (derived by tenure and relative index)				
tau_f	firing tax rate	policy parameter	5x3	factor/rate	Code (derived by tenure and relative index)				
tau_c	administrative firing cost rate	policy parameter	5x3	factor/rate	Code (derived by tenure and relative index)				
tau	total firing cost tax rate	policy parameter	5x3	factor/rate	Code				
subld	employment subsidies or flat taxes per employed person	policy parameter	5x3	nominal value	set to 0 in calib				
subtrain	subsidies to firm-sponsored training	policy parameter	5x3	factor/rate 1)	set to 0 in calib				
ttotf	average total employer's social security contribution rate	policy parameter	5x3	factor/rate	DataInput+Root <sup>2)</sup>				
tprof	corporate income tax rate	policy parameter	scalar	factor/rate	DataInput <sup>3)</sup>				
subi	rate of tax allowance for physical investment	policy parameter	scalar	factor/rate 4)	set to 0 in calib				
tcap	tax rate on the capital stock	policy parameter	scalar	factor/rate	Root <sup>5)</sup>				
taxfirm	total tax payments of firms (excl. firing taxes and employers' ssc)	endogenous variable	scalar	nominal value	Code				
Demographic Variable	es								
Parameter/Variable	Description	Туре	Dimension	Dimension/Unit	Source for Code				
gamv	probability of surviving	exogenous parameter	8x3	factor/rate	DataInput				
omv	probability of staying in the same age group	exogenous parameter	8x3	factor/rate	Code				
nv	number of individuals in an age-skill group	endogenous variable	8x3	nominal value	Code (aggr. number of individuals normalized to 100 in calib)				
skill_distributionnb	share of new entrants of different skill types	endogenous variable	1x3	factor/rate	DataInput				

<sup>1</sup>) relative to firm-sponsored training effort; <sup>2</sup>) structure from DataInput is adjusted in calib to match aggregate revenues; <sup>3</sup>) aggregate expenditures are matched in calib via allowance; <sup>4</sup>) relative to physical investment; <sup>5</sup>) set to match aggregate revenues in calib

# A. Annex A - Illustrative Scenario - Labour Market Analysis of the Recent Migration of Refugees

## A.1. Introduction

This chapter provides results of an illustrative scenario to give an overview about economic channels which influence the labour market and the economy. In accordance with the European Commission we apply the model to analyse the economic impact of one of the currently most important topics, namely the refugee crisis in Europe. As Germany is one of the most important destination countries we focus the analysis on this country.

Since 2014 one can observe a significant increase of asylum seekers. This is mainly a result of the war in Syria. Nevertheless, refugees from other countries also play an important role. Dominant countries of origin are Syria, Iraq and Afghanistan. In relation to the size of the population, important countries of destination in Europe are Hungary, Sweden, Austria, Finland and Germany. In absolute numbers, Germany was the most important country of destination with 477,000 asylum applications in 2015. In the following illustrative scenario we analyse the impact of the migration of asylum-seekers on the labour market and the economy in Germany.

There are a few studies which discuss the economic effects of the current migration of refugees. The European Commission (2015) analyses the impact on the EU as a whole and the impact on Germany in the Autumn 2015 forecast by applying the QUEST model. They differentiate two scenarios. In the first scenario, it is assumed that the skill-structure of refugees equals the structure in the country of destination (EU, Germany), in the second scenario they assume purely low-skilled migration. Both scenarios combined allow delimiting upper and lower bounds for the effects of migration as data indicate that refugees on average are less educated than natives but not all of them are low-skilled. The Commission assumes an increase of the population in Germany of 1.1%, which is similar to the increase we assume here, namely 0.92%. The simulation of the low-skilled migration scenario (resp. the native migration scenario) with the QUEST model leads to the result that GDP rises by nearly 0.5% (0.7%) in the year 2020 compared to a scenario without refugees, employment by about 1% (in both scenarios). As a result of the higher labour supply, wages develop moderately and stay behind by 0.7% (resp. 0.6%).

Brücker et al. (2015) focus the analysis on Germany as well based on expectations about inward migration. They assume that a large share of refugees (about 60%) has no or very low educational qualifications and simulate a moderate level of total migration (300,000 to 500,000) in 2015 and 2016. The authors find that in the short-run the unemployment rate rises by 0.15 percentage points and wages decline by 0.07% compared to the base case without migration of additional refugees. In the long-run unemployment lies 0.07 percentage points higher than in the base case, wages are

unaffected. Ruist (2013) analyses Swedish data and finds crowding out effects of migration of refugees only between migrants from developing countries, the native population and migrants from industrialized countries were nearly unaffected. Berger et al. (2016) analyse the impact of refugees on the Austrian economy. They assume an increase of migration by 325,000 persons from 2015 to 2018, or 3.8% of the population at the beginning of 2015. Similar to the paper of Brücker et al., the authors assume a high share of low-skilled refugees. Up to the year 2020, employment would rise by about 70,000 persons in this case and unemployment by 0.6 percentage points. The increase of unemployment is concentrated on foreign workers but there is also a considerable effect on native low-skilled persons. GDP would increase by one percent, GDP per capita however declines.

In the next chapter we describe underlying assumptions to simulate the scenario for Germany. This provides an overview on required data input to perform such a simulation in the LMM model. Given the disaggregated structure of the model, in particular information about age groups and educational level are necessary. In addition, it is important to define differences of labour market characteristics between refugees and natives if one expects that differences exist. Subsequently, we describe the simulation results and distinguish between the impact on the total population and the impact on the native population.

# A.2. Assumptions

The current subsection describes the underlying assumptions for the migration simulation with the LMM. Assumptions are necessary about the number of asylum seekers and positive asylum decisions as well as labour market and educational characteristics of refugees. Indeed, as the future development of the current refugee crisis is hard to project, the present analysis might be updated and refined at a later point in time when additional information is available. Data indicates that refugees differ from resident population in various aspects (age and educational structure, labour market characteristics). These differences are taken into account for the analysis of the recent migration of asylum seekers towards Europe and especially Germany. Concerning labour market characteristics of refugees, we mostly rely on Swedish data. This is warranted by the fact that, compared to other countries, Sweden had a pronounced refugee migration in the last decade (see e.g. Ruist (2013)), especially from Near- and Middle East countries. For this reason, labour market characteristics of refugees living in Sweden are likely to be reasonable for the current inflow of asylum seekers to Europe.

### Number of Asylum Seekers and Positive Decisions

Similar to a few other European countries, Germany has seen a significant increase of asylum seekers in 2014 and, in particular, in 2015. While the number of asylum seekers was slightly below 50,000 persons on average in the years 2008-2012, the number has risen to 200,000 in 2014 and almost 500,000 in 2015.<sup>36</sup> As illustrated in Table 27, the present analysis with the LMM focuses on the influx of asylum applicants in the years 2014-2016 and it is assumed that additional 700,000 asylum applications will be submitted in 2016. The high number for 2016 is a result of the delay of asylum applications due to capacity constraints with an important share already migrated to Germany in 2015.

Table 27: Number of Asylum Applications, Positive Decisions and Increase of Population (in thousands)

	2014	2015	2016	2017	2018	Total
Asylum Applicants	203	477	700	-	-	1,379
Positive Decisions	42	141	372	187	-	743
Population Increase (annual avg.)	10	104	359	696	743	

Source: Eurostat, Bundesamt für Migration und Flüchtlinge, own calculations.

For the share of positive asylum decisions, we refer to the Bundesamt für Migration und Flüchtlinge (2016). In the period January 2015 – February 2016, 52.6% of decisions granted asylum. Incorporating subsidiary protection and prohibitions of deportation, this share slightly increases to 53.8%, a number which we assume also for future asylum decisions. Furthermore, by taking into account figures on the duration of positive and negative asylum procedures as presented in Bundesamt für Migration und Flüchtlinge (2015), it is reasonable to assume an average duration of procedures (for ex-post positive decisions) of about half a year.<sup>37</sup>

This results in a strong increase of the number of positive decisions compared to previous years, as illustrated in Table 27. In the analysis with the LMM, we thus assume a total of 740,000 positive decisions in the years 2014-2017 with a maximum of more than 370,000 in the year 2016. The resulting increase of the population is illustrated in the last line of Table 27. As the model runs on annual averages and positive decisions take place during the year, the increase of the population is lagged to some extent. LMM simulation results for this pronounced increase of migration are presented until the year 2030 in the following analysis.

<sup>&</sup>lt;sup>36</sup> It should be noted, though, that these numbers are significantly lower than the number of refugees registered in the socalled Easy-Verfahren in German Erstaufnahmeeinrichtungen, amounting to 1.1 million in 2015. This difference might be attributed to, for instance, double registration, people leaving Germany (e.g. to Sweden) or capacity constraints in institutions registrating asylum applications.

<sup>&</sup>lt;sup>37</sup> The Bundesamt für Migration und Flüchtlinge reports a slightly higher average duration of procedures. As the duration of (ex-post) positive decisions is shorter than that of (ex-post) negative decisions, 6 months are plausible.

#### Age and Educational Attainment

Aside from the number of asylum-seekers and positive decisions, the setup of the simulation requires additional information. Important aspects of asylum-seekers are the age- and educational structure. The age structure is of special importance as children do not immediately participate on the labour market but have to be taken into account for the simulation of prospective years. Table 28 provides an overview about the age-structure of asylum applicants as provided by Eurostat and the transmission into the model (last two columns). More than a quarter of first-time asylum applicants is less than 15 years old and more than 50% are younger than 25. Compared to the native population, asylum seekers are much younger. The share of persons aged 65 and older is less than one percent.

Age groups	Number of first time applicants	Share	Model			
less than 14	113,595	23.8%	less than 15	122,239	25.7%	
14 to 17	34,575	7.3%	15 to 19	53,761	11.3%	
18 to 34	236,555	49.6%	20 to 24	69,575	14.6%	
35 to 64	89,085	18.7%	25 to 39	153,998	32.3%	
65 and older	2,685	0.6%	40 to 54	44,542	9.3%	
Total	476,495	100.0%	55 to 69	31,037	6.5%	
			70 to 79	1,343	0.3%	
			Total	476,495	100.0%	

Table 28: Age structure of asylum applicants in Germany (2015) and structure for the model

Source: Eurostat, own calculations.

There is a certain amount of uncertainty on the educational attainment of asylum seekers. The educational attainment of migrants already living in Germany is most likely not a good indication as high skilled migrants in particular had incentives and possibilities to migrate to Europe in the past. Meanwhile, consensus has emerged that educational attainment of current asylum seekers is likely to be low.

Studies and data about the educational attainment of refugees can be found in Table 29. The authors of the current study have tried to categorize different classifications into three groups according to the ISCED 1997 classification. The Central Bureau of Statistics in Syria provides data on the educational attainment of the population aged 15 and older in Syria in 2010. Syrian refugees represent a very large part of current asylum seekers in Germany. According to that, 78% of the Syrian population in 2010 were low skilled, 10% high skilled and around 13% had medium qualification.<sup>38</sup> It should be noted that the educational structure of male individuals is better than that of females. It is sometimes argued, that there might be positive selection of refugees in the

<sup>&</sup>lt;sup>38</sup> Some of the cited data allow for more detailed classification. The 78% of low-skilled individuals are comprised of 16% "Illiterate", 17% "Literate", 28% "Elementary" and 18% "Preparatory".

sense that the educational structure of refugees is better than that of the population in origin countries. However, Wößmann (2016) argues that the large number of asylum seekers does not indicate in that direction.

Battisti and Felbermayr (2015) cite data of surveys among Syrian refugees in Turkish camps. According to that data, 9% have acquired a university degree, 11% have completed upper secondary education and 80% of individuals have completed compulsory school at most.<sup>39</sup> Data of the IAB Nürnberg (Brücker (2015)) indicate a similar educational structure. According to that, 71% of employed individuals and individuals without employment from countries of war or civil war have not finished training qualification, 8% have medium qualification and 8% of individuals have an academic degree.

The 'Bundesamt für Migration und Flüchtlinge' (BAMF) has organised a survey among more than 100,000 asylum-seekers in Germany in 2015. Evaluation of the results showed that Syrian refugees are better educated than refugees from other countries. Based on all interviewed refugees in Germany 2015, the share of low-skilled individuals is lower than in the other studies but amounts to 62%, much higher than in the native population in Germany.

As there is some uncertainty about the skill-structure we perform a sensitivity analysis to illustrate the impact of different assumptions on the labour market and economic outcome in Germany. We start with a scenario in which we assume that persons entitled to asylum on average have the same educational structure than the population in Germany. This scenario neglects effects of different educational attainments. Nevertheless, differences in labour market characteristics (lower participation and productivity as well as a higher unemployment risk) will influence the simulation results. Furthermore, the fact that refugees are on average younger will have an effect. In the second scenario, we assume a distribution of educational attainment as in the survey of the BAMF. In addition to the labour market characteristics, the lower average educational attainment influences the impact on the economy in this scenario.

<sup>&</sup>lt;sup>39</sup> Similarly to the data of Syrian Bureau of Statistics, there is a rather high share (16%) of illiterate individuals.

Source	Population	Low	Medium	High
Battisti and Felbermayr (2015)	Syrian Refugees in Turkish Refugee Camps	80.0%	11.1%	8.9%
IAB, Brücker (2015)	Employed and Unemployed Refugees in Germany (from countries of (civil) war)	71.0%	8.0%	8.0%
BAMF	Refugees in Germany (all countries)	62.0%	17.5%	13.0%
Central Bureau of Statistics Syria	Total population Syria (2011)	77.9%	12.6%	9.5%

Table 29: Information on Highest Educational Attainment

Source: different sources, own categorization into groups (according to ISCED 1997): low: ISCED 0-2, medium: ISCED 3-4, high: ISCED 5-6.

Possible deviation to 100%: no answer.

BAMF: See Online Article of Mitteldeutschen Rundfunk (mdr), <u>http://www.mdr.de/nachrichten/syrische-fluechtlinge-bestens-ausgebildet100.html</u>.

#### Labour market characteristics

Compared to the native population, asylum-seekers not only have less favourable educational characteristics. Even for the same educational attainment, they are also less integrated in the labour market. This is reflected in labour market participation, the unemployment rate and lower productivity and lower wages respectively. We use the LFS as basis for labour market integration and the EU-SILC for productivity and wage differentials. As refugees from the Near and Middle East played only a minor role in Germany in the past, also leading to a very small sample size in the LFS and EU-SILC, the information is based on data about Sweden. In Sweden, there exists a comparably large group of persons born in countries of the Near and Middle East. Thus, this information can be seen as a good indicator for labour market integration of refugees in Germany. Note that we assume lower labour market integration not only for prime-age refugees. It is also applied for young refugees aged below 15 (around one quarter of all refugees, see Table 28) who enter the labour market later up to 2030. This is the main reason for prolonged labour market effects (in terms of lower employment rates and lower wages) even in the first scenario. With respect to the participation rate, we apply the participation rate of foreigners born in Near and Middle East countries as well as North Africa directly to refugees in Germany. As labour market integration takes some time we distinguish persons living in Sweden for less than five years and more than five years. Participation rates according to age and education are presented in Table 30. As one can see, in particular in the first five years of residence, the participation rate is very low. Even for mediumand high-skilled asylum-seekers participation is considerably lower than that of natives.

	residence less or equal five years				residence more than five years			
	Low	Medium	High		Low	Medium	High	
15-19	29.1%			15-19	34.7%			
20-24	42.9%	56.0%		20-24	80.8%	85.5%		
25-39	61.5%	64.2%	69.2%	25-39	76.2%	83.1%	87.1%	
40-54	53.0%	57.6%	73.7%	40-54	66.3%	79.1%	86.9%	
55-69	21.2%	30.7%	48.0%	55-69	32.4%	47.3%	68.9%	

Table 30: Participation rates of refugees based on Swedish data

Source: LFS, own calculations.

Table 31: Unemployment and Wage gap of refugees compared to the native population

	Low	Medium	High
Unemployment gap (in p.p.)	24.4	14.8	17.9
Wage gap	25.0%	15.4%	14.6%

Source: LFS, EU-SILC, own calculations.

With respect to the unemployment rate and the wage differential to natives we use the difference of foreigners born in Near and Middle East as well as North African countries to other persons in Sweden and apply it to Germany. Table 31 provides the results based on the available information from LFS and EU-SILC. Data show that unemployment of considered refugees is considerably higher than that of the other population in Sweden. The unemployment rate of low-skilled individuals is nearly 25 percentage points higher, even for high- skilled persons the difference in unemployment is substantially. The same holds for the wage gap. In Sweden, the wage gap of refugees from the considered countries of low-skilled amounts to a quarter. It decreases with the level of education but remains high with around 15%.

Table 32 provides an overview of assumptions for the modelling scenarios with the LMM.

Variable / Indicator	Modelling Assumption				
Number of Aculum Applicants	2014 (203.000) and 2015 (477.000) applications according to Eurostat.				
Number of Asylum Applicants	Assumption of 700.000 applications for 2016.				
Share of Positive Asylum Decisions	Share of 53.8% based on decisions Jan 2015 - Feb 2016 (according to				
	BAMF). Assumption of average duration of procedure of half a year.				
Positive Asylum Decisions	Results from number of applications and share of positive decisions.				
Age Structure of Asylum Applicants	Structure for applications in 2015 according to Eurostat.				
Labour Market Characteristics of Defugaes	Labour market characteristics (participation, unemployment, wages)				
Labour Market Characteristics of Refugees	derived from Swedish data according to LFS and EU-SILC.				
Educational Attainment Scenario 1	Assumption: structure of highest educational attainment as in native				
	population in Germany.				
Educational Attainment Cooperio 2	Assumption: structure of highest educational attainment according to BAMF				
Euucational Attainment Scenario 2	survey. Predominantly (more than 60%) low level of education.				

Table 32: Overview of Assumptions for Modelling Scenarios

### A.3. Results

In economic terms, the increase of migration of asylum-seekers is equivalent to an increase of labour supply in the economy. After a positive decision, persons eligible for asylum are allowed to take up a job and will therefore search for employment, work as self-employed or decide not to participate. Persons eligible for asylum form an inhomogeneous group, differing for example with respect to the country of origin, age, sex, and the level of education. For this reason they differ with respect to the choice of profession, productivity and labour market experience. It is also of importance to which extent qualifications and work experience are officially recognised, which influences the success on the labour market in the country of destination. These characteristics are reflected in lower productivity, wages, participation rates and higher unemployment rates compared to natives of the same age, sex and educational level. They are important determinants for macroeconomic and labour market consequences of the migration shock.

In general, one has to distinguish between short- and long-term effects of migration for at least three reasons. The first reason is a consequence of the change of labour supply over time. As a large part of migrants is very young, they will join the labour force only after several years or even two decades. In addition, persons eligible for asylum may be parents such that their children are too young to participate on the labour market at present but will do some day in the future. The second reason is a result of the rigidity of capital adjustment. The increase of labour supply together with a lagged adjustment of the capital stock in the short run leads to lower productivity of the labour force. As a consequence, wages develop more moderately in comparison to a situation with less migration. In contrast, the rate of return to capital should increase in the first years after the increase of labour supply. The higher rate of return incentivizes investment to reach an optimal level. Labour demand in the short run is also influenced. Wage moderation induces an increase in labour demand together with lower costs for firms to fill a vacancy. These lower costs arise as a result of a higher number of job applicants per vacancy making it easier to fill a vacancy. The third reason is that migrants, and in particular refugees, typically require some time to be sufficiently integrated in the labour market. In the model simulations, this is reflected via lower participation rates in the first years as described in Chapter A.2.

According to the scientific literature, the long-run effect of migration on the economy depends on productivity or more generally on the qualifications of migrants. In the case of coincidence of the structure of qualification and age of migrants with natives, there is no long-run effect on productivity and wages. However, there are several reasons why this does not hold in general. First, probability of employment of migrants is very often lower than that of natives (lower participation and higher unemployment).<sup>40</sup> Second, the level of qualification and work experience differ between migrants and native population and third, it is harder for migrants to be able to apply qualifications and experience to the same extent as natives. All three aspects, as shown in Chapter A.2, are applicable to the current situation of migration of asylum-seekers. From this point of view we would expect also long-run effects on the native population. On the other hand, there could even be positive long-run labour market effects of migration for natives if migrants and natives are imperfectly substitutable. LMM allows for imperfect substitutability but, for simplicity, we assume perfect substitutability in the following scenarios. As the share of low-skilled persons among those eligible for asylum is probably higher than of German natives we expect a stronger pressure on the labour market for natives with low qualifications.

In the public discussion it is often argued that the increase of asylum-seekers boosts public consumption or transfers to private households leading to higher aggregate demand and a corresponding higher growth in the economy. This would, inter alia, require a detailed analysis of the public costs of refugee migration. Many of these expenses such as accommodation, food or public training education expenses are not explicitly modelled in the LMM. Thus, these costs would have to be calculated separately (see for instance chapter 5 in Berger et al. (2016)). This detailed analysis is beyond the scope of this scenario. In addition, as the current version of LMM rests on the assumptions of a small open economy and a perfect competition on the goods market, the impact of these additional expenses would be limited to public and private consumption and the current account. Although this plays a role in the short run to some extent we do not emphasise this impact on the economy in this simulation with the LMM. We concentrate on the effect of the higher labour supply on the economy.

### Simulation results

As mentioned above we provide results for two different scenarios. In the first scenario, we assume that the educational structure of asylum-seekers follows exactly the distribution of low-, mediumand high-skilled individuals of the population already living in Germany, from now on called native population<sup>41</sup>. In the second scenario, the results of the BAMF survey are used as basis for the distribution of education of refugees. As already stated, we should expect a more even impact on the native population in the first scenario. In the long-run labour market effects should vanish, meaning that the impact on participation, the unemployment rate and the effect on wages should be close to zero. In the short-run, the lower capital-labour ratio due to the higher labour supply should have an impact on the labour market. In the second scenario, the different structure in education between

<sup>&</sup>lt;sup>40</sup> This depends largely on the region of origin. Well educated citizens of the EU working in another EU member state can have a higher employment probability than natives.

<sup>&</sup>lt;sup>41</sup> This includes persons who migrated to Germany in the past.

natives and refugees should imply an impact not only in the short-run but even in the long-run. We start with the results of the first scenario, followed by the second scenario.

#### Scenario 1

Figure 2 shows the impact on employment in Germany for the years 2014 to 2020 and 2025 as well as 2030 in the first scenario. Employment starts to increase significantly in 2015 and rises until 2030. There are several reasons for the long delay of employment. First, as a large share of asylum-seekers is younger than 15 years it takes time until these children participate on the labour market. If a child with an age of 5 immigrated to Germany in 2015 it will participate on the labour market at the earliest in 2025. Second, following Swedish experience, we assume that integration on the labour market takes some time. In the first 5 years, the participation rate of refugees is lower than in subsequent years. Third, the procedure for granting the right of asylum takes some time (finished in 2017, see Table 27). Fourth, the adjustment of the capital stock takes some time, implying lower employment in the first years. These effects lead to a strong delay in the impact on the labour market.

The upper part of Figure 2 shows that employment in Germany rises by 0.9% in 2030 due to refugees (in 2017, only half of the effect is realized). Given the same skill structure than the native population, the various skill groups are affected similarly. Although the increase in employment is very similar to the increase in population (population increases by 0.92%) one has to keep in mind that asylum-seekers are much younger on average than the native population. As a result of the younger population (less retirees) one should expect employment to increase by more than 0.92%. The lower increase is caused by the lower participation- and higher unemployment rate of refugees. Overall, the younger population structure is offset by the lower employment rate such that the increase in population coincides with the increase in employment.



Figure 2: Change of employment: Scenario 1 (total and native population)

Low: ISCED 0-2, medium: ISCED 3-4, high: ISCED 5-6 (according to ISCED 1997). Source: LMM simulation results.

The lower part of Figure 2 illustrates the impact of the labour supply increase on the native population. In accordance with the literature, there is some impact on employment of the native population in the short-run. In 2017, native employment decreases by less than 0.1%, but catches up in subsequent years such that 2030 employment is nearly the same compared to a scenario without the strong increase of the number of refugees. Thus, the short-run displacement of native workers as a consequence of additional labour supply amounts to approximately 15 % of the increase of total employment (-0.07 % native employment vs. 0.45 % total employment in 2017) in this scenario.



Figure 3: Change of unemployment rate in percentage points: Scenario 1 (total and native population)

Low: ISCED 0-2, medium: ISCED 3-4, high: ISCED 5-6 (according to ISCED 1997). Source: LMM simulation results.

The impact of migration on the unemployment rate is shown in Figure 3. The upper figure illustrates again results for the total population, the lower figure for the native population. The increase of labour supply leads to an increase of the total unemployment rate. This effect results from the worse labour market integration of refugees based on the experience in Sweden. Within the same age- and skill-group, refugees from the Near- and Middle East have a higher unemployment rate than the native population. For this reason the change of the unemployment rate does not converge to zero in the long-run but increases even more as the share of refugees on

the population participating on the labour market increases.<sup>42</sup> The stronger effect on low-skilled individuals follows from the higher differential in the unemployment rate of refugees compared to the native population. A second reason is the younger age structure of refugees. As younger cohorts have a higher unemployment rate compared to older workers, unemployment rises. However, this effect diminishes over time as refugees grow older. Overall, the unemployment rate rises by 0.2 percentage points until 2030.

For the native population, unemployment changes only slightly, and the increase concentrates on the first years. Over time, as capital adjusts to the higher labour supply, unemployment of natives returns to a base level again. In 2030 the unemployment rate of natives is as high as in the scenario without additional refugees. Overall, the increase of labour supply due to asylum-seekers implies a rise of unemployment in Germany in the next decade(s). However, it is concentrated on refugees, the impact is very small for natives in the first scenario.

Besides the impact on employment and unemployment, the increase of labour supply also has an impact on hourly wages. As Figure 4 shows wages are affected negatively by the strong increase of asylum-seekers. Until the year 2017 wages decrease by about 0.3% compared to a situation without additional labour supply, meaning that wage growth is lower by this amount.<sup>43</sup> The impact on low-skilled persons is less pronounced than on high-skilled as an effect of capital-skill complementarity and delayed capital adjustment.<sup>44</sup> In the years after 2017, the impact on wages remains at this level implying lower wages also in the long-run (2030). For the native population wages of the native population catch up and reach nearly the level of a situation without additional refugees.

<sup>&</sup>lt;sup>42</sup> The Swedish data suggest pronounced gaps between native and migrant unemployment rates in the short- and in the longrun.

<sup>&</sup>lt;sup>43</sup> The slight increase of wages in the first year follows from the assumption of perfect foresight of companies. The additional labour supply induces firms to invest already in the first year such that the capital stock in 2014 increases by more than labour supply inducing higher wages in 2014.

<sup>&</sup>lt;sup>44</sup> Due to the delayed capital adjustment, the capital-labour ratio initially declines, which reduces labour productivity and, thus, wages. The lower capital-labour ratio induces firms to invest to achieve the optimal capital intensity. LMM features capital skill complementarity so that the lack of capital in the short and medium term is partly substituted by low-skilled individuals. Therefore, the decline of labour productivity (and wages) is less pronounced for this group than for higher skilled individuals.



Figure 4: Change of hourly wages: Scenario 1 (total and native population)

Low: ISCED 0-2, medium: ISCED 3-4, high: ISCED 5-6 (according to ISCED 1997). Source: LMM simulation results.

The stronger and long-lasting effect on wages of the total population follows from two facts. First, refugees are younger implying lower average wages as wages increase with experience (age). Second, based on Swedish data, wages and productivity of refugees are lower compared to natives such that wages decline more heavily for the total population than for natives. Although wages of natives catch-up, the same will not happen for the total population for these two reasons. The long-lasting effect is a consequence of the rising share of refugees in the labour force over time, although it is dampened by the increase of the average age and therefore higher experience and productivity of additional refugees.

Overall, based on the simulation results, one can conclude that even in the case of the same educational structure the increase of the number of refugees has an impact on the labour market and the economy. Given the results for the native population one can see, however, that this effect is largely concentrated on refugees and a consequence of their unfavourable labour market integration. The effect would be dampened if it were possible to integrate refugees in the labour market to the same extent as the native population. It would not completely vanish as the average age of refugees is much lower compared to natives.

The evolution of macroeconomic aggregates is shown in Figure 5. The higher labour supply and employment induces firms to increase investment and the capital stock in the economy to restore an optimal capital-labour ratio and the productivity of employees. Higher employment and capital stock imply a higher GDP. The figure shows, as already stated, that employment rises by 0.9% in the long-run (2030). The capital stock and investment do not adjust to the same extent as the level of employment. The capital stock increases significantly less by about 0.65%. The reason is the lower average productivity of refugees compared to the native population, induced by the younger age structure and inadequate employment compared to the educational level. As GDP reflects both, employment and the capital intensity, it increases markedly but less than employment with more than 0.7% in 2030. It should be noted, though, that the increase of GDP is less pronounced than the population increase. As a consequence GDP per capita declines compared to the baseline.

The increase of the population and additional labour-, capital- and transfer-income leads to additional private consumption. It rises by more than GDP as refugees receive higher public benefits (unemployment benefits) than the native population but less than employment as average labour income is lower compared to natives. Until 2030 private consumption increases by more than 0.8% compared to the baseline.



Figure 5: Evolution of macroeconomic aggregates: Scenario 1

Source: LMM simulation results.

### Scenario 2

In the second scenario we assume a skill-distribution of refugees according to the survey results of the BAMF. According to that survey, more than 60% of asylum seekers have low educational attainment, which is pronouncedly more than in scenario 1. Subsequently, we will not discuss the outcome of the simulation in detail but instead focus on differences to the first scenario.



Figure 6: Change of employment: Scenario 2 (total and native population)

Low: ISCED 0-2, medium: ISCED 3-4, high: ISCED 5-6 (according to ISCED 1997). Source: LMM simulation results.

The impact on employment is shown in Figure 6 for the total as well as for the native population. The much higher share of low-skilled persons has a significant effect. Employment rises by 0.7% until 2030 in contrast to 0.9% in the first scenario. The lower employment rate of low-skilled

refugees (lower participation and higher unemployment) results in the significantly lower impact on employment. Given that more than 60% of the refugees are low-skilled in this second scenario, the increase in employment is concentrated on low-skilled individuals with an employment gain of nearly 3.3% until 2030. The boost in medium- and high-skilled employment is more moderate in this scenario (about 0.4% instead of 0.9%). The simulation results show that we observe also some displacement of native employment with employment of refugees, which predominantly affects low-skilled natives. Native low-skilled employment decreases by about 0.8% until 2030. <sup>45</sup> The drop in native low-skilled employment is composed of lower participation and higher unemployment (see lower part in Figure 7). Employment of medium- and high-skilled natives remains nearly unchanged.

Given that employment changes less pronounced than in the first scenario, unemployment rises by more (around 0.3 percentage points in 2030 in contrast to 0.2 percentage points in scenario 1, compare Figure 7 and Figure 3). Interestingly, the increase of the unemployment rate focuses fully on low-skilled persons for whom unemployment rises by more than 1.5 percentage points. Even for low-skilled natives unemployment rises by 0.3 percentage points. Again, unemployment of medium- and high-skilled natives is unaffected due to the stronger low-skilled labour supply. The reason for the differential impact is the heavy concentration of the increase of labour supply on low-skilled persons. Labour demand for low-skilled will not expand according to labour supply leading to some pressure on the low-skilled labour market.

<sup>&</sup>lt;sup>45</sup> In his analysis for Sweden, Ruist (2013) finds no displacement effects of refugee migration for migrants from high-income countries and people born in Sweden, but he finds displacement effects for migrants from low- and middle income countries.



Figure 7: Change of unemployment in percentage points: Scenario 2 (total and native population)

Low: ISCED 0-2, medium: ISCED 3-4, high: ISCED 5-6 (according to ISCED 1997). Source: LMM simulation results.

As it is not possible to provide sufficient productive jobs for additional low-skilled persons, they will also take up less productive jobs leading to wage moderation for low-skilled individuals, see Figure 8. Overall, wages of low-skilled individuals rise by 2.1 percentage points less than in a scenario without refugee migration. This is to some extent the result of lower wages (age structure, productivity) of refugees. Comparing the lower figures of Figure 4 and Figure 8 however reveals that in scenario 2 also low-skilled natives are affected by lower wages. In scenario 1, this did not happen (at least in 2030). In scenario 2, wages of low-skilled natives will be about 1.2% below the

baseline scenario.<sup>46</sup> The impact is less than on overall low-skilled wages but significantly more than in scenario 1. In other words: Without any supporting policy measures the additional supply of lowskilled workers in scenario 2 will lead to lower wages especially in the low-skill segment. In order to alleviate the pressure on wages, the government may decide to invest in measures that support training of low-skilled workers to increase their productivity.

<sup>&</sup>lt;sup>46</sup> This negative impact is resulting from the decline of labour productivity of low-skilled workers and the wage bargaining process. It can be reconciled with statutory minimum wages in Germany (which are not explicitly taken into account in this simulation) by the fact that the minimum wage may not be binding for many workers and by a possible minimum wage moderation effect by the minimum wage commission due to higher labour supply and unemployment.



Figure 8: Change of hourly wages: Scenario 2 (total and native population)

Low: ISCED 0-2, medium: ISCED 3-4, high: ISCED 5-6 (according to ISCED 1997). Source: LMM simulation results.

Figure 9 provides an overview about the evolution of macroeconomic aggregates in scenario 2. Qualitatively, the picture looks very much the same as in scenario 1. The capital stock evolves much more moderate than employment and GDP rises by more than the capital stock but also less than the level of employment. The reasons are the same as in scenario 1. However, the stronger focus on low-skilled refugees leads to a more pronounced difference between these variables. Whereas in scenario 1 the ratio of GDP to employment amounts to 0.8, it is only around 0.65 in scenario 2. These results indicate that the decline of GDP per capita is stronger in scenario 2. Furthermore, private consumption rises more than GDP but less than employment. The reasons are the same as in scenario 1.



Figure 9: Evolution of macroeconomic aggregates: Scenario 2

Source: LMM simulation results.

The simulation results show a pronounced impact of the increase of the number of refugees on the labour market and the economy in scenario 2 where asylum seekers have low educational attainment according to the BAMF survey. In contrast to scenario 1, the simulation results indicate displacement effects of low-skilled natives in terms of adverse employment and wage outcomes for this group. These results highlight the importance of educational attainment and the relevance of improving and adequately using skills of refugees. Detailed simulation results for the two scenarios can be found in Table 33 and Table 34.

Scenario 1 - Overall	2014	2015	2016	2017	2018	2019	2020	2025	2030
GDP	0.03%	0.08%	0.18%	0.31%	0.38%	0.42%	0.45%	0.65%	0.73%
Private Consumption	0.05%	0.10%	0.23%	0.42%	0.49%	0.52%	0.54%	0.72%	0.83%
Investment	0.99%	1.08%	1.14%	1.14%	1.13%	1.12%	1.12%	0.99%	0.87%
Capital Stock	0.05%	0.10%	0.16%	0.22%	0.27%	0.32%	0.36%	0.54%	0.64%
Gross wage rate (labour costs per hour)	0.04%	0.02%	-0.12%	-0.32%	-0.30%	-0.27%	-0.26%	-0.32%	-0.27%
-low	0.01%	-0.02%	-0.12%	-0.24%	-0.20%	-0.18%	-0.18%	-0.23%	-0.21%
-medium	0.02%	0.00%	-0.13%	-0.29%	-0.26%	-0.23%	-0.24%	-0.30%	-0.26%
-high	0.07%	0.06%	-0.11%	-0.36%	-0.36%	-0.32%	-0.30%	-0.35%	-0.29%
Net wage rate	0.04%	0.02%	-0.12%	-0.31%	-0.29%	-0.26%	-0.25%	-0.31%	-0.26%
-low	0.01%	-0.02%	-0.12%	-0.23%	-0.20%	-0.17%	-0.18%	-0.22%	-0.21%
-medium	0.02%	0.00%	-0.12%	-0.28%	-0.25%	-0.23%	-0.23%	-0.29%	-0.25%
-high	0.07%	0.06%	-0.11%	-0.36%	-0.36%	-0.31%	-0.30%	-0.35%	-0.28%
Participation rate - 15-69 yrs. (change in pp)	0.00	-0.03	-0.11	-0.21	-0.20	-0.19	-0.17	-0.01	-0.01
-low	-0.01	-0.03	-0.08	-0.14	-0.14	-0.13	-0.11	0.03	0.02
-medium	-0.01	-0.03	-0.11	-0.21	-0.21	-0.20	-0.18	-0.02	-0.02
-high	0.00	-0.03	-0.11	-0.22	-0.22	-0.21	-0.19	-0.04	-0.01
Employment (# workers)	0.01%	0.07%	0.23%	0.45%	0.53%	0.56%	0.60%	0.85%	0.90%
-low	0.00%	0.06%	0.21%	0.43%	0.52%	0.55%	0.59%	0.83%	0.89%
-medium	0.01%	0.07%	0.24%	0.47%	0.55%	0.58%	0.62%	0.87%	0.92%
-high	0.02%	0.08%	0.23%	0.42%	0.49%	0.53%	0.57%	0.80%	0.88%
Unemployment rate (change in pp)	0.00	0.01	0.07	0.14	0.14	0.14	0.15	0.20	0.20
-low	0.00	0.03	0.11	0.21	0.21	0.21	0.22	0.29	0.29
-medium	0.00	0.01	0.06	0.12	0.13	0.12	0.13	0.17	0.17
-high	-0.01	0.01	0.06	0.14	0.15	0.15	0.15	0.20	0.21
Scenario 1 - Natives	2014	2015	2016	2017	2018	2019	2020	2025	2030
Gross wage rate (labour costs per hour)	0.04%	0.04%	-0.06%	-0.20%	-0.17%	-0.13%	-0.12%	-0.13%	-0.08%
-low	0.01%	0.00%	-0.05%	-0.11%	-0.06%	-0.03%	-0.03%	-0.01%	0.00%
-medium	0.03%	0.01%	-0.07%	-0.17%	-0.13%	-0.10%	-0.09%	-0.11%	-0.07%
-high	0.07%	0.07%	-0.06%	-0.26%	-0.24%	-0.19%	-0.17%	-0.17%	-0.10%
Net wage rate	0.04%	0.03%	-0.06%	-0.20%	-0.17%	-0.13%	-0.12%	-0.13%	-0.08%
-low	0.01%	0.00%	-0.05%	-0.11%	-0.06%	-0.03%	-0.03%	-0.01%	0.00%
-medium	0.03%	0.01%	-0.07%	-0.17%	-0.13%	-0.10%	-0.09%	-0.11%	-0.07%
-high	0.07%	0.07%	-0.06%	-0.26%	-0.24%	-0.19%	-0.17%	-0.17%	-0.10%
Participation rate - 15-69 yrs. (change in pp)	0.00	0.00	-0.01	-0.02	-0.01	-0.01	-0.01	-0.01	0.00
-low	0.00	-0.01	-0.01	-0.02	0.00	0.00	0.00	0.00	0.00
-medium	0.00	-0.01	-0.02	-0.03	-0.01	-0.01	-0.01	-0.01	-0.01
-high	0.00	0.00	0.00	-0.02	-0.01	-0.01	0.00	0.00	0.00
Employment (no. of workers)	0.00%	0.00%	-0.03%	-0.07%	-0.04%	-0.03%	-0.03%	-0.03%	-0.01%
-low	0.00%	-0.02%	-0.04%	-0.07%	-0.03%	-0.01%	-0.01%	0.00%	0.00%
-medium	0.00%	-0.01%	-0.04%	-0.07%	-0.04%	-0.03%	-0.03%	-0.02%	-0.01%
-high	0.01%	0.01%	-0.02%	-0.07%	-0.06%	-0.05%	-0.04%	-0.04%	-0.04%
Unemployment rate (change in pp)	0.00	0.00	0.01	0.03	0.02	0.02	0.02	0.02	0.01
-low	0.00	0.00	0.02	0.03	0.01	0.01	0.01	0.00	0.00
-medium	0.00	0.00	0.01	0.03	0.02	0.02	0.01	0.02	0.01
-high	-0.01	-0.01	0.01	0.04	0.03	0.03	0.02	0.02	0.01

Low: ISCED 0-2, medium: ISCED 3-4, high: ISCED 5-6 (according to ISCED 1997). Source: LMM simulation results.

Scenario 2 - Overall	2014	2015	2016	2017	2018	2019	2020	2025	2030
GDP	0.01%	0.04%	0.10%	0.20%	0.24%	0.26%	0.29%	0.41%	0.46%
Private Consumption	-0.01%	0.03%	0.13%	0.29%	0.33%	0.36%	0.38%	0.52%	0.61%
Investment	0.51%	0.56%	0.60%	0.60%	0.59%	0.59%	0.59%	0.52%	0.45%
Capital Stock	0.03%	0.05%	0.08%	0.11%	0.14%	0.16%	0.19%	0.28%	0.34%
Gross wage rate (labour costs per hour)	0.03%	0.00%	-0.11%	-0.27%	-0.26%	-0.24%	-0.24%	-0.31%	-0.29%
-low	-0.02%	-0.26%	-0.90%	-1.65%	-1.57%	-1.53%	-1.62%	-2.09%	-2.11%
-medium	0.02%	0.02%	-0.01%	-0.04%	-0.03%	-0.01%	0.00%	0.00%	0.02%
-high	0.04%	0.04%	-0.04%	-0.16%	-0.16%	-0.14%	-0.12%	-0.13%	-0.08%
Net wage rate	0.02%	0.00%	-0.11%	-0.26%	-0.25%	-0.23%	-0.24%	-0.30%	-0.28%
-low	-0.02%	-0.25%	-0.88%	-1.61%	-1.52%	-1.49%	-1.58%	-2.05%	-2.08%
-medium	0.02%	0.02%	-0.01%	-0.04%	-0.02%	-0.01%	0.00%	0.00%	0.02%
-high	0.04%	0.04%	-0.04%	-0.16%	-0.16%	-0.13%	-0.12%	-0.13%	-0.08%
Participation rate - 15-69 yrs. (change in pp)	-0.01	-0.03	-0.11	-0.21	-0.21	-0.20	-0.18	-0.04	-0.05
-low	-0.01	-0.11	-0.38	-0.69	-0.70	-0.69	-0.60	-0.01	-0.08
-medium	-0.01	-0.02	-0.04	-0.07	-0.07	-0.06	-0.05	0.01	0.01
-high	0.00	-0.01	-0.05	-0.11	-0.10	-0.10	-0.08	-0.01	0.01
Employment (# workers)	0.00%	0.05%	0.18%	0.37%	0.43%	0.46%	0.49%	0.68%	0.72%
-low	0.01%	0.23%	0.87%	1.78%	2.08%	2.19%	2.31%	3.16%	3.26%
-medium	0.00%	0.02%	0.09%	0.18%	0.21%	0.22%	0.24%	0.35%	0.38%
-high	0.01%	0.04%	0.11%	0.21%	0.25%	0.27%	0.29%	0.40%	0.44%
Unemployment rate (change in pp)	0.00	0.03	0.11	0.22	0.23	0.23	0.24	0.32	0.32
-low	0.02	0.18	0.60	1.13	1.14	1.14	1.20	1.55	1.55
-medium	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.04	0.04
-high	0.00	0.00	0.03	0.07	0.07	0.07	0.07	0.09	0.09
Scenario 2 - Natives	2014	2015	2016	2017	2018	2019	2020	2025	2030
Gross wage rate (labour costs per hour)	0.03%	0.02%	-0.03%	-0.11%	-0.08%	-0.06%	-0.05%	-0.05%	-0.03%
-low	-0.01%	-0.17%	-0.58%	-1.03%	-0.90%	-0.85%	-0.90%	-1.18%	-1.22%
-medium	0.02%	0.02%	0.01%	0.00%	0.02%	0.03%	0.04%	0.06%	0.08%
-high	0.04%	0.05%	-0.01%	-0.11%	-0.10%	-0.07%	-0.06%	-0.04%	0.01%
Net wage rate	0.03%	0.02%	-0.04%	-0.11%	-0.09%	-0.07%	-0.06%	-0.06%	-0.04%
-low	-0.01%	-0.17%	-0.57%	-1.03%	-0.90%	-0.84%	-0.90%	-1.17%	-1.21%
-medium	0.02%	0.02%	0.01%	0.00%	0.02%	0.03%	0.04%	0.06%	0.08%
-high	0.04%	0.05%	-0.01%	-0.11%	-0.10%	-0.07%	-0.06%	-0.04%	0.01%
Participation rate - 15-69 yrs. (change in pp)	0.00	-0.01	-0.02	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01
-low	-0.01	-0.03	-0.09	-0.15	-0.13	-0.12	-0.13	-0.17	-0.18
-medium	0.00	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.01	0.01
-high	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.01
Employment (no. of workers)	0.00%	-0.01%	-0.04%	-0.08%	-0.05%	-0.04%	-0.05%	-0.05%	-0.04%
-low	-0.02%	-0.12%	-0.35%	-0.60%	-0.52%	-0.49%	-0.53%	-0.70%	-0.76%
-medium	0.00%	0.00%	0.00%	0.00%	0.02%	0.02%	0.03%	0.05%	0.07%
-high	0.00%	0.00%	-0.01%	-0.03%	-0.02%	-0.02%	-0.01%	-0.01%	0.00%
Unemployment rate (change in pp)	0.00	0.00	0.02	0.04	0.03	0.02	0.02	0.03	0.02
-low	0.00	0.05	0.16	0.28	0.23	0.22	0.23	0.30	0.32
-medium	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01
-high	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.00	0.00

Tahle 34+	Detailed	Simulation	Results -	Scenario 2
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Low: ISCED 0-2, medium: ISCED 3-4, high: ISCED 5-6 (according to ISCED 1997). Source: LMM simulation results.

# B. Annex B

### B.1. Specific Information for Modelling Experts

This chapter provides information on how particular institutional details are modelled in the different countries. It provides information on the modelling of overall public revenues, income taxation and social security contributions and of the different pension schemes. This information is of interest mainly for modelling experts of the European Commission.

### B.1.1. Revenue Statistics

This chapter provides information on adjustment to data from the Revenue Statistics that were carried out because EU-LMM includes items (such as occupational pension schemes) that are not included in the Revenue Statistics or because contributions are classified differently in the model and the Revenue Statistics. In these cases, data for the adjustment were provided by OECD staff and national experts or national sources.

#### Denmark

Contributions to occupational pension schemes agreed between the social partners are not included in the Revenue Statistics. According to OECD's Global Pension Statistics, contributions to these schemes amount to 6.6 % of GDP on average in the years 2011-2014. This amount is included in the item 'Social Security' in EU-LMM.

In 2013 and 2014, revenues were exceptionally high in Denmark due to one-off measures associated with the conversion of the endowment pensions to the age pension plan and from bringing forward the ordinary redemption of endowment pensions.<sup>47</sup> We subtract these one-off revenues in order to apply 'structural revenues'.

Different than in most other countries, there are fixed (non-earnings related) social security contributions (unemployment, supplementary pension) in Denmark, which are included in the variables 'zw', 'zu' and 'zf' and which are also taken into account in calculating revenues in the model. However, the variables 'zw' and 'zu' also include sickness benefits, which makes it difficult to distinguish these flat social security contributions and sickness benefits in the model. Therefore, we diminish social security revenues by the expenditures for sickness benefits (which are taken from the Social Expenditures database of the OECD).

<sup>&</sup>lt;sup>47</sup> See, Skatteministeriet (the Danish Ministry for Taxation), <u>hyperlink</u>.

### France

Occupational pension schemes (such as the ARRCO scheme for the majority of private-sector employees) are not included in the Revenue Statistics. 'Social Security' revenues in the model are increased by an appropriate amount, taken from Vidlund et al. (2012).

### Germany

Contributions of individuals who have opted out of the public health insurance system into a private system are not included in the Revenue Statistics. Revenues from the item 'Social Security' are increased by numbers (for the 'Krankheitsvollversicherung' and the 'Pflegeversicherung') derived from the 'Gesundheitsberichterstattung des Bundes' (Federal Health Monitoring).

### Netherlands

Occupational pension schemes are not included in the Revenue Statistics. Based on information from the OECD Global Pension Statistic, 'Social Security' revenues in the model are increased by 5 % of GDP.

### Poland

Revenues from the National Health Fund are included in the item 'Social Security Contributions' in the Revenue Statistics. However, given that this contribution is part of the income tax rate in the labour market model, these revenues are redirected from the item 'Social Security' to 'Income' for the calibration of the model.

'Social Security' of the Revenue Statistics does not include contributions to the defined contribution scheme ('Open Pension Funds'). 'Social Security' revenues in the model are increased by an appropriate amount. Data for both adjustments (National Health Fund and the defined contribution scheme) have been provided by OECD staff.

### Slovak Republic

Category 2000 ('Social Security') of the Revenue Statistics does not include contributions to the defined contribution scheme. Data on these contributions are taken from OECD's 'Financing of Social Security Benefits' dataset. 'Social Security' revenues in the model are increased by an appropriate amount.

#### Sweden

Category 2000 ('Social Security') of the Revenue Statistics does not include contributions to the occupational pension schemes. Data on these contributions are taken from the Swedish Pensions

Agency (2012-2015). 'Social Security' revenues in the model are increased by an appropriate amount.

#### United Kingdom

Category 2000 ('Social Security') of the Revenue Statistics does not include contributions of those individuals who have contracted out of the state second pension. Data on these contributions can be found in OECD's 'Financing of Social Security Benefits' dataset. 'Social Security' revenues in the model are increased by an appropriate amount.

### B.1.2. Pension System

This chapter provides some information on how pension systems are modelled. We provide some insight on the general approach of modelling pension schemes as well as some country-specific details.

### General Information

Many countries are explicitly connecting future adjustments of pension benefits to the increasing life expectancy. Given that life expectancy is kept constant in a standard simulation, we do not take into account the reductions of future pension benefits. However, when simulating demographic ageing, this fact should be taken into account.

Pension benefits credited for childcare (and some other non-contributory periods) are not explicitly taken into account. Given that we do not model the fertility decision endogenously, it seems sufficient to us that these benefits are implicitly taken into account by the adjustment of the flat pension benefit ('p00adjustment'), see chapter 2.11.

LMM includes occupational pension schemes, but these are not included in OECD's Social Expenditure data. The Gauss file ,OccupationalPensionExp' derives expenditures of these occupational systems for LMM. Aggregate pension expenditures are adjusted by this amount.

#### France

Modelling a pension system that is based on (i) the average earnings of the best 25 years and (ii) the total number of contributory periods is tricky in LMM. Even early in lifetime, there are incentives to contribute because of (i) acquiring a period of insurance and (ii) contributing to the best 25 years if for some reason earnings later in lifetime are not expected to be higher. Therefore, we follow the following approach: (i) calculate an 'actual' pension for an individual who contributes for 40 years (at an earnings profile that is determined by the Mincer estimation) and (ii) calculate a 'lifetime' accrual rate that is necessary to yield the same pension benefit (see the calculation in the file 'Pensionsfr.xlsx') for this individual.

#### Spain

For the calculation of the accrual rate, we take an approach similar to the method for France (see 'Pensionses.xlsx').

Receipt of unemployment benefits creates pension credits as the government takes over part of the contributions in case of unemployment. However, unemployment assistance does not create pension credits, except for people aged 55 or older. Data on recipients of unemployment benefits and assistance is taken from the Spanish Ministry for Employment and Social Security.

#### B.1.3. Income Taxation and Social Security Contributions

This chapter provides information on the implementation of country-specific institutional details concerning income taxation and social security contributions in the labour market model.

### Belgium

The non-earning spouse allowance (which implies that a notional amount of income can be transferred between spouses under certain conditions) is taken into account in the calibration of the tax rates. It is explicitly considered in the Stata-File, so that this procedure involves a non-standard way of deriving the parameter-file TaxBelgium.xlsx.<sup>48</sup>

#### Czech Republic

The assessment base for income taxation is gross earnings augmented with employer's social security contributions, a possibility that is not explicitly implemented in the labour market model. Our approach here is to implement

$$xtax = -\frac{tf}{ts} \Rightarrow taxable income = (1 - xtax * ts) * incgross = (1 + tf) * incgross$$

where 'tf' and 'ts' are the employer's and the employee's contribution rates. By this method, taxable income is calculated in the right way.

<sup>&</sup>lt;sup>48</sup> For instance, application of the Tax-Benefit model of the OECD for a couple with one earner would take into account the spouse allowance in the parameter file. As we consider the allowance on our own in the Stata-File, we do not want this reduction of income taxes to be included in the parameter file TaxBelgium, so that we replicate 'Single' files also for the '1Earner' and the 'Principal' sheets.
#### France

Employers' contributions in the TaxBenefit model include 'other' contributions such as the supplemental pension and the AGFF contribution and also take into account a reduction of employer-paid social insurance contributions ('Fillon Act'). The supplemental pension is also taken into account in our modelling of the pension system.

CSG and CRDS are part of the income tax in the Tax-Benefit model and in the Revenue Statistics. The assessment base of the CSG and the CRDS is 98.25% of gross pay and CSG is partly deductible for income taxation. We follow the OECD and also categorise these two contributions as income tax. For simplicity, we assume that these contributions have the same assessment base as the income tax (even though the assessment base actually is 0.9825\*gross pay). Given that we make this assumption both in the TaxFrance-file and in the labour market model, this method delivers fine results. Compulsory employer and employee contributions are deductible for income taxation, (except for CSG and CRDS). As the latter two are part of our income tax, we can set 'xtax'=1.

The PPE and the tax credit for low income households are taken into account in the calibration of the average tax rate.

Local Taxes are not included in the Tax-Benefit model of the OECD, because 'they vary widely'. As long as they are considered in the Revenue Statistics, they are included in the aggregate revenues of the labour market model. Thus, tax rates are scaled appropriately in the calibration routine of LMM.

#### Spain

Given that the Tax-Benefit model does not incorporate the lower ceiling for social security contributions, we manually set the rate to zero in the TaxSpain-file below the ceiling.

In general, individuals are taxed separately in Spain, but families can opt for being taxed as married couples or as heads of households. The Tax-Benefit model calculates tax liabilities on the basis of these different options and assumes that households opt for the more beneficial situation. That way, this system is also taken into account when calibrating the tax rates in the labour market model.

#### Sweden

The EITC is implicitly taken into account via lower income tax rates. Furthermore, a tax credit equal to 100 % of compulsory employee's social security contributions is granted. On the other hand, as contributions are not deductible for income taxation, we set 'xtax' equal to zero in the LMM. This

issue is, however, somehow tricky to implement in case of policy reforms. The amount of the tax credit (i.e. the average income tax rate) is changed if the employees' rate changes because of a policy reform.<sup>49</sup>

A reduced employers' social security contribution is applied for individuals aged under 26. We calculate the rates as if there was no reduction and then reduce the resulting rates in the DataInputSweden file.

Occupational pensions are included in the model by using information from Pensions at a Glance. For simplicity, we assume that 90 % of all employees are covered by the ITP scheme, which has a contribution rate of 4.5 % below the threshold and 30 % above.

<sup>&</sup>lt;sup>49</sup> Assume, for example, an increase of the employee rate (in order to finance higher social expenditures). Given the institutional setting, this implies a one-for-one decrease of income tax revenues (as the tax credit increases in line with the increase of the employee's rate).

## B.2. Parameters of Mincer-Estimation

As described in Chapter 2.3, wage profiles in the model are derived by a Mincer equation. Table 35 gives the estimates of the Mincer equation as described above. The variables  $r_m$  and  $r_h$  reflect return to schooling of medium- and high-skilled persons and  $r_{mn}$  and  $r_{mf}$  for example return to schooling of medium-skilled natives and foreigners.

	All employees				Dummies for natives and foreigners								
	α	r <sub>m</sub>	r <sub>h</sub>	δ	γ	α	r <sub>mn</sub>	r <sub>hn</sub>	r <sub>lf</sub>	r <sub>mf</sub>	r <sub>hf</sub>	δ	γ
AT	1.96	0.37	0.77	0.033	-0.00044	2.00	0.35	0.75	-0.15	0.11	0.51	0.034	-0.00049
BE	2.27	0.18	0.52	0.026	-0.00031	2.29	0.16	0.49	-0.11	0.08	0.48	0.027	-0.00034
CZ	4.25	0.26	0.69	0.018	-0.00038	4.25	0.26	0.71	-0.07	0.28	0.81	0.019	-0.00038
DE	1.90	0.27	0.69	0.032	-0.00052	1.87	0.29	0.72	0.13	0.28	0.59	0.032	-0.00052
DK	4.68	0.13	0.37	0.028	-0.00043	4.68	0.13	0.39	-0.04	0.10	0.34	0.028	-0.00043
ES	1.33	0.27	0.74	0.039	-0.00047	1.36	0.30	0.73	-0.22	-0.07	0.40	0.040	-0.00051
FI	2.44	0.05	0.43	0.024	-0.00039	2.44	0.05	0.43	-	-0.03	0.28	0.024	-0.00039
FR	1.96	0.19	0.58	0.025	-0.00035	1.95	0.19	0.59	-0.02	0.16	0.47	0.026	-0.00035
IT	1.60	0.32	0.66	0.043	-0.00058	1.62	0.33	0.66	-0.17	-0.04	0.27	0.044	-0.00062
NL	2.24	0.22	0.63	0.038	-0.00055	2.24	0.22	0.63	-0.09	0.12	0.53	0.038	-0.00055
PL	1.95	0.24	0.84	0.030	-0.00049	1.95	0.25	0.85	-0.29	0.15	1.00	0.028	-0.00043
SE	4.23	0.17	0.35	0.048	-0.00073	4.28	0.14	0.34	-0.26	0.00	0.24	0.050	-0.00077
SK	0.96	0.21	0.54	0.012	-0.00026	0.96	0.21	0.54	-0.07	0.05	0.53	0.012	-0.00027
UK	1.83	0.17	0.58	0.026	-0.00047	1.85	0.16	0.57	-0.08	0.11	0.53	0.025	-0.00044

Table 35: Mincer Parameters, all employees and additional dummies for natives and foreigners

Source: OECD, own calculations.

# B.3. List of Variables that have to be updated

#### Table 36: List of Variables that have to be updated

Macroeconomic							
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference
scalingfactor	gross value added (to scale values) <sup>1</sup>	endogenous var.	in 100 bn. of national currency	scalar	Eurostat	GVA = GDP-Taxes on products+Subsidies on products	SystemofNationalAccounts.xlsx
К	physical capital stock	endogenous var.	in percent of GVA	scalar	AMECO, Eurostat	average 2011-2014 value;	SystemofNationalAccounts.xlsx
r	exogenous real interest rate	exogenous parameter	in percent	scalar		set to replicate capital share and capital stock	
gx	exogenous real (trend) growth rate	exogenous parameter	in percent	scalar	AMECO	same for all countries: growth of real GDP/capita	SystemofNationalAccounts.xlsx
gdp	gross domestic product	endogenous var.	in 100 bn. of national currency	scalar	Eurostat	current (2014) value	SystemofNationalAccounts.xlsx
tb	trade balance	endogenous var.	in percent of GVA	scalar	Eurostat	average 2011-2014 value; tb = External balance of goods and services / GVA	SystemofNationalAccounts.xlsx
dg	gross government debt	endogenous var.	in percent of GVA	scalar	Eurostat	current (2014) value; dg = Government consolidated gross debt / GVA	SystemofNationalAccounts.xlsx
isk	capital share	endogenous var.	in percent of GVA	scalar	AMECO, own calculations	based on AMECO adjusted labour share and own calculations based on SNA	SystemofNationalAccounts.xlsx
ch	public health expenditures	policy parameter	in percent of GVA	scalar	OECD Health Data	average 2011-2013 value	PublicHealth.xlsx
cgdata	public consumption expenditures	exogenous parameter	in percent of GDP	scalar	Eurostat	average 2011-2014 value;	SystemofNationalAccounts.xlsx
Labour Market							
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference
eff	number of hours spent working	endogenous var.	normalized to 1 for young low-sk.	5x3	LFS	derived by eff0.do Stata-File	LFS_variables_xxx.xlsx, Sheet effort
heff	number of hours spent in training	endogenous var.	relative to eff[1,1] <sup>2</sup>	5x3	LFS	derived by heff.do Stata-File	LFS_variables_xxx.xlsx, Sheet heff-calc
hefffirm	amount of firm-sponsored training	endogenous var.	relative to eff[1,1] <sup>2</sup>	5x3	LFS	derived by heff.do Stata-File	LFS_variables_xxx.xlsx, Sheet heff-calc
partrate	participation rate	endogenous var.	in percent	5x3	LFS	derived by partratdeltap.do Stata-File	LFS_variables_xxx.xlsx, Sh. participation
deltabar	share of individuals not disabled	exogenous parameter	in percent	8x3	EU-SILC	derived by deltabar.do Stata-File	EUSILC_variables_xxx.xlsx, Sheet deltabar
u	unemployment rate	endogenous var.	in percent	5x3	LFS	derived by unratu0.do Stata-File	LFS_variables_xxx.xlsx, Sh. unemployment
emplfac	prob. of having a job without searching	input for exog. var. <sup>3</sup>	in percent	5x3	LFS	derived by emplfac0.do (emplfac0_dk_years).do Stata-File	LFS_variables_xxx.xlsx, Sheet emplfac
layoffshare	Share of layoffs among separations	input for end. var. <sup>3</sup>	in percent	5x3	LFS, EU-SILC	derived by firingrateLFS.do (LFS data on firing) and leavereason.do (EU-SILC data on quits)	layoffshare.xlsx
wagemincer	age-dependent wage profile	input for end. var. <sup>3</sup>	relative to wage[youngest work,.] <sup>4</sup>	5x3	EU-SILC	derived by mincer_regressions.do Stata-File	EUSILC_variables_xxx.xlsx, Sh. Mincerxxxreg
skillwagemincer	skill-dependent wage profile	input for end. var. <sup>3</sup>	relative to youngest low-skilled	1x2	EU-SILC	derived by mincer_regressions.do Stata-File	EUSILC_variables_xxx.xlsx, Sh. Mincerxxxreg
wagmincerflag	do Mincer estimates refer to net or gross wages?		binary	scalar		0if gross-wages are used for calculation of Mincer equation, 1if net-wages are used	
hiringcosts	aggregate hiring costs	endogenous var.	as percent of labour costs	1x3	empirical literature		
consumption profile	private consumption age-profile	endogenous var.	relative to priv. cons. of age 20-24	8x1	Eurostat	age-profile of consumption per adult equivalent	consumptionprofile.xlsx

<sup>1)</sup> as output is normalized to 100 in the model, this number is only necessary to get a reference to the actual figures; <sup>2)</sup> number of hours spent working of the youngest low-skilled; <sup>3)</sup> a variable is derived from this input in 'calib'; <sup>4)</sup> wage of youngest age group at the labour market of each skill group.

## Table 36 (continued): List of Variables that have to be updated

Demographic								
Parameter/Variable	Description	Туре	Unit/Scale	Dimension Data Source		calibrated	Reference	
gamv	probability of surviving	exogenous parameter	in percent	8x1	Eurostat	1-year rates 'aggregated' into model cohorts	Demography.xlsx	
skill_distribution	share of different skill groups in total population	endogenous var.	in percent	1x3	Eurostat	current (2013) value for age group 25-64 years	SkillStructure.xlsx	
Public System I								
Expenditure and Reven	nue Shares, Tax Rates							
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference	
shtcons, shtw, shtssc	various revenue shares	endogenous var.	as percent of GVA	scalars	OECD Rev. Stat. 1)	average 2011-2014 value	TaxStructures.xlsx	
shtprof, shtindiv	various revenue shares	endogenous var.	as percent of GVA	scalars	OECD Rev. Stat. 1)	average 2011-2014 value	TaxStructures.xlsx	
shtcap, firmsubsidies	various revenue/expenditure shares	endogenous var.	as percent of GVA	scalars	OECD Rev. Stat., Eurostat	average 2011-2014 value, shtcap different from 0 if it supports calibration of K and isk	TaxStructures.xlsx, SystemofNationalAccounts.xlsx	
shynonpar	total amount of social assistance	endogenous var.	as percent of GVA	scalar	EU-SILC, OECD	Social exclusion expenditures for non-participating persons, derived by divsocialexcl.do Stata-file	EUSILC_variablesxxx.xlsx, Sheet socialexcl	
						sum of education-, family-, housing- and		
shlump	total amount of lump-sum transfers	policy parameter	as percent of GVA	scalar	EU-SILC, OECD	part of social excl. allowances (to retired persons) - lump sum payments to households	EUSILC_variablesxxx.xlsx, Sh. lump-sum total	
tprof	effective marginal corporate income tax rate	policy parameter	in percent	scalar	ZEW (2014), DG TAXUD			
factctotcg	share of public consumption taxed by cons. taxes	policy parameter	in percent	scalar	Eurostat	derived as intermediate public consumption plus cons. of fixed publ capital as share of total publ cons.	SharePublicConsumption- TaxedbyConsumptionTaxes.xlsx	
Pension System								
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference	
mp	pension accrual rate of labour income	policy parameter	in percent of gross labour income	5x3	institutional detail		Pensions.xlsx	
m1	pension accrual rate independent of labour income	policy parameter	in percent of labour costs	5x3	institutional detail		Pensions.xlsx	
b1	pension accrual for unemployment periods	policy parameter	in percent of gross labour income	5x3	institutional detail		Pensions.xlsx	
pinc	indexation of pension claims	policy parameter	in percent	8x3	institutional detail		Pensions.xlsx	
sig0m, sig1m	supplements for pension contributions of mixed gr.	policy parameters	in percent	1x3	institutional detail		Pensions.xlsx	
sigOp, sig1p	supplements for pension stock of mixed gr.	policy parameters	in percent	1x3	institutional detail		Pensions.xlsx	
corrp	reference for the pension corridor (statutory retirement age)	policy parameter	∈ [0,1]	1x3	institutional detail		Pensions.xlsx	
pensinvfac	'imputation' for public disability pensions	policy parameter	in percent	5x3	institutional detail		Pensions.xlsx	
va2	adjustment factor in disability pension system	policy parameter	in % of gross pension of mixed gr.	8x3	EU-SILC	derived from the data	Pensions_xxx.xlsx, Sheet pensionrepl	
p00early	flat disability pension benefit	policy parameter	in percent of labour costs	8x3 (5x3)	institutional detail		Pensions.xlsx	
p00	flat pension payments	policy parameter	in percent of labour costs	8x3 (4x3)	institutional detail		Pensions.xlsx	
expenpenscalib	public pension expenditures	endogenous var.	as percent of GVA	scalar	OECD Soc.Exp., other	adjustment of data for e.g. occup. pensions	SocialExpendituresOECD.xlsx	

<sup>1)</sup> some adjustments to include additional items.

## Table 36 (continued): List of Variables that have to be updated

Unemployment Insurance and Social Benefit System									
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference		
lump_00	structure of lump-sum transfers to households	policy parameter	share (sum of 8x3 entries is 1)	8x3	EU-SILC	share of the sum of education-, family-, housing- and part of social excl. allowances (to retired) for age- and skill groups on total exp. (sums up to 1)	EUSILC_variablesxxx.xlsx, Sh. lump-sum total		
xi1	share of unempl. benefits indexed to prev. earnings	policy parameter	in percent	5x3	inst. detail, EU-SILC	if unempl. benefits are totally wage dependent: xi1 equals the overall eligibility rate otherwise: dependent on institutional details	EligibilityandReplRate.xlsx		
brepl	unemployment repl. rate of earnings-related benefits	policy parameter	in percent	5x3	inst. detail, EU-SILC	if unempl. benefits are totally wage dependent: brepl equals the overall replacement rate otherwise: dependent on institutional details	EligibilityandRepIRate.xlsx		
b_00	benefits for unemployed not indexed to prev. earnings	policy parameter	in percent of gross income	5x3	inst. detail, EU-SILC	sum of b00-unemployment: if unempl. benefits are totally wage dependent 0; otherwise dependent on institutional details b00-social exclusion: social exclusion benefits paid to unemployed persons (based on divsocialexcl.do Stata-file) b00-sickness benefits: sickness benefits paid to unemployed receiving flat benefits (based on eligibility-x1)	EligibilityandReplRate, EUSILC_variablesxxx.xlsx		
ynonpar	social assistance for inactive individuals	policy parameter	relative share	4x3 <sup>1</sup>	EU-SILC	social exclusion exp. for non-participating persons, derived by applying divsocialexcl.do Stata-file	EUSILC_variablesxxx.xlsx, Sheet socialexcl		
Public System II Life-Cycle- and Skill-St	ructure of Tax/Benefit System								
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference		
twavgstart	'initial' income tax rate of workers <sup>2</sup>	policy parameter	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	EUSILC_variablesxxx.xlsx, Sheet taxwage		
twpavgstart	'initial' income tax rate of retirees <sup>2</sup>	policy parameter	in percent	4x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	EUSILC_variablesxxx.xlsx, Sheet taxwage		
twearlyavgstart	'initial' income tax rate of disability pensions <sup>2</sup>	policy parameter	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	EUSILC_variablesxxx.xlsx, Sheet taxwage		
tsscwavgstart	'initial' soc. sec. contr. rate of employees <sup>2</sup>	policy parameter	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	EUSILC_variablesxxx.xlsx, Sheet ssc		
tsscfavgstart	'initial' soc. sec. contr. rate of employers <sup>2</sup>	policy parameter	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	EUSILC_variablesxxx.xlsx, Sheet emplcontr		
tsscpavgstart	'initial' soc. sec. contr. rate of retirees <sup>2</sup>	policy parameter	in percent	4x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	statutory rates		
tsscearlyavgstart	'initial' soc. sec. contr. rate of disability pensions <sup>2</sup>	policy parameter	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	statutory rates, EUSILC_variablesxxx.xlsx		
tuavgstart	'initial' income tax rate of unemployed <sup>2</sup>	policy parameter	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	statutory rates, EUSILC_variablesxxx.xlsx		
tufixavgstart	'initial' income tax rate of flat unempl. benefits <sup>2</sup>	policy parameter	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	statutory rates, EUSILC variablesxxx.xlsx		
tsscuavgstart	'initial' soc. sec. contr. rate of unemployed <sup>2</sup>	policy parameter	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	statutory rates, EUSILC variablesxxx.xlsx		
tsscufixavgstart	'initial' soc. sec. contr. rate of flat unempl. benefits <sup>2</sup>	policy parameter	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	statutory rates		
zw, zu	flat social transfer paid to workers and unemployed <sup>3</sup>	policy parameters	in percent of labour costs	5x3	EU-SILC, LFS	avg benefits as share of avg labour costs times share of persons receiving benefits	EUSILC_variablesxxx.xlsx		
xtaxw, xtaxearly	share of ssc of workers/disabled deductible from inc. tax	policy parameters	in percent	5x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	instit. detail, EUSILC_variablesxxx.xlsx		
xtaxp	share of ssc of retirees deductible from income tax	policy parameter	in percent	4x3	OECD, inst. Detail, EU-SILC	apply Tax'Country'.xlsx on EU-SILC data	instit. Detail		
assessmentfactor	share of labour income s.t. soc. sec. contribution	policy parameter	in percent	5x3	EU-SILC	calculate share of income in diff. Income brackets	Pensionsxxx.xlsx, Sh. assessmentpensionxxx		
taxtau_s0	tax rate on severance payments	policy parameter	relative to inc. tax [0], in perc. [1]	5x3	institutional detail		TaxationSeverancePay.xlsx		
taxtau_s0-flag	flag related to taxtau_s0 (see above)		binary	scalar	institutional detail		TaxationSeverancePay.xlsx		
zt	flat soc. sec. contr. of firm	policy parameter	in percent of labour costs	5x3	institutional detail		TaxDenmark.xlsx		

<sup>1</sup>) no social assistance for mixed group (non-participants are retired); <sup>2</sup>) 'initial' in the following sense: the structure of tax rates determined here, but adjusted in calib to match revenue shares; <sup>3</sup>) zu is only paid to unemployed persons receiving earnings dependent unemployment benefits.

## Table 36 (continued): List of Variables that have to be updated

EPL Parameters												
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference					
EPL-Index	overall EPL index	policy parameter	relative to Germany of prev. version	scalar	OECD	application of OECD EPL index indicators	EPL.xlsx					
ts-share	relative importance of severance payments	policy parameter	in percent of total EPL	scalar	OECD	application of OECD EPL index indicators	EPL.xlsx					
tenure	tenure in job	'endogenous' var.	relative to tenure[1,1]	5x3	LFS	derived by tenure.do Stata-file	LFS_variables_xxx.xlsx, Sh. Tenure					
General Model Parame Production	eters (Currently Identical for all countries) in 'Param'											
Parameter/Variable	Description	Type	Unit/Scale	Dimension	Data Source	calibrated	Reference					
sigprod	substitution elasticity in production	exogenous parameter	exponent	1x3	empirical lit.	investment reaction in line with empirical estimates	Report, p. 75, elasticities, elasticities.xlsx					
psi	scaling factor for capital adjustment costs	exogenous parameter	factor	scalar	empirical lit.	half of adjustment of capital stock within 6 years	Report, p. 78, elasticities, elasticities.xlsx					
					·							
Labour Supply Elasticities												
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference					
v I	intensive labour supply elasticity	preference par.	exponent	1x3	empirical lit.		Report, p. 72					
v_par	connected with participation elasticity	preference par.	exponent	4x3	empirical lit.	set to match empirical extensive labour supply elasticities	Report, p. 72, elasticities, elasticities.xlsx					
v par retirement	connected with retirement elasticity	preference par.	exponent	1x3	empirical lit.	set to match empirical retirement age elasticities	Report, p. 73, elasticities, elasticities.xlsx					
eps d	education costs	exogenous parameter	exponent	scalar	empirical lit.	set to match empirical education elasticity	Report, p. 86, elasticities, elasticities.xlsx					
sig	intertemporal elasticity of substitution	preference par.	exponent	1x3	empirical lit.		Report, p.71					
Human Capital												
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference					
alphahumcap	individual human capital prod. function exponent	exogenous parameter	exponent	5x3	empirical lit.		Report, p. 87					
alphafirm	HC production function firm-spons. training exponent	exogenous parameter	exponent	5x3	empirical lit.		Report, p. 87					
htfp	individual HC production function factor	exogenous parameter	factor	5x3	empirical lit.		Report, p. 87					
epsthetaheff	elast. of productivity w.r.t. to firm-sponsored training	exogenous parameter	elasticity	scalar	empirical lit.		2nd Report (ch. 2.14), FirmTrainings.xlsx					
elfirmhumcostvalue	exponent of firm-sponsored training costs	exogenous parameter	exponent	scalar	empirical lit.		2nd Report (ch. 2.14), elasticities					
thetanb_00	productivity of 'newborns'	exogenous parameter	relative to prod.[youngest work,.] <sup>1</sup>	1x3	EU-SILC		EUSILC_variables_xxx.xlsx, Sh. Mincerxxxreg					
Labour Market Parame	eters											
Parameter/Variable	Description	Туре	Unit/Scale	Dimension	Data Source	calibrated	Reference					
barg	bargaining power of firms	exogenous parameter	exponent	1x3	empirical lit.	bargaining power in our model in relation to bargaining power mostly used in literature	Report, p. 84					
sigma	exponent of matching function	exogenous parameter	exponent	5x3	empirical lit.	connected with barg. power and Hosios condition	Report, p. 83					
v_u	job search costs	preference par.	exponent	5x3	empirical lit.	set so that elasticity of unemployment rate matches empirical estimates	Report, p.73, elasticities, elasticities.xlsx					
epsvac	vacancy costs	exogenous parameter	exponent	5x3	empirical lit.		Report, p.78					
v_f	managerial costs	exogenous parameter	exponent	scalar	empirical lit.	set to match empirical layoff elasticity	Report, p. 79, elasticities, elasticities.xlsx					
Variables in 'DataInput', that do not need to be updated												
Parameter/Variable	Description	Туре		reason								
deltap	'depreciation' of pension rights	is currently set	to zero for all co	untries								
va1	adjustment of pension payments	policy parameter	is currently set	to zero for all co	untries							
corrm	reference for accumulating pension points of mixed gr.	policy parameter	is currently set	to zero for all co	untries							

<sup>1)</sup> productivity of youngest age group at the labour market of each skill group.

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