The Austrian Tax Transfer Model ATTM

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EXECUTIVE SUMMARY (GERMAN)

Das Mikrosimulationsmodell ATTM (Austrian Tax-Transfer Model) ermöglicht die ex-ante Analyse von Reformen des österreichischen Steuer- und Transfersystems. Gegenwärtig sind folgende Komponenten des Systems in ATTM implementiert.

- Sozialversicherungsbeiträge
- Lohn- und Einkommensteuer
- Familienbeihilfe
- Kinderbetreuungsgeld
- Familienförderungen der Bundesländer
- Altersteilzeitregelung
- Vorzeitige Alterspension aufgrund langer Versicherungsdauer (Hacklerregelung)
- Arbeitslosengeld/Notstandshilfe
- Sozialhilfe
- Ausgleichszulage

ATTM beinhaltet dabei die Parameter der gelisteten Komponenten aus den Jahren 2005- 2023.Es kann jede beliebige Veränderung dieser Komponenten simuliert werden. Nach einer entsprechenden Erweiterung könnten auch indirekte Steuern (USt, MöSt, etc.) in das Analysespektrum einbezogen werden. Dazu kann die Datenbasis durch Integration der Konsumerhebung für Österreich, die von Statistik Austria alle 5 Jahre durchgeführt wird (die aktuelle Erhebung bezieht sich auf 2019/20), mittels statistischer Methoden („Statistical Matching“) erweitert werden.

ATTM basiert auf repräsentativen Individualdaten (EU-SILC der Jahre 2005 - 2021), die umfassende Informationen zu Einkommen, Beschäftigungsstatus und soziodemographischen Charakteristika der österreichischen Bevölkerung beinhalten. Das Modell nutzt diese Informationen, um Verhaltensanpassungen im Rahmen eines mikroökonometrisch geschätzten Arbeitsangebotsmodells zu schätzen, und die Verteilungseffekte von Reformen zu bestimmen.

Vorteile von ATTM

Die Untersuchung der Auswirkungen von Reformmaßnahmen mittels Mikrosimulationen zeichnet sich gegenüber anderen Analysemethoden durch folgende Vorteile aus.

Berücksichtigung von Anreizwirkungen, Verhaltensanpassungen und Beschäftigungseffekten

Reformen des Steuer- und Sozialsystems bewirken Veränderungen von individuellen Grenzsteuersätzen, Nettolöhnen und Arbeitsanreizen. Es ist daher möglich, dass sich Personen aufgrund der Reform zu einer Erhöhung oder Reduktion ihres Arbeitsangebots entscheiden. Diese Anpassungen können in den Simulationsrechnungen geschätzt und auf die Gesamtbevölkerung hochgerechnet werden.

Detaillierte Verteilungsanalysen

Durch Nutzung der soziodemographischen Daten kann bestimmt werden, wie sich Reformen der Steuer- und Sozialpolitik auf Haushalte mit hohen bzw. niedrigen Einkommen, Arbeitnehmer, Selbständige, Pensionisten, Alleinstehende, Alleinerzieher, Familien, Frauen etc. auswirken. Darüber hinaus kann bestimmt werden, ob durch die jeweiligen Reformen die Einkommensverteilung gleicher oder ungleicher wird.

Detaillierte Analyse der fiskalischen Reformkosten

einer Komponente des Steuer- und Sozialsystems wirken sich auch auf andere Reformen Komponenten aus. Eine Erhöhung der Bemessungsgrundlage der Sozialversicherungsbeiträge würde beispielsweise das Lohnsteueraufkommen senken, da ein größerer Teil des Bruttolohns für SV-Beiträge aufgewendet und damit nicht mehr versteuert wird. Bei einer Bestimmung der Gesamtkosten von Reformen müssen derartige Effekte berücksichtigt werden.

Analyse der Auswirkungen, bevor Reformmaßnahmen in Kraft treten

Die oben genannten Analysen der Beschäftigungs-, Verteilungs-, und Kosteneffekte kann für jedes beliebige Reformszenario ex-ante durchgeführt werden. Somit können Entscheidungsträger bereits vor einer Einführung mehrere Reformvarianten vergleichen und sich gemäß ihren Zielsetzungen entscheiden.

Anwendungs-bereiche

Das Spektrum an möglichen Reformen der Steuer- und Sozialpolitik ist breit und die Anzahl an Anwendungsbereichen von Mikrosimulationen daher groß. Die folgende Liste beinhaltet beispielhaft einige Fragestellungen, für deren Analyse Mikrosimulationsmodelle gut geeignet sind.

Aktivierende Arbeitsmarktpolitik

Arbeitslosenunterstützung

Die Anreize für Beschäftigungslose, eine Arbeit aufzunehmen, werden maßgeblich durch die Ausgestaltung der Arbeitslosenleistungen (Transferentzugsraten, Zuverdienstgrenzen etc.) bestimmt. ATTM erlaubt einen Vergleich der Anreizwirkungen und, damit einhergehend, der Verteilungswirkungen und Kosten verschiedener Transfermodelle.

Kombilohnsysteme

Eine teilweise Subventionierung von Löhnen würde die Anreize für Geringverdiener, eine Beschäftigung aufzunehmen, verbessern. Mit ATTM können die Beschäftigungswirkungen und Kosten quantifiziert und verschiedene Finanzierungsalternativen beurteilt werden.

Beschäftigungsförderung älterer Arbeitnehmer

In ATTM ist die Altersteilzeitregelung sowie die vorzeitige Alterspension aufgrund langer Versicherungsdauer (Hacklerregelung) implementiert. Somit können Veränderungen bzw. Neugestaltungen dieser Regelungen hinsichtlich ihrer Beschäftigungswirkungen und der damit verbundenen Kosten analysiert werden.

Armutsbekämpfung und Soziale Grundsicherung

Mit ATTM kann beurteilt werden, inwieweit Grundsicherungsmodelle zur Armutsbekämpfung geeignet sind, und wie stark die Anreize, eine Beschäftigung aufzunehmen, für Transferempfänger sind.

Sozialversicherung

ATTM erlaubt die Analyse der Verteilungs- und Beschäftigungswirkungen sowohl von Änderungen in der Struktur der Sozialversicherungsbeiträge (z.B. Erhöhung der Höchstbemessungsgrundlage bei gleichzeitiger Entlastung geringer Einkommen) als auch beispielsweise eine Ausweitung der Bemessungsgrundlage auf andere Einkunftsarten (etwa Einkommen aus Vermietung und Verpachtung).

Steuerpolitik

Mit ATTM können die Beschäftigungs- und Verteilungswirkungen sowie die Kosten möglicher Alternativen zu Steuerreformen umfassend beurteilt werden. In der derzeitigen Version können Reformen bei direkten Steuern (LSt/ESt) analysiert werden. Nach einer entsprechenden Erweiterung um Daten über Konsumausgaben könnten auch indirekte Steuern (USt, MöSt,...) in die Analyse einbezogen werden. Es könnten dann beispielsweise Reformmodelle entwickelt werden, die die steuerliche Belastung von Arbeitseinkommen auf Energieträger verschieben und somit unter anderem die Anreize zur Schwarzarbeit senken.

Bisherige Anwendungen von ATTM

Bedarfsorientierte Mindestsicherung

Im Rahmen einer ex-ante Evaluation wurden im Frühjahr 2010 die Auswirkungen der Einführung der Bedarfsorientierten Mindestsicherung (BMS) analysiert. Vor allem aufgrund der Tatsache, dass Einkommen nicht mehr vollständig auf den Transfer

angerechnet wird, werden die monetären Leistungen im Durchschnitt um etwas weniger als € 100 pro Monat steigen. Um deutliche Beschäftigungseffekte zu erzielen, müssten jedoch noch weitere Reformschritte (Zusammenführung von Notstandshilfe und BMS, stärkere Anreize zu über Geringfügigkeit hinausgehende Beschäftigung über Subventionierung der SV-Beiträge bei Geringverdienern) erfolgen (Steiner und Wakolbinger, 2010).

Steuerreformen 2009 bis 2023

Die Verteilungswirkungen der Steuerreformen 2009 und 2016 wurden für die gesamte österreichische Bevölkerung sowie im Detail für die Bevölkerung in den einzelnen Bundesländern analysiert. Darüber hinaus wurden nachgelagerte Reformen wie etwa die Einführung des Familienbonus 2019 bzw. die Änderungen im Einkommensteuertarif 2020 bis 2023 inkl. Abschaffung der kalten Progression analysiert. Einige der Analysen erreichten beträchtliche mediale Aufmerksamkeit.

Kalte Progression

Große mediale Aufmerksamkeit erreichten die Quantifizierungen der Verluste durch die kalte Progression, die jährlich anfallen. Der Grund für die Verluste ist, dass die Parameter des Steuersystems nicht an die Inflation bzw. die Lohnsteigerungen angepasst werden, obwohl die Löhne (auch) aufgrund der Inflation wachsen. Dies führt zu steigenden Durchschnittssteuersätzen bzw. überproportionalen Steuereinnahmen auf Seiten des Staates.

Chapter 1
INTRODUCTION

The Austrian Tax-Transfer Model ATTM is a microsimulation model designed to analyse the effects of fiscal and social policy reforms involving changes in the regulations on income taxes, social security contributions, unemployment benefits, family allowances, childcare benefits, social welfare payments and early retirement regulations. It was originally developed by Viktor Steiner and Florian Wakolbinger in 2009 and has been recurrently updated to account for changes in the tax-benefit system and to update the data base. This version of the model is based on the Austrian samples of the European Union Survey on Income and Living Conditions (EU-SILC) for the year 2005 - 2021. The database includes household and individual data on income and sociodemographic characteristics.

ATTM includes a detailed representation of the Austrian tax-transfer system as well as a microeconomic labour supply model. The latter serves as a tool to analyse potential changes in labour supply triggered by fiscal and social policy reforms. This makes it possible to investigate first round effects of policy reforms (distributional and fiscal effects under the assumption that labour supply does not change) as well as second-round effects occurring when households' labour supply changes. The labour supply model also accounts for potential demand-side restrictions on individual labour supply choices. Accounting for these restrictions and abstracting from macroeconomic feedback

effects on the labour market, labour supply effects of policy reforms can also be interpreted as employment effects.

Some examples for questions which ATTM is designed to answer are:

- How does a reduction of marginal tax rates for lower incomes change the distribution of household income in the population and which groups (families, single-parents, employees…) are affected, and to what extent?
- By how much can employment be expected to increase as a cause of changes in the regulations of social welfare payments?
- To which extent do tax-reform alternatives finance themselves by spurring labour supply?
- What is the difference between employment and non-employment income for various types of households?

There are several decisive advantages of microsimulation models (MSM) like ATTM. First, MSM incorporate a comprehensive image of the various components of the tax-transfer system including all the interactions among them at the level of individual households. Thus, MSM are, unlike other ways of empirical analysis, capable of investigating the effects of policy changes on net household income considering all the potential changes in transfer income a change in a single component, for example, the marginal tax rate, may trigger. Another important advantage of MSM is that changes in labour supply can be estimated considering non-convexities of budget constraints induced by the complexities of the tax-benefit system prevalent in modern welfare states. For example, an increase in means-tested social transfers may affect net household income quite differently depending on eligibility rules, the presence of children in the household and the source of other income, and thus lead to heterogeneous response in household labour supply. Last not least, since behavioural MSM allow differentiating between behavioural response and the change of the household's budget constraint induced by some policy, ex-ante evaluations of fiscal and social policies become possible. This is an important advantage of MSM over ex-post evaluation methods which are not useful for the evaluation of policies which have not been implemented yet or have been implemented only very recently or in a substantially different form than the one under consideration.

ATTM is programmed in the statistical software package STATA and designed in a flexible way which enables the researcher to quickly analyse a wide variety of fiscal policy alternatives that involve changing the parameters of the tax- and transfer system. More fundamental reform alternatives (i.e., replacing an individual-based taxation by household taxation) requires changing the program code and will thus require more time, though.

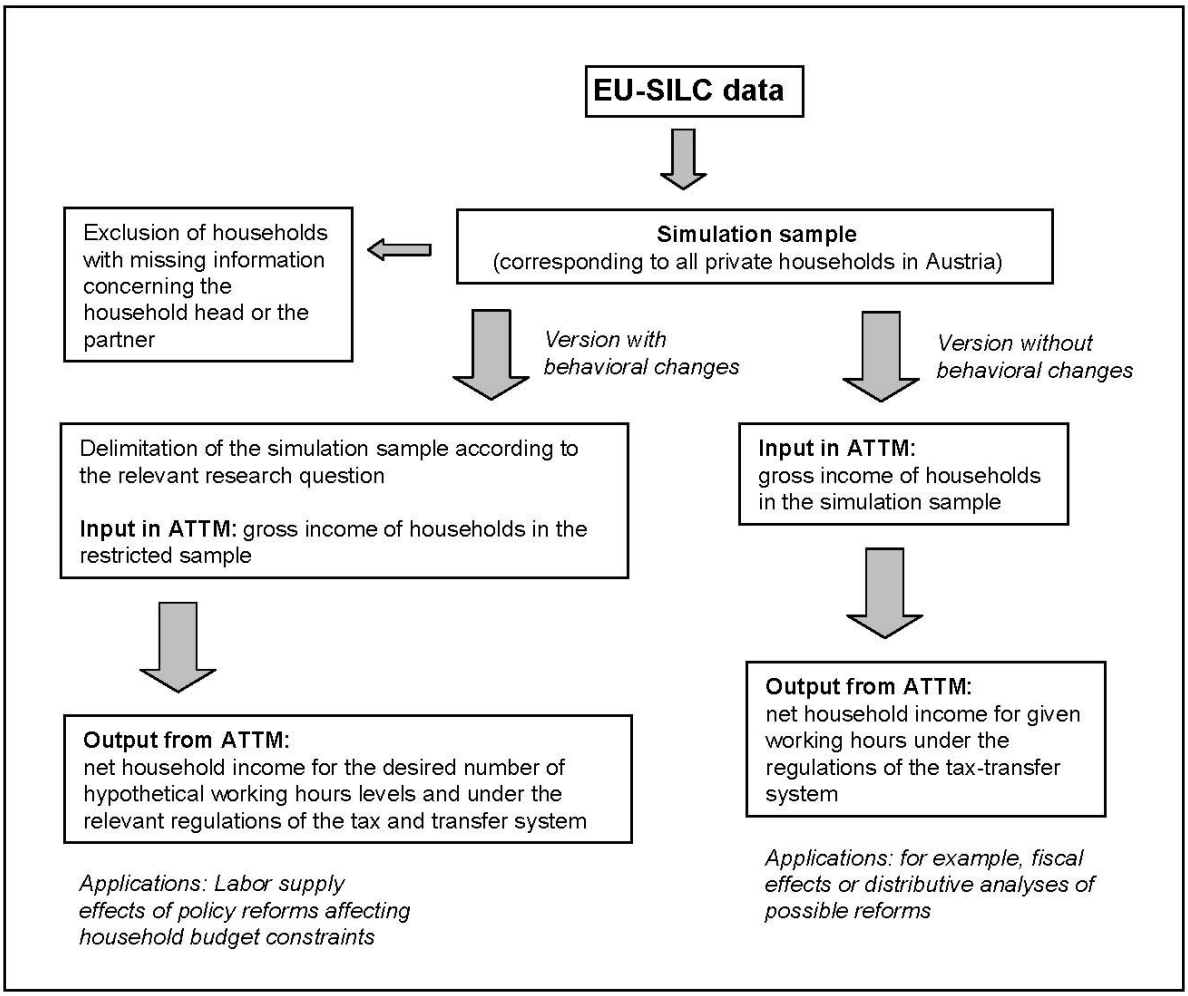
Chapter 2 of this documentation describes the scope and possibilities of ATTM. Chapter 3 documents the data ATTM is based on, while Chapter 4 describes the microeconometric household labour supply model. Section 5 describes the relevant components of the Austrian tax-transfer system and how they are implemented in ATTM.

Chapter 2
THE SCOPE OF ATTM

Tax-Transfer Microsimulation Models (MSM) are tools to analyse implemented or potential reform alternatives of the tax-transfer system. The decisive advantage of microsimulation models in this context is that, by comprehensively describing the tax-transfer system, they allow investigating the income as well as distributional effects of fiscal- and social policy reforms. Moreover, by employing household survey data which include a variety of sociodemographic characteristics as well as employment history and gross income, it is possible to estimate potential shifts in household labour supply, which might occur because fiscal policy reforms might change net hourly wages or income when being not employed. Other margins of behavioural response, which are currently not implemented in ATTM, relate to household consumption and savings decisions, retirement behaviour and the take-up of social transfers.

Thus, ATTM can analyse fiscal and social policy reforms under the assumption that labour supply remains constant, it allows for investigating the effects of exogenous labour supply changes, and, by making use of a microeconometric labour supply model, it can be used to analyse both first order (income) as well as second order effects (induced labour supply shifts) of such reforms. Figure 1 presents the two simulation versions that are possible in the current version of ATTM, and which are described in more detail in the following sections.

Figure 1: Simulation versions and potential applications of ATTM



Source: Official statistic refers to Statistik Austria 2021a-e

2.1 Simulations under constant labour supply

ATTM can be used to simulate how a person's or household's tax burden and benefit claims would change under the assumption that her labour supply does not change. The resulting shift in household income can be interpreted as the short-run effect of a fiscal policy reform alternative. Projecting the individual effects to the whole population using sampling weights allows determining the aggregate costs of the analysed reform alternatives, how income for various groups of households would change, and it allows checking whether and to what extent the microsimulation results match reality. This can

be done by comparing incomes, taxes and transfers simulated by ATTM under status quo conditions to official statistics. The data base for the current version of ATTM contains the Austrian samples of the European Union Survey on Income and Living Conditions (EU-SILC) for 2005 – 2021, which are described in Chapter 3. EU-SILC data are yearly updated, wave 2021 is the most recent wave available at the time of editing this documentation. The income data in EU-SILC wave 2021 refer to the year 2020. For out-of-sample simulations, nominal variables recorded in the data base, such as household incomes apart from wages and certain transfers are uprated by mid-term projections of purchaser prices published by WIFO (2023). Wages are uprated using indices of collectively negotiated wages ("Tariflohnindex") published by Statistik Austria (2023a). Since ATTM is not used for longer-term policy simulations, there is no adjustment of demographic and socio-economic factors.

Table 1: Income, taxes and benefits in ATTM/SILC and official statistics using 2019 data

	ATTM/SILC (bn. €)	Official statistic (bn. €)
Wage income (dependent employment, pensions) [1]	194.6	203.3
Other income (agriculture, self-employment, renting and leasing) [2] *	16.1	16.8***
Income tax [3]**	30.8	32.7
Social Security Contributions (employees, employers, self-employed) [3]**	68.8	70.7
Family supplement (Familienbeihilfe) [4]**	3.1	3.5
Unemployment benefits (Arbeitslosengeld, Notstandshilfe) [5]**	4.1	2.9

Source: Official statistics refer to 1) Statistik Austria (2021b) 2) Statistik Austria (2021a), 3) Statistik Austria (2021a,e), 4) Statistik Austria (2021d), 5) Statistik Austria (2021c)
* Both ATTM/SILC as well as official statistics refer to 2018
** Values from an ATTM-Simulation of the Austrian Tax and Transfer System based on SILC 2019
*** Since official statistics for 2020 and later are not yet available, we refer to 2019 for all figures included in the table.

Table 1 shows that the total income originally reported in EU-SILC for 2018 is somewhat lower than the income in the official wage and income tax statistic (Statistik Austria 2021a, b). Consequently, income tax revenues and social security contributions simulated by ATTM are also slightly lower than the amounts reported in the official statistics. Simulated family supplements slightly underestimate, and simulated unemployment benefits considerably overestimate the officially reported values. For unemployment benefits, this is likely to be due to incomplete take-up of means-tested transfers, in particular

unemployment assistance and social assistance, which is currently not modelled in ATTM. If non-take up doesn't change significantly between the status quo and a policy reform, non-take up will not affect the simulated change in the benefits amount.

2.2 Simulations under exogenous variation in labour supply

Another useful application of ATTM is the analysis of hypothetical changes in the labour supply of one or more household members and the effects on household incomes. For instance, ATTM can determine the changes of household income if one spouse stops working because of taking care of a children, or if both partners reduce their labour supply from 40 to 25 hours a week. A key assumption in this context is that gross hourly wages do not change with shifts in the number of hours worked.

Such analyses can be performed for the households observed in the database as well as for "representative" households. ATTM contains a module to construct and graphically depict hypothetical budget constraints of representative households. Household types can be differentiated by marital status (single or a couple household), gender of the household head, his or her labour force status, and the number and age group of children living in the household. Households with at least one earner can also be differentiated by the level of the hourly wage of the household's main earner. By making use of the wage regressions described in Section 4, it is also possible to use predicted wages, i.e., for currently non-employed people for whom wages are not observed.

The module also allows performing these calculations by the federal state of residence of the household. This is of special importance for assessing the impact of certain social transfers, such as child or housing benefits whose level and eligibility criteria differ between the nine Austrian federal states. ATTM can be used to compare budget constraints of model households for all nine states simultaneously.

2.3 Simulations with labour supply adjustment

Other than the already mentioned wage estimation, ATTM does also include a structural labour supply model which makes possible estimating the labour supply and employment effects induced by fiscal or social policy reforms (see Section 0). Such effects could result from, say, higher net hourly wages resulting from a lower wage tax which make additional working hours more profitable, or higher family supplements which could allow parents to work less hours. As described in Chapter 4.2, the labour supply model accounts for potential demand-side restrictions in the sense that, due to some labour market rigidities,

not all people who want to work will get a job offer, which we term “involuntary unemployment”.

This type of analysis is performed for people whose labour supply can reasonably be assumed to be “flexible” with respect to certain institutional parameters. Thus, people being in full-time education, on maternity leave, already retired or severely disabled are excluded, since their labour supply is considered as being fixed and invariant towards policy changes. Moreover, the labour supply of entrepreneurs and civil servants is assumed “inflexible” since they either respond along other margins to fiscal policy changes or their working hours are mainly institutionally determined, as in case of civil servants. One could, of course, abandon these restrictions and quite easily include those people into the estimation of the labour supply model. Employees working in the public sector who are not civil servants are, of course, included in the labour supply model. Although labour supply behaviour of the self-employed and civil servants is usually assumed “inflexible”, they are included in the distributional analysis.

The inclusion of labour supply and employment effects in the analysis makes it possible to estimate potential self-financing effects of policy reforms. If, say, a reduction in the marginal tax rates induces people to work longer hours, the loss in tax revenue will at least partially be compensated by a higher tax base resulting from higher employment. By the same token, it is also possible to determine how and to what extent a fiscal or social policy reform will boost or reduce employment of various groups of society, and how many jobs are likely to be created in the longer run.

Chapter 3
THE DATABASE EU-SILC

The analysis of income and above all, employment and distributional effects of fiscal policy reforms requires detailed and comprehensive household data that is representative for the Austrian population. The Austrian sample of the European Union Survey on Income and Living Conditions (EU-SILC, provided by Statistik Austria, 2022) is the most appropriate data base for a behavioural tax-benefit microsimulation model for Austria. It provides a detailed account of individual and household incomes and contains all the relevant information for the estimation of wage and labour supply models embedded in the ATTM.[1]

[1] There are two other data sources which could potentially be used for building a MSM for Austria. First, the Wage and Income Tax Statistics (Lohn- und Einkommensteuer) by the Federal Statistical Office (Statistik Austria) provide

The 2021 wave of EU-SILC, which is the most recent wave within the ATTM-database, contains a survey of 12,274 persons living in 6,021 households. The sample consists of 10,409 persons above the age of 15 and 1,865 children below the age of 16. EU-SILC surveys the living conditions at the time of the interview, but retrospectively collects income and employment data such that the 2021 wave contains income and types of employment of the year 2020. Wage income and most of the monetary public transfers in the Austrian part of EU-SILC are completely derived from administrative statistics linked to the survey data since 2012. The main income components that remain to be based on survey data are incomes from self-employment and from renting and leasing (see Statistik Austria, 2013). The following table shows some descriptive statistics on sociodemographic and income data for the EU-SILC 2021 survey as well as for grossed-up population statistics using the SILC sample weights[2].

Wages are the primary source of income in Austria. More than 4.4 million out of a population in employable age of some 5.9 million people received wages from dependent employment. More than one fourth of the Austrian population receives some form of pension income, making pensions the second most important income source (Statistik Austria, 2021b,f). Next to quite generous pensions for retirement with a low effective retirement age and high replacement rates especially for high-income earners (OECD, 2019), the Austrian social security system features pensions for widows and widowers, orphans, and victims of severe accidents.

information on personal income, the amount of wage or income tax assessed, and on variables relevant for tax purposes, such as the source of income and certain tax expenditures. Since there is individual taxation and child transfers are not integrated in the Austria tax code, these data do not provide information related to the household composition, such as marital status and the number of children. This severely restricts the simulation of transfer incomes at the individual and household level. Since information on socio demographic individual characteristics, like education or labor market experience, is also not available in the tax statistics, the estimation of labor supply reactions would not be possible. Another disadvantage of these data is that only wage income is timely available, whereas the integrated statistics of wages and income have a lag of three to four years (Statistik Austria, 2008a) and seem currently not to be available for academic research. A non-behavioural MSM using a 1%-sample of the Austrian Wage Tax statistics has recently been constructed by Berka et al. (2009). Another potential data source is the Consumption and Income Survey (Statistik Austria, 2005). The main shortcoming of the 2004/05 survey is that only total net household income is recorded, while simulation analysis requires gross income by type of income, like wage income, pensions, or income from self-employment. Other disadvantages of this data sources are that employment is only coded in three categories (non-employed, part-time, and full-time employed) and that it is available only every five years. There is a somewhat outdated non-behavioural MSM named ITABENA, (Hofer et al. 2003) based on the Consumption and Income Survey 1999/2000 which has more detailed information in income components but otherwise suffers from the same shortcomings for tax-benefit simulations as the recent survey.

[2] Sample weights are derived as described in Statistik Austria (2008c).

Table 2: Descriptive Statistics on Households and Income in EU-SILC 2021 survey data

		mean	s.d.	n
Number of persons	sample	–	–	12,274
	grossed up	–	–	8,757,572
Number of households	sample	–	–	6,021
	grossed up	–	–	3,990,132
Household Size	Sample	2.0	1.1	–
	grossed up	2.2	1.3	–
Age (years)	Sample	44.2	22.9	–
	grossed up	41.8	22.3	–
Gross income from dependent employment (Euro)	sample	37,784	32,492	5,900
	grossed up	34,921	30,760	4,445,853
Gross income from self-employment including agriculture (Euro)	sample	26,123	54,804	1,119
	grossed up	25,682	51,982	830,230
Gross pension income (Euro)	sample	24,791	18,647	3,900
	grossed up	22,433	17,839	2,515,689
Unemployment and social benefits (Euro)*	sample	5,756	4,641	1404
	grossed up	5,728	4,488	1,169,635
Family allowance including „Kinderabsetzbetrag“ (Euro)*	sample	4,025	2,089	1,405
	grossed up	4,300	2,299	1,025,265

Source: Statistik Austria (2022), own calculations
* Values from an ATTM-Simulation of the Austrian Tax and Transfer System based on SILC 2021

Income from self-employment including income from agriculture is on average lower than wage income. Only about six percent of the Austrian population received income from this source. EU-SILC does also include income from renting and leasing, which an additional 2.8 percent receive. Not mentioned in the table is capital income since EU-SILC does only feature net income from dividends and interest. This is because personal

capital income is not recorded since it is not included in the personal tax base[3], but taxed differently with a flat rate of 25%. A comparison of capital income in EU-SILC with household financial assets surveyed by the Austrian National Bank (Beer et al., 2006) shows that capital income is very much under-recorded in EU-SILC[4].

Some 310,000 persons in Austria receive unemployment benefits or social assistance (average per 2021, see Statistik Austria, 2023) The latter is paid if unemployment benefits, or other sources of income are not available or lower than some standard rates differing according to the household size. All parents having children below the age of 18 or below the age of 24 in case the children are disabled or in education are eligible for family allowances. Their amount differs according to the age of and the number of the children in a household. However, those family allowances are not means-tested.

While apart from the fact that EU-SILC covers the population living in households and does not include people living abroad or in institutions like asylums and old age homes, the survey represents the Austrian population very well with respect to its sociodemographic distribution.

Table 3 below shows the distribution of wage income by decile in the official statistics and in EU-SILC 2021. Disregarding gender, all listed deciles as well as the mean are slightly higher in SILC 2021 than in the official statistics. However, the number of employees in the official tax statistics is somewhat larger than the grossed-up number in SILC. This pattern results, as noted already, in a slight underestimation of income (and tax revenue in due course) by SILC and ATTM.

[3] It is, however, possible to voluntarily include capital income in the tax-base, which is profitable in case of a marginal tax rate of less than 25%.

[4] While according to Beer et al., 2006, average household financial assets are € 54,666, which yield gross capital income of € 2733 if an interest rate of 5% is assumed, average gross household capital income in EU-SILC was only € 311.

Table 3: Comparison of wage income in official wage tax statistics and EU-SILC 2021 by percentiles of the wage distribution (Euro)

	wage tax statistics			EU-SILC 2021		
	total	Women	men	total	women	men
p10	3,308	2,800	3,927	3,142	2,643	3,744
p20	9,612	7,515	12,365	10,000	6,977	14,118
p30	16,693	13,373	22,395	17,003	12,553	24,566
p40	23,220	18,366	30,108	23,998	18,398	31,943
p50	29,486	22,993	35,640	30,735	23,353	37,780
p60	35,384	28,003	40,996	36,895	28,817	42,768
p70	41,674	33,957	47,735	43,145	35,049	50,068
p80	50,564	41,491	57,915	52,677	42,617	59,577
p90	67,255	54,509	77,054	69,132	56,359	80,333
mean	34,453	27,243	40,695	34,921	27,376	41,694
n	4,575,068	2,123,038	2,452,030	4,445,853	2,103,198	2,342,655

Source: Statistik Austria (2021f, 2022)

As noted above already, we project the individual wages and incomes included in SILC 2021 into the current year and future years by using the macroeconomic mid-term economic forecasts on wages, employment, and output (WIFO, 2023). This allows for ex-ante policy simulations.

Chapter 4
ESTIMATION OF WAGE AND LABOR SUPPLY MODELS

To analyse behavioural response of households to changes in fiscal and social policies, estimates of wages of individuals currently not employed and labour supply elasticities are required. Behavioural effects may occur because policy reforms could, at given gross hourly wages, increase or decrease net wages or, by changing the system of social transfers, increase or decrease the income for persons not being employed. Through these channels, the incentives to supply labour are likely to be altered. The procedure of investigating those incentives and their results involves two steps. First, since hourly wages of currently non-employed people cannot be observed, they are estimated from a wage regression. Secondly, a structural labour supply model is estimated which determines the labour supply of households as a function of net

household income, leisure of the household head and, in case of a couple household, of her or his spouse, and other characteristics affecting a household's utility of leisure, such as the age of the spouses and the presence of children. These two steps are linked by the calculation of net household income, of which individual labour income is only one important component, considering the complex interactions of the Austrian tax-benefit system at the level of private households. As a final step, it is determined to what extent individual labour supply decisions can be realized given demand-side restrictions in the labour market.

4.1 The wage imputation

For counterfactual simulations, hourly wages of currently non-employed people are required. We derive hourly wages from information on monthly gross earnings (based on administrative data and imputations) and working hours. Although we restrict our estimation sample to people aged between 20 and 64 years (currently in the period 2015 to 2019), hourly wages are missing for about a quarter of all people in our sample. In most cases this relates to people not employed during the reference year, but a smaller share of hourly wages is also missing because people do not report working hours. Since people are observed up to 4 periods in EU-SILC we can use the panel structure to impute individual hourly wages for people who have been employed at least in one year within our five-years observation period. Although this increased the share of non-zero wages by about 10 percent, hourly wages must be imputed for a relatively large share of people in our sample.

Imputation of wages for non-employed people is traditionally based on the estimation of selectivity-corrected wage equations and the two-step Heckman (1979) procedure. Since our aim is not to interpret single coefficients of the wage equation, or to interpret the latter in a "structural" way, but to obtain optimal wage predictions for currently non-employed people, we deviate from this standard approach and apply a purely statistical estimation approach here. That is, we try to find the combination of variables from a large set of potential explanatory variables that yields the best out-of-sample wage predictions which we then use to impute wages of currently non-employed people. In our approach, not the fit within the sample of employed people but the fit of the out-of-sample wage predictions is relevant. Of course, within-sample fit as measured by the R-squared in the linear regression model can always be improved by including additional regressors, but this does not necessarily improve out-of-sample predictions of the model as this also increases the variance of the prediction. To account for bias and variance of the prediction, the standard measure to evaluate the predictive quality of a regression model is the Root Mean Square Error (RMSE) of the out-sample predictions, which we also for our wage imputation.

4.1.1 Estimation methods

To obtain out-of-sample predictions, the sample of observations with positive wages (employed people) is split into sub-samples for estimation (so called "training samples" in the Statistical Learning literature) and validation ("test") samples. The various estimation methods mainly differ in the way the samples are split and the flexibility of the estimating equation.

Modelling non-linear effects of explanatory variables in the linear regression model requires to add polynomials of metric variables and interaction terms between dummy variables to the set of potential regressors. There are many variables that may affect individual wages (see the data section below), and it is not clear in which way these variables should enter the wage regression. Specifying quadratic terms for metric variables and bivariate interaction terms of dummy variables we end up with up with about 120 potential regressors in our most general wage regression. Although it is no problem to estimate the corresponding number of coefficients given our relatively large panel data set, there is a real danger of overfitting and producing large out-of-sample prediction errors.

To avoid this danger, parsimonious model specifications are chosen by minimizing the out-of-sample mean prediction error. In the Statistical Learning literature, two of the most popular estimation methods for models with metric dependent variables are LASSO (Least Absolute Selection and Shrinkage) and Random Forests (RF), see, e.g., Hastie et al. (2009). LASSO for metric dependent variables is a linear regression model with regressors with little out-of-sample predictive power restricted to zero. While LASSO usually yields good out-of-sample predictions, it requires to specify all interaction terms that are to be included in the full model to avoid a too restrictive model specification. The non-parametric RF estimator, which usually also yields good out-of-sample predictions, automatically chooses the set of interaction terms during the estimation steps and is thus more flexible than LASSO.

We apply the RF estimator and two variants of LASSO ("cross validation LASSO, CV-LASSO" and "rigorous LASSO, R-LASSO"), and compare the optimal predictions from these estimators to those obtained by OLS regressions both within sample and out-of-sample. While OLS is likely to yield the smallest RMSE within sample, we would expect it to perform worse than LASSO and RF out-of-sample. To obtain OLS out-of-sample predictions, we simply randomly split the sample by half and use the one half of observations for estimation and the other for prediction.

For LASSO estimation, we use the Stata programmes "cvlasso" as well as "rlasso" contained in "lassopack" (Ahrens et al., 2019). Depending on the size of the tuning

parameter that determines the shrinkage penalty, LASSO sets a certain number or regressions coefficients equal to zero. The tuning parameter is determined by cross-validation by CV-LASSO, and analytically by R-LASSO. We use the default option of 10 folds for cross validation and selected the shrinkage parameter using the „lse cvlasso" option ("se rule"). Since we work with panel data, we cluster by the personal identifier instead of the default option for determining the tuning parameter in R-LASSO.

The RF estimator reduces prediction variance by averaging over many Regression Trees (RT), each of which only uses a randomly drawn sub-set of all potential regressors. For estimation, we use the Stata programme "rforest" (Schonlau and Zou, 2020). There are various methods to regularize the size of the RT. We chose the default option that selects a number equal to the square root of the explanatory variables in the model for each of the RT and regularize by the minimum number of observations in each leave of the RT, which we set equal to 30 observations.

4.1.2 Data

Our data for this ATTM version are derived from the Austrian part of EU-SILC for the five-years period 2015-2019. Individuals and households are observed for up to 4 time periods in the observation period. We do not use sampling weights at the estimation stage. We exclude extremely low and high wages, which probably arise from measurement errors, by censoring hourly wages at, respectively, the first and 99th percentiles of the wage distribution.

We predict gross hourly wages including both regular as well as extra payments. Those extra payments play a quite important role in Austria since they account in most cases for one sixth of the regular monthly payments and are paid typically as two additional monthly wages in summer (holiday allowance) and December (Christmas allowance). To account for the well-known gender wage differences, we estimate the wage equation separately for men and women.

For the RF estimation, we only need to specify the linear terms of potential predictors, because the estimator selects relevant interaction terms automatically during the estimation steps. The set of linear terms of explanatory variables includes the usual human capital variables (dummies for educational and vocational attainment, years of employment and unemployment experience), job characteristics (12 industry dummies, 4 firm-size dummies), individual and household characteristics, average unemployment rates by age, educational level and the 9 regional states as well as regional and year dummies. Individual and household characteristics include a dummy if an individual is severely handicapped, other household income than individual labour income, marital status, and the number of children by age group. These latter variables are expected to

affect wages indirectly through an individual's labour force participation and are usually included in the selection equation in Heckman-type estimation equations.

The year, region, industry, and firm size dummies are orthogonalized, i.e., they are defined in such a way that setting all dummies referring to a particular variable, such as industry, equal to zero yields the mean effect of the respective variable on the wage. We use this estimate to predict wages for currently non-employed workers for whom it is not known in which industry or firm they will become re-employed. Likewise, setting all orthogonalized region and year dummies equal to zero yields average predictions for, respectively, Austria overall and the whole observation period.

In the OLS and LASSO regressions we include, in addition to the linear terms of the variables in the RF specification, as additional regressors:

- squares of the metric variables (expect for the number of children in age categories)
- bivariate interaction terms between the education dummies and years of previous employment as well as unemployment
- bivariate interactions of other household income and marital status as well as marital status and the children dummies
- bivariate interactions between the average unemployment rates differentiated by level of education, age, and regions as well as interactions between region and year dummies.

Altogether, the number of potential predictors in the full specification of the linear models adds up to more than 100. Descriptive Statistics for the linear terms of these variables that correspond to those included in the RF estimation are contained in Table??? in the Appendix.

4.1.3 Estimation Results

Table 3 reports the RMSE of the wage predictions for the various estimators. The out-of-sample performance of the OLS estimator is much worse than within sample, which indicates that the model with the variables defined above and including all interaction terms strongly overfits within sample. The LASSO estimators show the best performance in terms of out-of-sample wage predictions, with a somewhat better performance of the CV-LASSO than the R-LASSO, at least for men. This estimator performs almost as well out-of-sample as the OLS estimator within sample but only includes a relatively small number of regressors. In contrast, the RF estimator performs only slightly better than OLS out-of-sample.

Table 4: RMSE of various estimators

	male	female
in-sample OLS	12.5	9.0
out-of-sample OLS	16.2	11.3
Random Forest	15.7	11.2
CVLASSO	12.7	9.2
RLASSO	12.9	9.2

Source: EU-SILC waves 2015-2019

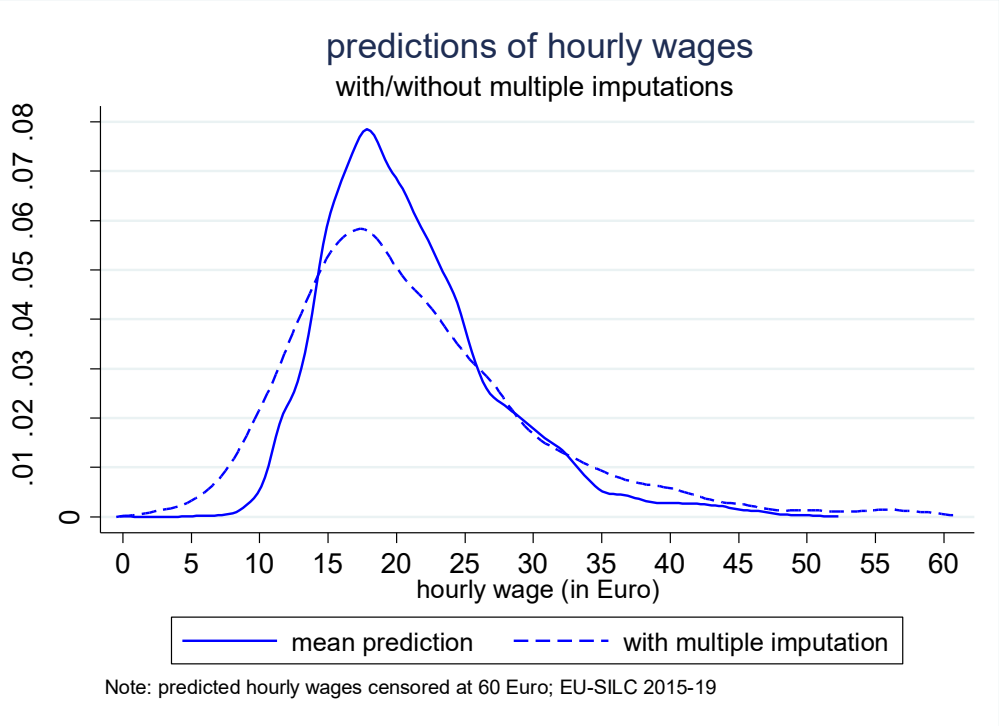
Table A4 in the Appendix summarizes the predicted wage distributions for men and women obtained from the various estimators. While mean predictions are almost identical across estimators, there are some noticeable distributional differences. Except for the bottom part of the wage distribution, wage predictions obtained by the CV-LASSO estimator seem to be very similar to the within-sample OLS predictions. In contrast, the RF estimator yields high wage predictions below the 25 percentile and relatively small predictions for the top decile of the distribution. Furthermore, the standard deviation of the wage predictions obtained from the RF estimator is much smaller than for both the CV-LASSO and the OLS estimator. Overall, the CV-LASSO estimator not only outperforms the other estimators regarding the out-of-sample RMSE criterion, but also yields wage predictions that are similarly distributed as those obtained by within-sample OLS predictions.

Estimation results for our preferred CV-LASSO estimator are summarized in Table A5 in the Appendix. Since s.e. for single LASSO coefficients are not interpretable (and not relevant for predicting wages), we do not report them here. The variables remaining in the model include some of the dummy variables for educational and vocational attainment as well as their interactions with years of employment and unemployment. A few industry- and firm size dummies also turn out as relevant wage predictors for both men and women. Somewhat surprisingly, marital status and interactions of this variable with other household income and some of the child dummies remain in the male but not the female wage regression. The only other variable that remains in the regression for both men and women is the average unemployment rate by education level. Overall, of the more than 100 regressors included in the full specification of each of the wage equations, only 27 and 14 regressors plus the regression constant term remain in the final male and female wage equation, respectively. It may by noted that the "importance plots", which measure the predictive importance of the various variables included in the RF specification, rank most of the variables at the top which are also included in the preferred CV-LASSO specification.

4.1.4 Wage Imputation

Although CV-LASSO yields the best out-of-sample predictions of all the estimators considered here, two problems remain when using these predictions to impute hourly wages for observations with missing wages. First, the variance of predicted wages underestimates the true variance of the wage distribution, as can be seen by the compressed distribution of predicted wages in Figure 2. Secondly, using a single wage prediction for a given individual with a missing wage does not account for estimation error and the resulting variability of the prediction.

Figure 2: Compressed distribution of predicted wages



Source: EU-SILC waves 2015-2019

Both problems can be mitigated by multiple imputation of missing wages (see, e.g., Rubin, 1987). As usual, we use 5 imputations for each missing observation. Missing wages are predicted using „K-Nearest Neighbour Predictive Matching“ with K=10 observations and the set of predictors as selected by the CV-LASSO estimator of the wage equations for men and women. Predictions for observations with missing (zero) wages were

obtained by the mean of the five imputed values for each missing observation. As shown by Figure 2, the distribution of wages with multiple imputed missing wages is much less compressed than the distribution of predicted wages without imputations and shows the log-normal shape typical for wage distributions.

Table 5 summarizes the (unweighted) distributions of observed, predicted, and simulated wages. The latter were obtained by substituting for missing wages the multiple imputed wage predictions. Overall, the distribution of imputed wages is very similar to the censored distribution of observed positive wages across all percentiles of the wage distribution, as shown in Table 5

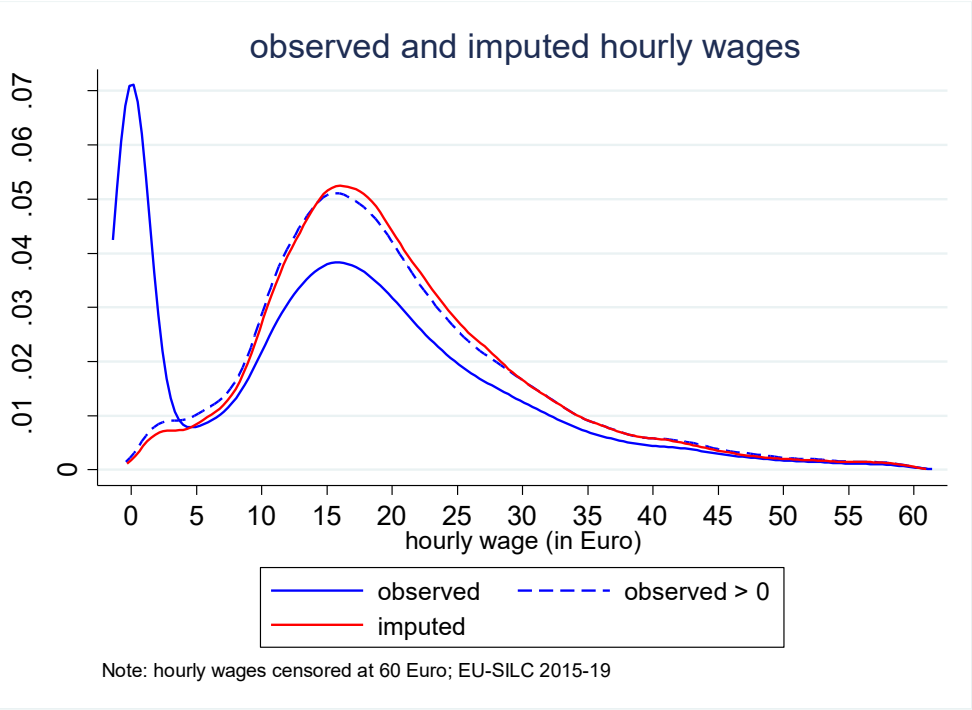
Figure 3 shows that the small differences between the two distributions mainly occurs at the bottom and the middle of the wage distribution. Compared to the distribution of observed positive wages, the imputed wage distribution is only slightly shifted to the right. Except for hourly wages below 5 Euro, both distributions suggest the typical log-normal shape of hourly wage distributions. Figure 3 also shows how the large mass of zero wages gets imputed into the imputed wage distribution.

Table 5: Distributions of observed, predicted, and simulated wages

	observed all	observed > 0	predicted	pre_xmiss	imputed
Total					
mean	16.3	21.4	21.0	21.3	21.4
sd	14.7	13.2	6.4	9.4	12.4
cv	0.9	0.6	0.3	0.4	0.6
p5	0.0	6.0	12.8	9.8	7.0
p10	0.0	9.4	14.2	11.7	10.0
p25	2.6	13.5	16.6	15.1	13.9
p50	15.4	18.5	19.9	19.5	18.8
p75	23.1	26.0	24.2	25.5	25.9
p90	33.0	36.3	29.7	33.1	35.4
p95	41.9	45.4	33.0	39.1	43.7
min	0.0	0.6	0.2	0.9	0.6
max	99.7	99.7	51.7	96.1	99.7
N	35,207	26,861	35,120	8,346	35,207
Men					
mean	18.4	24.0	23.8	23.8	24.0
sd	16.4	14.7	6.7	10.2	13.8
cv	0.9	0.6	0.3	0.4	0.6
p5	0.0	7.5	14.7	11.5	8.4
p10	0.0	10.8	16.6	13.4	11.5
p25	3.6	15.3	19.4	17.1	15.7
p50	17.3	20.5	22.8	21.8	20.8
p75	25.6	28.9	27.2	28.1	28.6
p90	37.2	41.0	32.6	36.3	39.9
p95	46.9	51.3	37.0	42.9	49.7
min	0.0	1.2	0.2	1.9	1.2
max	99.7	99.7	51.7	96.1	99.7
N	17,797	13,622	17,759	4,175	17,797
Women					
mean	14.2	18.7	18.2	18.8	18.7
sd	12.3	10.7	4.5	7.6	10.0
cv	0.9	0.6	0.2	0.4	0.5
p5	0.0	5.0	11.9	8.9	5.8
p10	0.0	8.3	13.1	10.6	9.0
p25	1.4	12.1	15.1	13.8	12.5
p50	13.8	16.6	17.5	17.5	16.9
p75	20.5	23.0	20.3	22.4	22.9
p90	28.9	31.3	24.2	28.3	30.5
p95	35.4	38.4	27.5	34.1	37.3
min	0.0	0.6	6.5	0.9	0.6
max	72.7	72.7	37.1	65.2	72.7
N	17,410	13,239	17,361	4,171	17,410

Source: EU-SILC waves 2015-2019

Figure 3: Distributions of observed, predicted, and simulated wages



Source: EU-SILC waves 2015-2019

4.2 The household labour supply model

ATTM uses a static structural discrete-choice labour supply model as suggested by van Soest (1995) and applied by Steiner et al. (2008), among others. A great advantage of discrete-choice models is that non-linearities in household budget constraints can be modelled much easier than using more traditional specifications of continuous labour supply models. Another important advantage is that they allow, in combination with a MSM, to account for the endogeneity of net household income in a consistent way. Furthermore, the empirical hours distribution is characterized by a strong concentration on certain threshold values usually associated with marginal employment not covered by social security, part-time employment, full-time employment, and overtime.

The discrete-choice labour supply model implemented in ATTM assumes that the observed households can choose between *J* working hour categories. One of these categories typically represents unemployment, i.e., zero working hours. The ranges of the other categories can be flexibly determined in the ATTM parameter file. The choice of

hours-categories is motivated by both economic considerations as well as the distribution of working hours in the data. In this context, ATTM faces, as other microsimulation-models (see, e.g., Steiner et al., 2008) the problem that for some ranges of working hours there are too few observations in the dataset, which makes fine-tuning of categories problematic and restricts *J* to a small number. This is typically the case for men who most probably work close to 40 hours a week, work overtime, or work not at all, while only a few have part-time jobs or are marginally employed. This restricts the number of male hour-categories to three or four.[5]

Table 6: Distribution of observed working hours for households where both spouses are flexible

			Men				
	Weekly hours*		0 (–)	1-20 (16.9)	21-40 (38.1)	> 40 (55.8)	Sum
Women	0	(–)	11	6	99	56	172
	1 – 12	(6.8)	4	0	57	35	96
	13 – 20	(19.2)	3	5	164	92	264
	21 – 34	(27.4)	4	8	213	142	367
	35 – 40	(38.5)	10	14	220	134	378
	> 40	(55.8)	4	6	61	77	148
	Sum		36	39	814	536	1,425

* Average weekly working hours (per category) in parentheses
Source: ATTM and Statistik Austria (2022)

For estimating the labour supply elasticities presented in the following, we chose to specify six working hours categories for women (0, 1-12, 13-20, 21-34, 35-40 and more than 40 hours) and only four for men (0, 1-20, 21-40 and more than 40 hours). The following tables document the distribution of persons with flexible labour supply with respect to the different hour-categories in EU-SILC. Since ATTM separately estimates

[5] If students and pensioners were included in the analysis part-time working patterns would be more diverse and additional hour-categories could be introduced. In general, we do not include these groups in the household labour supply model, however, since their working behaviour is structurally different from people of working-age. Technically, the structure of the discrete-choice model (conditional logit) does allow for the inclusion of categories with only a few observations. However, in general we refrain from this possibility to avoid out-of-sample prediction of estimation results, although the ATTM parameter file allows for changing the definitions of working hour categories to up to ten categories for each gender.

labour supply effects for households where both spouses have flexible labour supply, households where only one spouse is flexible, and flexible singles of either gender, we document the hours distribution separately for each of these groups.

Table 7: Distribution of observed working hours for households where only the female partner is flexible, and flexible female singles

	Inflexible spouse		Singles	
Hour category	Average hours	n	Average hours	n
0	_	84	_	84
1 – 12	8.0	33	6.7	21
13 – 20	19.0	94	19.1	89
21 – 34	27.5	105	28.6	186
35 – 40	38.8	116	38.9	407
> 40	50.6	40	53.2	154
Sum		472		941

Source: ATTM and Statistik Austria (2022)

Table 8: Distribution of observed working hours for households where only the male spouse is flexible, and flexible male singles

	Inflexible spouse		Singles	
Hour category	Average hours	n	Average hours	n
0	_	11	_	11
1 – 20	16.7	8	15.8	45
21 – 40	37.8	125	37.9	478
> 40	51.3	99	58.3	262
Sum		243		796

Source: ATTM and Statistik Austria (2022)

Under the assumption of constant gross hourly wages across labour supply categories, there is a corresponding level of disposable income for each household i choosing hour category j. Since the current version of the model does not model the household's savings decision, disposable income corresponds to the household's consumption level, C_{ij}. This allows formulating a household utility function.

$$V_{ij} = U(Lf_{ij}, Lm_{ij}, C_{ij}, Z_i) + \varepsilon_i$$

which assigns for each possible choice j of hour-categories a utility level V depending on the leisure of the female and male partner in household i, $Lf_{ij}$and Lm_{ij}, their disposable income or consumption C_{ij}, some household characteristics Z_{ij} and an error term ε_{ij}.

If the error terms ε_{ij} are assumed to be independently and identically distributed across hour categories and households according to the Extreme-Value type I (EVI) distribution, the probability that alternative *k* is chosen by household *i* is given by a conditional logit model following McFadden (1974).

$$P_{ik} = \Pr(V_{ik} > V_{ij}, \forall j = 1...J) = \frac{\exp(U_{ik})}{\sum_{j=1}^{J} \exp(U_{ik})}, k \in J .$$

The decision rule is simple: Alternative *k* is chosen if the net income and hours of leisure under this alternative yield a utility index which is greater than that for any other alternative.

One limitation of the labour supply model is that the conditional logit specification implies the independence-of-irrelevant-alternatives (IIA) assumption. This assumption implies that the relative probabilities (odds-ratios) of two alternatives do not depend on the presence of the other alternatives in the model, or in fact any other alternative. This assumption is especially problematic if some of the alternatives considered are very similar. On the other hand, if the IIA is valid the conditional logit model can also be used

to simulate the effect of some policy change on some alternative which currently does not exist, e.g., a special type of subsidized part-time employment.[6]

To estimate the parameters of the utility function U, one maximizes the likelihood for the observed choices, which is derived from the expression above. ATTM allows for a quadratic as well as a translog-specification of the utility function. Both specifications are local second-order approximations of a general utility function which does not restrict substitution between leisure and consumption to be independent of the utility level or income. In fact, elasticities may vary freely across households, depending on the level of income, the level of leisure or working hours of the two spouses, and household composition.

In case of a quadratic specification of the utility function, the systematic part of a partner-household's utility function is given by

$$U_{ij} = \beta_1 C_{ij} + \beta_2 C_{ij}^2 + \beta_3 Lf_{ij} + \beta_4 Lm_{ij} + \beta_5 Lf_{ij}^2 + \beta_6 Lm_{ij}^2 + \beta_7 C_{ij} Lf_{ij} + \beta_8 C_{ij} Lm_{ij} + \beta_9 Lf_{ij} Lm_{ij}.$$

Of course, we would expect the marginal utility to be positive with respect to income and leisure of both spouses and decreasing in the level of income and leisure consumed. Theory does not, however, imply restrictions on the sign of the marginal utility of one spouse's leisure to changes in the level of the other spouse's leisure.

The utility function for a single household is a special case of the above equation, with β_9, and, depending on whether the household head is female or male, the respective coefficients on male and female leisure being restricted to zero. The above specification allows for varying household preferences by employing "taste shifters" which affect the coefficients of the linear income and leisure terms, i.e.:

[6] The IIA does not hold in the presence of unobserved household characteristics which vary across alternatives. These effects can be accommodated by a random-effects specification of the conditional logit model. Estimated labour supply elasticities derived from a random-effects model (mixed conditional logit) do not differ significantly from those derived from the standard conditional logit model, which we present in Tables 8 and 9. Steiner et al. (2008, pp. 9f.) do the same using German data and find no significant differences either.

$$\beta_1 = \alpha_0^C + X_1'\alpha_1^C$$
$$\beta_3 = \alpha_0^{Lf} + X_2'\alpha_1^{Lf}$$
$$\beta_4 = \alpha_0^{Lm} + X_3'\alpha_1^{Lm}$$

X_1, X_2 and X_3 are column vectors including sociodemographic characteristics like age, number and age of children, disability indicators and whether the observed person is Austrian citizen, and the αs are vectors of coefficients which are jointly estimated with the βs from the utility function above.

The specification of the labour supply model described above implies that individuals and households are not restricted in their choice of working hours. To account for involuntary unemployment, we extend the standard discrete-choice labour supply model by modelling the probability that a person is rationed in the labour market.[7] Following previous studies by Blundell et al. (1987), Bingley and Walker (1997), and Bargain et al. (2010), we model the choice of working hours and the rationing probability jointly by a double-hurdle representation of individual decisions. The first hurdle refers to the labour-force participation and working hours decision, the second hurdle to labour market rationing, i.e., the probability that a person participating in the labour market is involuntarily unemployed.

For everyone, involuntary unemployment is given as a latent variable by

$$I_i^* = Z_i'\gamma + \eta_i,\ I_i = \begin{cases} 1, \text{ if } I_i^* \geq 0 \\ 0, \text{ if } I_i^* < 0 \end{cases}$$

with Z a vector of exogenous variables, γ a corresponding parameter vector to be estimated, and η a random individual effect assumed to be conditionally independently and identically normally distributed: $\eta_i \overset{iid}{\sim} N(0, \sigma^2)$. In addition to individual characteristics, which also affect the working hours decision, Z contains labour market indicators, such as the unemployment-vacancy ratio by region and occupation. The observed indicator variable I is identified from information in EU-SILC on an individual's job search activity

[7] Rationing with respect to non-standard hours categories (part-time, overtime hours) could be accounted for by including dummy variables for these categories in the utility function (see, e.g., van Soest 1995). As shown by sensitivity checks, this extension does not significantly affect our elasticity estimates. Thus, we only consider labor market rationing related to involuntary unemployment.

and availability for work.[8] Since EU-SILC does not contain information on desired working hours of currently unemployed people, we must make assumptions on those desired hours. While full-time employment can be assumed to be the typical desired choice for men and women without children, the choice of desired working hours for single mothers and wives with children is likely to be much more heterogenous. We assume that unemployed mothers with children of school age or below want to work between 13 and 20 hours.[9]

Each person participating in the labour market either realizes her desired working hours or is involuntarily unemployed; voluntary unemployment occurs if the person does not participate in the labour market. The probability of rationing (involuntary unemployment) is given by $Pr(I_i^* > 0) = \Phi(Z_i'\gamma)$, with $\Phi(\cdot)$ the standard normal distribution. The individual likelihood contribution consists of one of the following terms: (i) the probability that the individual is observed in the zero hours category and does not want to participate in the labour market; (ii) the joint probability that the individual is observed in the zero hours category and is rationed in the labour market (involuntary unemployed), and (iii) the joint probability that the individual is observed in one of the categories with positive working hours and is not rationed in the labour market, where the latter is given by $\Phi(-Z_i'\gamma)$. Assuming the stochastic term in the utility function, ε, and in the rationing equation, η, to be independent, conditional on X and Z, these joint probabilities are simply the product of the two respective probabilities. Thus, maximization of the sample likelihood function with respect to the preference parameters in the utility function and the γ coefficients in the rationing equation is relatively simple and can rely on standard methods.

Estimation results for the labour supply model are reported in the Appendix. Based on these estimates, the expected values of individual working hours and participation rates can be derived under the prevailing and alternative welfare systems.

ATTM estimates, as already noted, this labour supply model separately for couple households where both spouses have flexible working hours, for couple households where either only the female or the male spouse has flexible labour supply, and for singles of either gender. To illustrate the procedure and results, estimation results for partner-households are presented in the Appendix. Due to the quite large number of

[8] If the questions on job search activity within the last four weeks before the interview and availability for work within 3 months have both been answered with "yes", we have set the indicator variable to 1 (=involuntary unemployed).

[9] To check the sensitivity of estimation results with respect to this assumption, below we estimate the model also under the alternative assumption that single mothers want to work less hours.

interaction terms, coefficient estimates are hardly interpretable. Thus, estimation results are usually interpreted in terms of labour supply elasticities, as described in the tables below.

To obtain the expected elasticities, we calculate the expected value of weekly working hours, given the observed working hours in each hour-category and the estimated probability that the household is in this category. Note that since we employ six hours categories for women and four for men, there are in total 24 hour-categories a household could choose from. We do this calculation once with the observed or estimated (for currently non-employed people) wages and once under the assumption that gross wages for either females or males increase by one percent. Then, assuming that the estimated parameters of the structural labour supply model are invariant to changes in the wage (or, more generally, changes in the tax-benefit system), we can derive labour supply elasticities at the extensive (labour force participation) and intensive margin (hours adjustment).

Table 9: Estimated labour supply elasticities for flexible couples

	changes in participation rates (in percentage points)			
	with respect to own wage		with respect to spouse's wage	
	Women	Men	Women	Men
mean [s.d.]	0.099 [0.219]	0.044 [0.039]	-0.014 [0.098]	0.008 [0.036]
p10	0.047	0.017	-0.071	-0.003
p20	0.075	0.023	-0.039	-0.001
p50	0.113	0.037	-0.012	0.005
p80	0.146	0.058	0.016	0.012
p90	0.169	0.079	0.036	0.019
	changes in hours worked (in percent)			
	with respect to own wage		with respect to spouse's wage	
	Women	Men	Women	Men
mean [s.d.]	0.258 [0.778]	0.126 [0.096]	-0.069 [0.507]	0.007 [0.096]
p10	0.127	0.062	-0.216	-0.017
p20	0.176	0.077	-0.124	-0.01
p50	0.266	0.111	-0.053	-0.001
p80	0.369	0.169	0.022	0.015
p90	0.455	0.213	0.074	0.028

Source: ATTM and Statistik Austria (2022)

These elasticities can be computed using the so-called probability technique[10] by simply taking the absolute difference in employment probabilities and the relative difference in the expected value of weekly working hours, respectively. The results of these calculations for various types of households are given in the tables below. To get the labour supply effects of fiscal policy reforms, we would simply replace the simulation of a one-percent increase in gross wages by a simulation with the same gross wages as

[10] An alternative method would be the so-called „calibration"-technique, see Steiner et al. (2008, p. 10) for a description.

under the status quo but with a change in the tax-benefit system, where this change would be translated into changes in households' budget constraints using the tax-transfer calculator.

Tables 8 and 9 document average changes in participation rates and working hours to a one-percent change in gross wages, where we differentiate between a change in the own wage and – in case of couple households – the wage of the spouse[11]. Own-wage elasticities for married women are, on average, substantially larger than for men, both at the extensive and the intensive labour supply margin. We obtain the largest elasticities for women with an „inflexible" spouse, for whom the average hours elasticity is 0.35 and the change in labour force participation to a 10% change in the own wage is about 1 percentage point.[12] For couples with flexible labour supply of both spouses, we calculate both the elasticities with respect to the own wage as well as the elasticities with respect to the partner's wage. As can be seen from the table, the latter are substantially lower than the former and close to zero for both women and men.[13]

[11] The estimated elasticities differ surprisingly little and not significantly between women with and without children.

[12] Given this group's average labour force participation rate is 55%, this percentage change translates into a participation elasticity of 0.36%.

[13] Estimated own-wage participation elasticities for married women are like those reported by Steiner et al. (2008, Table 2) for Germany, whereas the point estimate of the highest hours elasticity, also obtained for women with an inflexible spouse, is somewhat smaller (0.37). Estimated participation and hours elasticities for German men are surprisingly large compared to our estimates for Austria. Average cross-wage elasticities are estimated to be close to zero for all groups in Germany.

Table 10: Estimated labour supply elasticities for couples with only one flexible spouse and singles

	changes in participation rates (in percentage points)			
	Inflexible Spouse		Single	
	Women	Men	Women	Men
mean [sd]	0.104 [0.426]	0.013 [0.059]	0.063 [0.105]	0.049 [0.027]
p10	0.054	0.005	0.034	0.027
p20	0.082	0.007	0.046	0.032
p50	0.136	0.013	0.065	0.045
p80	0.182	0.027	0.091	0.059
p90	0.216	0.043	0.107	0.075
	changes in hours worked (in percent)			
	Inflexible Spouse		Single	
	Women	Men	Women	Men
mean [sd]	0.345 [1.043]	0.040 [0.197]	0.194 [0.456]	0.101 [0.065]
p10	0.157	0.017	0.1	0.053
p20	0.239	0.026	0.124	0.063
p50	0.389	0.044	0.183	0.082
p80	0.517	0.089	0.26	0.127
p90	0.589	0.121	0.323	0.175

Source: ATTM and Statistik Austria (2022)

Chapter 5
THE AUSTRIAN TAX-TRANSFER SYSTEM IN ATTM

The Austrian tax-transfer system is based on the household level, on individual taxation with a progressive personal income tax, high social security contributions, and a broad range of mostly means-tested monetary social transfers. The ATTM tax-transfer calculator models for each household the personal income tax ("Lohn- and Einkommensteuer"), the social security contributions ("Sozialversicherungsbeiträge") levied on income from dependent employment as well as self-employment[14] and the monetary social transfers received by each household. Social insurance comprises health, unemployment, and pension insurance. The transfers included in the microsimulation

[14] In Austria, almost all self-employed people are covered by social insurance.

model are unemployment benefits (“Arbeitslosengeld” and “Notstandshilfe”), family allowances (“Familienbeihilfe”), childcare benefits (“Kinderbetreuungsgeld”), social welfare payments (“Sozialhilfe”) and supplements to low pensions (“Ausgleichszulage”). Except for the received amount of scholarships, which is imputed from external sources, these components are simulated by ATTM because the amounts are affected by income and tax changes. Moreover, ATTM determines the eligibility for early retirement and subsidized part-time work for elderly people according to rules allowing for it in case of employment for more than 40 (women) and 45 (men) years (“Hackler-Regelung” and “Altersteilzeitgeld”).

ATTM simulates, for alternative household labour supply choices and gross wages, net household incomes after adding other incomes and deducting personal income taxes paid by the household. Income components other than income from dependent employment and social transfers, such as self-employment, capital income or pension income, are not simulated by ATTM, but directly taken from the income information in EU-SILC. Thus, it is assumed that these income components are not affected by the policy simulations undertaken with ATTM. This is consistent with the static specification of the household labour supply model that does not account for household savings and wealth accumulation.

Table 10 comprehensively documents the components of household income we just mentioned and notes whether they are determined within the simulation model or drawn from exogenous data sources. Below we describe the above-mentioned taxes and transfers in more detail, and we document to which extent they are implemented in the microsimulation model.

Table 11: Simulated and exogenous components of household income

		Income and tax components	determined within ATTM
Gross income	+	Income from dependent employment (including apprentice allowances)	
	+	Income from self-employment and business	
	+	Income from agriculture and forestry	
	+	Income from capital	
	+	Income from renting and leasing	
	+	Other income including pensions	
Transfer income	+	Unemployment benefit type 1 (Arbeitslosengeld) or	✓
	+	Unemployment benefit type 2 (Notstandshilfe)	✓
	+	Nationwide family allowance (Familienbeihilfe)	✓
	+	Federal state family allowance (Familienförderung der Länder)	✓
	+	Childcare benefits for new-born children (Kinderbetreuungsgeld)	✓
	+	Social welfare payments, including housing, clothing, and heating allowances (Sozialhilfe)	✓
	+	Low-pension supplements (Ausgleichszulage)	✓
	+	Scholarships (Studienbeihilfe)	
Taxes	–	Employees' social security contributions	✓
	–	Income Tax	✓
	=	Net household income	

Source: ATTM

5.1 Social security contributions

The basis for the assessment of social security contributions (SSC) is gross income from dependent employment and self-employment income from entrepreneurship and agriculture. There are no social security contributions levied on income from capital or renting and leasing. Moreover, in case of dependent employment, part of the social security contributions is assigned to the employee, and a (typically slightly larger) part to the employer. ATTM simulates SSC paid by both employees and employers.

Employees' SCC include payments for health-, pension- and unemployment insurance, contributions to the chamber of employees ("Arbeiterkammerumlage") and to a fund which feeds subsidies for residential building ("Wohnbauförderungsbeitrag"). Employers' SCC are more comprehensive and include next to the payments for health, pension and

unemployment insurance for the respective employee additional payments for accident insurance, the fund for residential building subsidies, another fund to feed, amongst other transfers, family allowances ("Familienlastenausgleichsfonds"), another fund securing payments for employees of bankrupt enterprises ("Insolvenzentgeltsicherungsfonds"), contributions to the employee's severance pay reserves ("Abfertigungsrücklage") and a municipality tax.[15.]

In principle, both the social employees' and employers' SCC are paid as a fixed percentage rate of earnings. There are a few exceptions, though: If wage income or self-employment income is below the lower SCC threshold – the so-called insignificance limit ("Geringfügigkeitsgrenze") for "marginal" jobs – there are no social security contributions apart from the contributions to severance pay reserves and accident insurance. On the other hand, the amount of income exceeding the assessment base for highest contributions ("Höchstbeitragsgrundlage", the upper SCC threshold) is exempt from social security contributions, apart from the payments to the funds feeding the family allowances and severance payments, and the municipality tax. Both the lower and the upper SCC threshold are adjusted every year by multiplying last year's value by a factor linked to wage or price inflation, respectively. In 2020, the yearly lower SSC threshold was € 460.66[16] multiplied by 14 (since there are typically 14 wage payments a year, one for each month plus holiday and Christmas payments each equal to regular monthly earnings). The upper SSC threshold in that year was 14 times € 5,370 = € 75,180.

Since July 2008 low wage incomes are either totally or partially exempt from contributions to the unemployment insurance, and health insurance payments differ with respect to whether the employee is a blue- or white-collar worker, employed in the public sector or a so-called "free employee" ("freier Dienstnehmer")[17].

The Austrian social security system features quite generous regulations concerning health insurance coverage of non-employed family members. Children's health insurance is always free, while the spouse's insurance is free in case she is currently taking care for children or has in the past taken care for children for at least four years, or if she or the spouse who pays the health insurance contributions is disabled to a certain degree such that they need care ("Pflegestufe 4"). If those exceptions do not apply, the fee for health insurance of non-employed spouses is 3.4% of the gross wage (Sozialversicherung, 2020).

[15] The contributions to these funds, the severance pay reserves fund, and the community tax are not part of the officially defined social security system which comprises health, pension, unemployment, and accident insurance. However, the Austrian tax-benefit system treats those payments like the social security contributions (i.e., they are fully exempt from income taxes).

[16] For self-employment income this threshold is 460.66 × 12=5,527.9. Although there is no insurance coverage in this case, it is possible to opt into health and accident insurance at the given percentage rates. This would result in quite low payments since there is no pension insurance then (SVS, 2020).

[17] Additional nuances of the Austrian social security system include different rates for health insurance of blue-collar workers employed in agriculture, pension insurance of persons employed in mining. Moreover, pension insurance payments for civil servants are slightly higher (12.55 %) than the payments for private sector employees, and they do not feature an assessment base for highest contributions. On grounds of this feature, pension payments for civil servants are typically higher.

The following table gives an overview of the rates charged for various features of the Austrian social security system as of 2020.

Since the type of employment (blue-collar, white-collar, self-employment) as well as the type of industry is well-documented, ATTM models all the fine differences in SSC regulations affecting these groups. A slight inaccuracy is due to EU-SILC data containing no information on whether non-employed spouses took care of children in the past for at least four years, which would allow them to be covered by the partner's health insurance without an additional fee. ATTM thus attributes the additional fee for health insurance to all non-employed spouses without children in their household who have past periods of non-employment of at least four years.

Table 12: Payments to the social security system as percentage rates of gross wage/income (as of 2023)

	blue collar workers		white collar workers		civil servants		self-employed	farmers	pensioners
	Employee	employer	employee	employer	employee	employer			
Health Insurance	3.87%	3.78%	3.87%	3.78%	4.75%	4.30%	6.80%	6.80%	5.10%
Pension Insurance	10.25%	12.55%	10.25%	12.55%	12.55%	***	18.50%	17.00%	–
Unemployment Insurance*	3.00%	3.00%	3.00%	3.00%	–	–	–	–	–
Contribution Chamber of employees** (Arbeiterkammerumlage)	0.50%	–	–	–	–	–	–	-	
Contribution Fund for residential building** (Wohnbauförderungsbeitrag)	0.50%	–	0.50%	0.50%	–	–	–	–	–
Fund securing payments at bankruptcy (Insolvenzentgeltsicherungszuschlag)	–	–	0.50%	0.55%	–	–	–	–	–
Accident Insurance	–	1.10%	–	1.10%	–	0.47%	€ 10.97/mth	1.90%	–
Contribution for assistance at farm (Betriebshilfebeitrag)	–	–	–	–	–	–	–	0.40%	–
Severance pay reserves (Abfertigungsrücklage)	–	1.53%	–	1.53%	–	–	1.53%	–	–
Fund for Family allowances (Familienlastenausgleichsfonds)	–	3.70%	–	3.70%	–	–	–	–	–
Supplement for Fund for Family allowances	–	0.43%	–	0.43%	–	–	–	–	–
Municipality Tax (Kommunalsteuer)	–	3.00%	–	3.00%	–	–	–	–	–
Underground-tax (U-Bahn Steuer)****	–	0.72%	–	0.72%	–	–	–	–	–
Yearly lower SSC threshold (Geringfügigkeitsgrenze)	7,012	7,012	7,012	7,012	7,012	7,012	6,011	–	–
Yearly upper SSC threshold (Höchstbeitragsgrundlage)	81,900	81,900	81,900	81,900	81,900	81,900	81,900	81,900	–

* Employees contribution for monthly gross income below 1,855 0%, below 2,056 1% and below 2,228 2%, ** Only levied on regular payments, not on holiday- and Christmas allowances, *** contribution differing with operational area of civil servant, **** in Vienna only

Source: Sozialversicherung (2023)

5.2 Wage and income tax

The Austrian personal income tax system features a progressive tax scale with stepwise increasing marginal tax rates. It is a system based on the incomes of individuals ("individual taxation") which provides deductibles in case of marriage/family and low partner income, however. The system makes a distinction between wage income from employment and pensions, and income from other sources, in particular self-employment, agriculture, renting and leasing. Capital income as well as income from corporate enterprises is taxed with a flat rate of 25%, without a basic allowance. Whereas wage income and pensions are divided into regular (12 monthly earnings) and special payments (Holiday- and Christmas payments), other income is fully subject to the progressive tax scale. While regular payments of the former are taxed according to the scale, special payments are subject to a lower flat rate of 6%[18], with a general yearly allowance of € 620.

5.3 Determination of taxable income

ATTM features the Austrian tax scales from the years 2005 - 2023.[19]Regular income is determined by subtracting all income-related expenses, including social security contributions. Thus, social security contributions are completely tax-free in the Austrian system. If there are, apart from those social security contributions, no other income related expenses, taxpayers can subtract flat expenses of € 132 ("Werbungskostenpauschale") and additional flat special expenses ("Sonderausgabenpauschale") of € 60 a year. Moreover, disabled persons can subtract disability allowances ranging from € 75 to € 726, according to the degree of disability ("Behindertenfreibetrag").

If an employee receives, in addition to her earnings, income from other sources up to € 730, the other income is not taxed ("Freibetrag für zu veranlagende Einkommensarten"). If other income exceeds € 730 however, this allowance is reduced

[18] Special payments exceeding € 25,000 per year are taxed with a rate of 27%, special payments exceeding € 50,000 per year with 35.75% and special payments exceeding € 83,333 per year are taxed with 50%

[19] There have been major tax reforms in 2009 and 2016, in 2019 a substantial family bonus of € 1,500 income tax reduction per child of age < 18 has been introduced. This bonus has been increased to € 2,000 in 2022. The most recent changes have been the reductions of the "first" marginal tax rate (for regular income ranging from € 11,693 to € 19,134 per year) from 25% to 20% and of the "second" marginal tax rate from 35% to 30%. Moreover, since 2023 the income thresholds as well as several deductibles are yearly uprated according to the inflation rate to avoid bracket creeping. However, the uprating is not fully linked to the inflation rate. Rather, all thresholds are uprated by 2/3 of the inflation rate plus an ad-hoc updating.

by the difference between the income and € 730. For additional income exceeding € 1,460, there is no such allowance anymore.

Up to 13 percent of the income from self-employment is tax exempted provided this amount is invested in assets satisfying certain standards ("Gewinnfreibetrag").

There is a commuting allowance ranging from € 546 to € 2,931 ("Pendlerpauschale"), depending on the distance between residence and place of employment, and whether public transport is available.

Deductibles

There are several deductibles in the Austrian tax system which may reduce the income tax assessed. Taxpayers with children and spouse's income not exceeding € 6,312 (2023) are eligible for the single-earner deductible of € 520 plus supplements of € 184 for the second and € 232 for the third and any other child. Single parents are eligible to this deductible as well ("Alleinerzieherabsetzbetrag"). In case the income tax becomes negative by subtracting the single-earner deductible, the taxpayer receives a tax credit.

If a taxpayer must pay alimony, he is eligible to a monthly *alimony deductible* of € 25.5 for the first, € 30.2 for the second and € 50.9 for the third and any other child not living in the taxpayer's household. To be eligible for the alimony deductible, children must be eligible for the family allowance described below.

There is a *child deductible* of € 58.4 per month and child eligible to the family allowance and living in the taxpayer's household. This deductible is paid in cash together with the family allowance, even if the taxpayer does not have any income.

All dependent employees are eligible for a *traffic deductible* ("Verkehrsabsetzbetrag") of € 421 (2023) per year, while pensioners are eligible for a *pensioner deductible* ("Pensionistenabsetzbetrag") of € 825 (2023) a year as well. Two things are noteworthy in this context. First, those deductibles are only applicable in case the amount of the assessed income tax greater than zero, and in case the assessed income tax is less than the deductible, the income tax will be reduced to zero, it will not become negative, Second, beginning with a taxable pension income of € 17,000 per year, the pensioner deductible is decreased at a marginal rate of 5 percent until it turns zero at a taxable pension income of € 25,500. In 2023, the *traffic deductible* is increased by an additional € 726 per year the taxpayer is eligible for commuter-allowance ("Pendlerpauschale") and if taxable regular income is lower than € 12,200 per year. For higher incomes, the addition is phased out linearly and reaches 0 at an income of € 13,000 per year. A similar addition (€ 1,214 in 2023) is implemented for pensioners.

If a taxpayer is eligible for an employer deductible, in principle, but the amount of her income tax assessed is zero or negative, then there is an additional *negative income tax* amounting to 55 percent of her social security contributions, up to a maximum amount of € 421 per year (2023). Furthermore, if the taxpayer is eligible for the commuting allowance („Pendlerpauschale"), the negative income tax amounts to 50 percent of her social security contributions, up to a maximum amount of € 526 per year. Moreover, since 2020 the income tax schedule features an additional negative tax ("KV-Erstattungsbeitrag" or "SV-Bonus") of € 684 (2023), which is phased out to zero between taxable incomes of € 16,832 and € 25,774.

As noted already, the income tax system in ATTM incorporates all the allowances and deductibles mentioned above, with the following exceptions:

First, farmers have the possibility to opt for a flat income determination procedure most frequently resulting in very low taxable incomes ("Pauschalierung der Landwirte"). Since there is no direct information in EU-SILC to determine whether this option is chosen, this system is currently not implemented in ATTM.

Second, as there is only little information on the degree of disability in EU-SILC, but the disability allowance ("Behindertenfreibetrag") is quite differentiated with respect to the degree of disability, we assign to all individuals who are denoted "somewhat handicapped" in the data, the allowance for a degree of 25%, and to all who are denoted "severely handicapped" the allowance for a degree of 75%.

Third, as there is no information on the number of children eligible for the alimony deductible ("Unterhaltsabsetzbetrag") in the data, we assume all persons paying alimonies to do so for one child only.

Fourth, as there is no information on membership in churches in the data, we assume that somebody is a member of the Catholic or Protestant Church with a probability equal to the overall fraction of members of the Catholic and Protestant Church in the respective federal state (Statistik Austria, 2007). Since a maximum amount of € 200 per year of contributions to religious communities is exempt from taxation, we subtract the contribution up to a maximum of € 200 from taxable income[20].

[20] According to 2001 census data, 73,6% of the Austrian population are Catholics and another 4,7% Protestants. Another 4,2% are Muslims, however, since we do not have detailed information on how contributions to Muslim Communities are calculated, we do not implement those contributions.

Fifth, EU-SILC does not contain any information on the share of income which the self-employed keep within the own enterprise or invest. Thus, the self-employed are assumed to invest 10 percent of their income in assets that qualify for the profit allowance ("Gewinnfreibetrag").

Sixth, since there is no information on the distance between residence and workplace and the availability of public transport on the way in our data base, the commuting allowance ("Pendlerpauschale") cannot be implemented in detail. ATTM uses data from the Austrian wage tax statistics (Statistik Austria, 2021b,f) on the number of employees eligible for the commuting allowance and the aggregate allowance in each of the nine federal states. The share of eligible employees is highest in Burgenland (33.5%) and lowest in Vienna (4.2%), while the average allowance, given eligibility, ranges from € 530 (Vorarlberg) to € 968 (Burgenland). ATTM uses a random procedure to assign the average commuting allowance to dependent employees with a probability equal to the share of eligible employees by region.

5.4 Unemployment benefits

There are two types of unemployment compensation payments. For the first 20 weeks[21] of unemployment there is the "unemployment benefit" ("Arbeitslosengeld", UB), thereafter there is "unemployment assistance" ("Notstandshilfe", UA) until unemployment ends. While UB is an insurance payment, UA is a means-tested social transfer. Both payments require showing efforts in finding a job as well as being principally able to take up a new job.

The amount of UB is 55 percent of the previous net wage income and paid as a daily benefit. In case the benefit is lower than the basis for pension supplements ("Ausgleichszulage"), the UB replacement ratio rises to up to 60 percent. In 2023 the maximum monthly UB amount is 55 percent of the upper social security threshold of € 5,850. Since the UB is based on the insurance principle (AMS, 2020), it is not means tested.

The amount of UA is 92 or 95 percent (depending on whether unemployment benefit is below or above the basis for pension supplements) of the amount previously received

[21] If the employee has been employed for at least 156 weeks during the last 5 years, the UB is paid for 30 weeks. If the employee is older than 40 and has been employed for at least 312 weeks during the last 10 years, the duration is 40 weeks, and for employees older than 50 who have been employed for 468 weeks during the last 15 years, the duration is 52 weeks.

as UB, with a maximum of € 1,110 per month (the basis of pension supplements in 2023). Both the UB and UA include a small family supplement of € 0.97 per day and dependent child (AMS, 2020).

The implementation of the system of unemployment benefits in ATTM faces the problem that, although EU-SILC records the cumulated duration of previous employment spells for each person, it does not provide sufficient information to determine the duration of employment during the reference period relevant for the UB entitlement period. It is thus currently not possible to precisely determine how long somebody would receive the UB, and whether she is eligible to it at all.

Given this limitation, the current version of ATTM assumes that all persons who received income from dependent employment during the year before being questioned are eligible for both UB and UA, since eligibility for UA requires to have received UB before. Since for estimations of labour supply elasticities the longer-term eligibility to benefits is relevant, we set the amount of the benefit received by those eligible to UB equal to the level of UA rather than to that of the UB. Since there is no information in EU-SILC on extraordinary hardships which would result in supplementary payments in addition to the UA and UB standard rates, these rules cannot be implemented in ATTM.

5.5 Family allowance

There is a nationwide family allowance ("Familienbeihilfe") paid out of a fund ("Familienlastenausgleichsfonds") financed by employers' contributions amounting to 3.7 percent of gross wages, plus a smaller supplement that differs between federal states. All children younger than 19 years are automatically and without regard of the parent's income eligible to the family allowance. Children who are severely disabled or follow some tertiary education can receive the allowance up to the age of 24, or 25 if the person has been obliged to do military or community service.

The amount of the nationwide family allowance depends on the age and the number of children in the household. As shown by Table 13, the total family allowance consists of a basic payment, an additional payment if the number of children is two and two higher additional payments ("Geschwisterstaffelung" plus "Mehrkindzuschlag") for more than two children. Moreover, there is a supplement of € 165 per month if the respective child is severely disabled, and an additional payment in August ("Schulstartgeld") of € 106 (2023).

Table 13: Family allowance rates as of 2023

	age of child			
	0 – 2	3 – 9	10 – 18	19 – 24
Basic allowance	120.6	129.0	149.7	174.7
Addition if two children („Geschwisterstaffelung“)	15,0	15.0	15.0	15.0
Addition if three children („Geschwisterstaffelung“)	55.2	55.2	55.2	55.2
Addition if four children (“Geschwisterstaffelung”)	112.0	112.0	112.0	112.0
Addition if five children (“Geschwisterstaffelung”)	169.5	169.5	169.5	169.5
Addition if six children (“Geschwisterstaffelung”)	226.8	226.8	226.8	226.8
Addition of more than six children per child (“Geschwisterstaffelung”	55.0	55.0	55.0	55.0
Supplement for severely disabled children	164.9	164.9	164.9	164.9

Source: Own tabulation based on BMF (2023).

5.6 Childcare benefits

Parents of new-born children receive childcare benefits (“Kinderbetreuungsgeld”) if their yearly gross income does not exceed the maximum of € 18,000 or 60 percent of the applicant’s yearly gross income. Only one parent can receive childcare benefits at a time, though the overall duration of the benefit increases if both parents use it subsequently. The maximum total amount is € 13,085 Euro if one parent use “Kinderbetreuungsgeld” and € 16,374 if both parents use it. Duration varies between 12 and 28 months for one parent and 15 and 35 months if both parents receive the transfer. The duration can be selected by the recipients, the total amount paid does not change with the duration. In addition, however, there is an additional income-dependent option of the benefit. Choosing this, parents receive 80 percent of their net income, but at most € 70 per day. The maximum duration for this option is 12 (one parent) or 14 (two parents) months. For this option, the upper limit for yearly gross income reduces from € 18,000 to € 7,800 per year (2023). Moreover, if parents divide “Kinderbetreuungsgeld” with at least 40% for one parent, they are eligible to an additional “Partnerschaftsbonus” of € 1,000. Starting with 2023, the childcare benefits will automatically be uprated according to inflation each year (BKA, 2023).

Since there is no direct information on the duration parents choose to receive childcare benefits in EU-SILC, we assume the non-income-dependent model with a total transfer of € 13,085 to be chosen. We are currently working on a more detailed implementation of the childcare benefits based on the estimation on take-up rates for the available options.

5.7 Social assistance

Social assistance (SA) is the basic transfer that secures subsistence if other sources of income like labour or other household or personal transfers fail to do so. Before SA was known as "Sozialhilfe" and regulated at the level of the federal states (Statistik Austria, 2021e). After the reform in 2010, which aimed at standardizing SA at some nationwide level, SA was termed "Bedarfsorientierte Grundsicherung". As it turned out, the federal states did not fully standardize the payments. For example, some federal states implemented supplementary payments for children and residential rents that were different from the national standard. In 2020, SA was reformed ("Sozialhilfe NEU") again. Within this reform, payments have been standardized, although the western federal states of Tyrol, Vorarlberg and Salzburg differ from the nationwide standard with respect to payments for rents. In general, rents are higher in the west of Austria.

Typical receivers of SA are single parents, since many of them are not eligible for UB or UA because they are not able to take up a job, often due to childcare responsibilities. Moreover, self-employed persons with no income and no entitlement to unemployment insurance payments[22] are also entitled to SA, given the wealth-limit of € 6.322 (2023) is not exceeded (houses/apartments the applicant uses herself to live in as well as necessary housing equipment is not subject to the wealth-limit).

The amount of SA is determined by the difference between a respective standard rate (see Table 13 and actual household income, including all sources of income plus transfer income plus "exploitable" assets.[23]. The nationwide family allowances are not included in the income subtracted from the standard rates when determining the payment, however. As can be seen from the table, the standard rates for persons eligible for the nationwide family allowance are typically lower. Standard rates for SA typically include average costs of renting and vary substantially across the federal states, as Table 16 shows. Typically, the standard rates of SA are paid 12 times a year. In addition, there are irregular payments, including coverage of the costs for heating in winter, clothing, and medical care. Moreover, most federal states have introduced a maximum social assistance payment for adults at 175% of the net pension supplement ("Netto-Ausgleichszulagenrichtsatz") of € 1,844 in 2023.

[22] Since 2009 self-employed persons can voluntarily insure against unemployment. To prevent moral hazard to some extent, one must choose to take up unemployment insurance within 6 months from the beginning of self-employment and is obliged to pay contributions for at least 8 years before becoming eligible for UB (SVS, 2020).
[23] These are monetary assets as well as property not used for own residence. In general, however, monetary assets up to € 4,587 do not reduce the SA amount.

Table 14: Social assistance standard rates in € per month as of 2023

	Singles	Singles receiving family allowance	Persons living together in households	receiving family allowance older than 18	receiving family allowance younger than 18	additional supplement for lone parents
Burgenland* ˜	1,054	–	790	316	202	–
Carinthia* ** *** ˜	1,054		738	–	263	126
Lower Austria* ** *** ˜	1,054		738	–	263	126
Upper Austria * ** *** ˜	1,054	–	738	–	263	126
Salzburg * ** *** #	1,054	–	738	–	263	126
Styria* ** *** ˜	1,054	–	738	–	221	126
Tyrol** + ## ˜	790	–	593	–	260	–
Vorarlberg** *** ## ˜	632	–	443	285	202	3%
Vienna ˜	1,054	–	790	–	284	–

* payment for third+ person living together in household is reduced
** payment for persons with family allowance dependent on number of such persons in household
*** supplement for lone parents' dependent on number of children
˜ income is not fully deducted from transfer payments, typically 15% to 35% of labour income up to a maximum of 20% of the transfer for singles is not deducted.
working hour dependent income deduction: 18% (> 20 hours per week) or 9% (<= 20 hours per week) of income is not deducted from transfer payment
+ additional payments comparable to "Sonderzahlungen" in employee income of € 95 four times per year for lone parents, pensioners with minimum pension ("Ausgleichszulage") if social assistance is received for 4 months or longer.
additional monthly payment for rent with maximum values depending on household size and location
Source: Federal States (2023)

ATTM includes the standard rates of social welfare payments for each federal state and calculates the payment by subtracting total wage and self-employment income plus transfer income (excluding the nationwide family allowance) and assets from the relevant standard rates. Irregular SA payments mentioned above are currently not included in ATTM.

By using the procedure described above, we overestimate the total amount of SA payments for two reasons. First, we assume a take-up rate of 100 percent; second, EU-SILC does not include data on exploitable assets, the approximate amount of which can only be inferred from information on capital income recorded in the data.

5.8 Low-pension supplements

Poor pensioners are eligible to low-pension supplements ("Ausgleichszulage"). The supplement is determined by the difference between a "low-pension standard rate" ("Ausgleichszulagenrichtsatz") and the actual pension. The standard rates are changed every year according to the inflation rate. In 2023, the standard rate is € 1,110 per month for singles and € 1,752 for couples. There are lower rates for orphan's pensions, depending on whether one or both parents have died already. Since January 2020, low-pension supplements are raised by € 164 (2023) per month if the retired person has been employed for at least 360 months, and by € 419 per month if previous employment duration has been at least 480 months. For couples, the supplement has been raised is € 419 per month if one of the two persons previously has been employed for at least 480 months (PV, 2023).

ATTM applies the standard rates for singles and couples and, given the pension payment received, calculates the height of low-pension supplements, if applicable. The regulations for orphan's pensions are not implemented since the data do not provide the necessary information on parents' status.

5.9 Early retirement supplements

While early retirement before the regular retirement age (60 for women[24] and 65 for men) leads, as a rule, to a reduction of the pension payments, there is a special regulation for people having been employed for more than 540 months ("Vorzeitige Alterspension aufgrund langer Versicherungsdauer", colloquially also called "Hackler-Regelung"). This regulation allows eligible people to retire at the age of 60-62 (women, depending on the date of birth) and 62 (men) without any reduction of their pension income. This regulation is not restricted to people who have been performing physically strenuous work, despite the connotation of the Austrian expression "Hackler" which means just this.

For people performing physically strenuous work[25] there is another possibility to retire early without a reduction of their pension income. Men and women aged 60 or older who have been employed in such jobs for at least 10 out of the last 20 years and in

[24] The retirement age for women is gradually increased from 2024 on until it reaches 65 in 2033.

[25] Strenuous work is defined according by decree of the Ministry of Labor according to the consumption of calories. Jobs in which the necessary daily consumption of calories exceeds 2,000 (men) or 1,400 (women) calories are defined as strenuous work (Bundeskanzleramt, 2009).

total more than 480 (women) or 540 (men) months are eligible for a „strenuous work" pension ("Schwerarbeitspension") (PV, 2020).

ATTM determines eligibility for part-time work and early retirement due to long cumulated duration of employment. Eligibility to early retirement due to strenuous work cannot be determined since EU-SILC does not provide information on the specific types of job an observed person performed in the years before having been interviewed. Implementation of the early retirement supplement rules described above is relevant for simulations in ATTM, since some persons with flexible labour supply might be eligible for early retirement supplements which may affect their working hours and retirement decisions.

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APPENDIX

Table A1: Estimation results for labor supply model with rationing, Dependent variable: hours category

explanatory variable	flexible couples	women with inflexible spouse	men with inflexible spouse	single women	single men
Monthly net income x womens' age	0.179 [0.063]***	0.496 [0.159]***		0.009 [0.079]	
monthly net income x mens' age	-0.03 [0.062]		-0.024 [0.250]		0.053 [0.081]
Monthly net income x womens' age²	-0.203 [0.074]***	-0.005 [0.002]***		0 [0.001]	
monthly income x mens' age²	0.033 [0.070]		0 [0.003]		-0.001 [0.001]
monthly net income	-1.996 [1.405]	-10.62 [3.502]***	0.971 [5.982]	2.068 [1.655]	0.201 [1.631]
monthly net income²	-0.031 [0.011]***	0.004 [0.022]	0.017 [0.037]	-0.114 [0.037]***	-0.092 [0.024]***
womens' leisure x age	-0.003 [0.024]	0.021 [0.055]		-0.03 [0.028]	
mens' leisure x age	-0.05 [0.033]		-0.075 [0.101]		-0.026 [0.031]
womens' leisure x age²	0.038 [0.029]	0 [0.001]		0.001 [0.000]*	
mens' leisure x age²	0.086 [0.038]**		0.001 [0.001]		0 [0.000]
womens' leisure x Austrian	-0.115 [0.053]**	-0.215 [0.117]*		-0.214 [0.106]**	
mens' leisure x Austrian	-0.286 [0.076]***		0.116 [0.251]		-0.074 [0.112]

Table A1continued

explanatory variable	flexible couples	women with inflexible spouse	men with inflexible spouse	single women	single men
womens' leisure x minor handicap	0.063 [0.052]	0.073 [0.076]		-0.024 [0.079]	
mens' leisure x minor handicap	0.134 [0.078]*		0.072 [0.181]		0.038 [0.110]
womens' leisure x severe handicap	0.136 [0.096]	0.205 [0.131]		0.37 [0.113]***	
mens' leisure x severe handicap	0.765 [0.095]***		0.954 [0.210]***		0.494 [0.126]***
womens' leisure x child aged 0 - 2	0.742 [0.063]***	0.829 [0.132]***		1.335 [0.150]***	
mens' leisure x child aged 0 - 2	-0.008 [0.097]		0.095 [0.296]		0.579 [0.384]
womens' leisure x child aged 3 - 10	0.482 [0.045]***	0.417 [0.077]***		0.675 [0.087]***	
mens' leisure x child aged 3 - 10	0.056 [0.073]		0.232 [0.183]		0.443 [0.639]
womens' leisure x child aged 11 - 18	0.056 [0.042]	0.184 [0.065]***		0.186 [0.079]**	
mens' leisure x child aged 11 - 18	0.037 [0.067]		0.199 [0.162]		-0.52 [0.341]
womens' leisure	-0.058 [0.521]	-1.725 [1.230]		2.13 [0.609]***	
mens' leisure	3.3 [0.761]***		2.848 [2.360]		2.892 [0.679]***

Table A1continued

explanatory variable	flexible couples	women with inflexible spouse	men with inflexible spouse	single women	single men
womens' leisure²	-0.026 [0.014]*	0.039 [0.022]*		-0.177 [0.027]***	
mens' leisure²	-0.289 [0.024]***		-0.242 [0.052]***		-0.276 [0.029]***
womens' leisure x income	-0.016 [0.016]	0.004 [0.028]		-0.302 [0.066]***	
mens' leisure x income	-0.05 [0.029]*		-0.006 [0.071]		0.024 [0.056]
womens' leisure x mens' leisure	-0.017 [0.021]				
Observations	1481	674	263	885	846

Notes: "×" indicates an interaction term; standard errors in brackets; * significant at 10%; ** significant at 5%;*** significant at 1% Monthly income is measured in th. €, leisure and age² have been divided by 10 and 100 respectively in order to avoid numerical problems in coefficient estimation.

Table A2: Estimation results for the rationing probability
Dependent variable: involuntary unemployed

	women with flexible spouse	men with flexible spouse	women with inflexible spouse	men with inflexible spouse	single women	single men
age	0.08 [0.119]	0.173 [0.115]	0.224 [0.250]	-0.119 [0.213]	-0.021 [0.111]	0.033 [0.093]
age²	-0.161 [0.141]	-0.126 [0.128]	-0.003 [0.002]	0.001 [0.002]	-0.001 [0.001]	0 [0.001]
severe handicap	-0.121 [0.482]	1.151 [0.307]***			0.64 [0.327]*	0.775 [0.322]**
minor handicap	0.183 [0.205]	0.402 [0.222]*			-0.295 [0.312]	0.273 [0.275]
completed apprenticeship	-0.732 [1.145]	1.016 [1.630]				-1.55 [2.153]
master craftsmen	0.099 [1.311]	1.67 [1.648]				-1.639 [2.210]
apprenticeship/ master/vocational			0.06 [0.675]		-1.347 [1.279]	
vocational school	-0.526 [1.359]	-3.473 [211.046]	0.454 [0.702]			-1.954 [2.435]
higher secondary school	-0.939 [1.207]	1.239 [1.620]			-1.458 [1.224]	
higher secondary/ high school			-0.293 [0.699]			
higher sec./ high school/university						-2.284 [2.395]
high school/university	-0.458 [1.388]	1.188 [1.842]			-1.508 [1.450]	

Table A2 continued

	women with flexible spouse	men with flexible spouse	women with inflexible spouse	men with inflexible spouse	single women	single men
experience	-0.002 [0.023]	-0.072 [0.024]***	0.02 [0.064]	0.008 [0.061]	0.049 [0.047]	-0.009 [0.032]
years of unemployment	0.054 [0.024]**	0.05 [0.028]*	0.063 [0.065]	0.157 [0.093]*	0.076 [0.051]	0.12 [0.039]***
years of unemployment unknown	2.494 [0.678]***	-0.117 [0.757]	-2.242 [160.239]	3.213 [2.432]	2.247 [0.805]***	1.533 [0.729]**
low-qualified	-0.04 [0.191]	-0.135 [0.232]	-0.017 [0.451]		-0.549 [0.249]**	-0.538 [0.263]**
semi-qualified	-0.129 [0.272]	0.478 [0.451]	-0.435 [0.705]		-0.302 [0.342]	-0.49 [0.485]
low/semi-qualified				0.965 [0.714]		
qualified	-0.411 [0.420]	-0.445 [0.444]			-0.3 [0.443]	0.171 [0.402]
high-qualified	-0.347 [0.432]	-0.24 [0.517]			-0.325 [0.526]	0.228 [0.518]
qualified/high-qualified			0.322 [0.708]	1.037 [0.931]		
white-collar	-0.372 [0.216]*	-0.336 [0.390]				
public white-collar	-0.504 [0.388]	-4.173 [264.960]				
white-collar/public white collar			-0.128 [0.428]	-1.228 [0.754]	-0.463 [0.275]*	-0.221 [0.324]
born in Austria or EU-country	0.004 [0.326]	-0.594 [0.282]**	-0.9 [0.598]	0.25 [0.993]	0.239 [0.402]	-0.115 [0.295]
born in former Yugoslavia	-0.168 [0.383]	-0.519 [0.324]				

Table A2 continued

	women with flexible spouse	men with flexible spouse	women with inflexible spouse	men with inflexible spouse	single women	single men
Born in Turkey	0.172 [0.512]	-0.27 [0.355]				
Unemployment rate in federal district	0.014 [0.054]	0.093 [0.063]	0.229 [0.166]	-0.113 [0.150]	0.031 [0.069]	0.152 [0.075]**
Unemployment rate in age category	-0.083 [0.153]	0.149 [0.156]	0.183 [0.453]	-0.318 [0.407]	0.014 [0.126]	0.023 [0.105]
Unemployment rate in educational category	-0.118 [0.243]	0.243 [0.321]	-0.061 [0.141]	-0.112 [0.158]	-0.227 [0.259]	-0.177 [0.427]
lives in town > 100.000 inhabitants	0.107 [0.212]	0.097 [0.228]	-0.574 [0.608]	0.577 [0.525]	-0.114 [0.272]	0.36 [0.258]
lives in town > 10.000 inhabitants	0.257 [0.196]	0.084 [0.252]	0.823 [0.400]**		0.004 [0.242]	0.316 [0.278]
child aged 0 - 2	-0.231 [0.261]	-0.104 [0.236]	0.399 [0.341]		0.291 [0.493]	
child aged 3 - 10	0.09 [0.167]	0.391 [0.196]**	-0.234 [0.278]		0.078 [0.265]	
child aged 11 - 18	-0.045 [0.173]	-0.147 [0.205]			0.148 [0.254]	
Constant	-1.065 [3.555]	-7.94 [3.889]**	-8.53 [7.555]	2.705 [5.606]	0.969 [3.753]	-1.403 [4.184]
Observations	1481	1481	674	263	885	846

Notes: Standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%monthly income is measured in th. €, leisure and age² have been divided by 10 and 100 respectively in order to avoid numerical problems in coefficient estimation.
Due to the limited number of observations, some explanatory variables have been combined or dropped in the estimations for singles as well as people with inflexible spouse.

Table A3: Descriptive statistics for data used in wage imputation

	mean	sd	min	max	mean	sd	min	max
	Men, N = 17,797				Women, N = 17,410			
hourly wage (original)	18.31	22.49	0.00	1375.23	14.12	16.34	0.00	648.12
hourly wage (top/bottom coded	18.40	16.42	0.00	99.70	14.22	12.26	0.00	72.70
hourly wage, only positive (tob/bottom coded)	24.03	14.72	1.15	99.70	18.70	10.66	0.64	72.70
share of positive wages	0.77	0.42	0.00	1.00	0.76	0.43	0.00	1.00
apprenticeship training	0.40	0.49	0.00	1.00	0.27	0.45	0.00	1.00
intermediate vocational education (BMS)	0.08	0.27	0.00	1.00	0.14	0.35	0.00	1.00
general college (AHS)	0.06	0.23	0.00	1.00	0.06	0.25	0.00	1.00
vocational college (BHS)	0.20	0.40	0.00	1.00	0.18	0.38	0.00	1.00
university / univ. of applied science (Fachhochschule)	0.19	0.39	0.00	1.00	0.22	0.42	0.00	1.00
severely disabled	0.06	0.23	0.00	1.00	0.06	0.23	0.00	1.00
years of employment	24.72	12.96	0.00	51.00	19.07	11.60	0.00	46.00
years of unemployment	1.27	3.35	0.00	40.00	3.60	5.95	0.00	43.00
yrs. of unempl. missing	0.03	0.18	0.00	1.00	0.05	0.23	0.00	1.00
average regional (state) unemployment rate	9.02	3.20	4.90	15.50	7.85	2.14	4.70	11.70
av. unempl. rate by age	9.83	2.29	7.10	15.90	8.13	1.08	6.40	10.10
av. unempl. rate by level of education	6.95	5.43	2.90	26.57	7.43	6.70	2.90	26.57
non-labour household income	22.67	22.08	-130.38	403.37	33.11	30.41	-18.00	819.03
married	0.68	0.47	0.00	1.00	0.67	0.47	0.00	1.00
dummy child <= 3 years	0.14	0.42	0.00	3.00	0.16	0.43	0.00	3.00
dummy 4 < child < 6 yrs.	0.09	0.32	0.00	2.00	0.11	0.34	0.00	2.00
dummy 7 < child < 12 yrs	0.19	0.50	0.00	5.00	0.22	0.54	0.00	5.00
dummy 13< child < 18 yrs	0.16	0.46	0.00	4.00	0.21	0.51	0.00	4.00
firm size <= 4 empl.	0.08	0.27	0.00	1.00	0.10	0.30	0.00	1.00
4 < firm size <= 9 empl.	0.08	0.27	0.00	1.00	0.11	0.31	0.00	1.00
10 <= firm size <= 19 empl	0.09	0.28	0.00	1.00	0.10	0.31	0.00	1.00
20 <= firm size <= 49 empl	0.14	0.34	0.00	1.00	0.13	0.34	0.00	1.00

Table A3 continued

	mean	sd	min	max	mean	sd	min	max
	Men, N = 17,797				Women, N = 17,410			
firm size >= 50 empl.	0.38	0.48	0.00	1.00	0.29	0.45	0.00	1.00
agriculturre	0.01	0.08	0.00	1.00	0.01	0.07	0.00	1.00
mining and energy	0.02	0.14	0.00	1.00	0.00	0.07	0.00	1.00
construction	0.18	0.39	0.00	1.00	0.07	0.26	0.00	1.00
retailing	0.08	0.28	0.00	1.00	0.02	0.13	0.00	1.00
transport	0.08	0.27	0.00	1.00	0.12	0.33	0.00	1.00
catering and hotels	0.06	0.23	0.00	1.00	0.02	0.13	0.00	1.00
information/communic.	0.03	0.16	0.00	1.00	0.05	0.22	0.00	1.00
finance and real estate	0.03	0.16	0.00	1.00	0.01	0.12	0.00	1.00
science	0.03	0.18	0.00	1.00	0.04	0.19	0.00	1.00
other services	0.05	0.23	0.00	1.00	0.08	0.27	0.00	1.00
public administration	0.02	0.14	0.00	1.00	0.03	0.17	0.00	1.00
education	0.04	0.19	0.00	1.00	0.10	0.30	0.00	1.00
health care	0.04	0.20	0.00	1.00	0.14	0.35	0.00	1.00
Burgenland	0.03	0.18	0.00	1.00	0.03	0.18	0.00	1.00
Kärnten	0.06	0.24	0.00	1.00	0.06	0.24	0.00	1.00
Niederösterreich	0.20	0.40	0.00	1.00	0.19	0.39	0.00	1.00
Oberösterreich	0.17	0.38	0.00	1.00	0.17	0.37	0.00	1.00
Salzburg	0.06	0.23	0.00	1.00	0.06	0.24	0.00	1.00
Steiermark	0.14	0.35	0.00	1.00	0.14	0.35	0.00	1.00
Tirol	0.09	0.28	0.00	1.00	0.09	0.28	0.00	1.00
Vorarlberg	0.04	0.20	0.00	1.00	0.04	0.21	0.00	1.00
Wien	0.20	0.40	0.00	1.00	0.22	0.41	0.00	1.00
2015	0.21	0.40	0.00	1.00	0.21	0.40	0.00	1.00
2016	0.20	0.40	0.00	1.00	0.20	0.40	0.00	1.00
2017	0.20	0.40	0.00	1.00	0.20	0.40	0.00	1.00
2018	0.20	0.40	0.00	1.00	0.20	0.40	0.00	1.00
2018	0.19	0.39	0.00	1.00	0.19	0.39	0.00	1.00

Source: EU-SILC waves 2015-2019.

Table A4: Wage predictions from alternative estimators

	in-sample OLS	out-of-sample OLS	Random Forest	R-LASSO	CV-LASSO
Men					
mean	23.72	23.89	23.70	23.94	23.82
sd	8.07	8.34	4.67	5.77	6.73
cv	0.34	0.35	0.20	0.24	0.28
p5	11.99	11.98	17.49	15.44	14.73
p10	14.40	14.31	18.50	17.26	16.61
p25	18.33	18.27	20.31	20.15	19.38
p50	22.69	22.82	22.87	23.35	22.76
p75	28.32	28.73	26.33	27.20	27.17
p90	34.53	34.95	30.04	30.99	32.61
p95	38.58	39.34	32.63	34.93	37.04
min	-1.88	-5.67	13.18	6.06	0.16
max	56.95	59.05	48.82	46.60	51.65
Women					
mean	17.97	18.12	18.09	18.14	18.17
sd	5.72	5.83	3.67	4.58	4.50
cv	0.32	0.32	0.20	0.25	0.25
p5	10.00	9.76	13.17	11.40	11.91
p10	11.27	11.25	13.83	12.79	13.19
p25	13.89	14.01	15.32	15.03	15.09
p50	17.09	17.34	17.48	17.55	17.42
p75	21.35	21.61	20.33	20.54	20.31
p90	25.90	26.27	23.33	24.26	24.24
p95	29.10	29.28	25.15	27.34	27.56
min	2.72	1.37	10.76	5.00	6.69
max	42.75	42.68	33.84	38.43	38.83

Source: EU-SILC waves 2015-2019.

Table A5: CV-LASSO regression results

	male	female
apprenticeship training	-2.53	-1.40
university / univ. of applied science		1.02
years of employment	0.18	0.15
years of unemployment	-0.23	-0.06
general college x years of employment	0.02	0.01
vocational college x years of employment	0.10	0.09
university x years of employment	0.46	0.31
married	0.70	
married x other household income	0.03	
Unmarried x (/13 < child < 18 yrs.)	1.68	
av. unempl. rate by level of education	-0.21	-0.15
av. unempl. rate by level of education squared	-0.01	
Vorarlberg (orthog.)	0.25	
firm size <= 4 empl. (orthog.)	-2.30	-2.19
4 <= firm size <= 9	-1.09	-0.96
10 <= firm size <= 19	-0.92	-0.09
20 <= firm size <= 49 empl.	-0.67	
agriculturre (orthog.)	-0.81	
mining and energy	2.34	
construction	-0.49	
transport	-1.41	
catering and hotels	-4.32	-1.93
finance and real estate	5.07	2.22
other services	-1.18	
education	-2.09	
_cons	19.46	15.42

Source: EU-SILC waves 2015-2019.