How Elastic is the Labour Supply of Female Migrants Relative to the Labour Supply of Female Natives?

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Abstract

This study estimates the wage elasticities of migrants and natives by using data from the German Socio-Economic Panel from 1984 to 2015 and a grouping instrumental variable estimator. Female migrants who live with a partner have lower own- and cross-wage elasticities than respective female natives, and the elasticities of non-Western female migrants are insignificant. The relationship between participation and elasticity is not in all cases positive, but parallel to labour market integration, the time since migration increases the elasticities of women. Elasticities indicate the potential to increase participation; therefore, it is especially important for non-Western female migrants to remove barriers to flexible wage responses.

1 Introduction

The labour market integration of women is much more problematic among migrants than natives, especially non-Western migrant women. The differences in the participation rates between female migrants and natives are much higher than those between male migrants and natives (Fig. 1). Many studies provide empirical evidence of the negative impact of migration on female migrants' labour market performance or earnings (see Blau et al. 2011; Cooke et al. 2009; Clark and Withers 2002;

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LeClere and McLaughlin 1997). However, the literature concerning migrant women's responses to financial incentives and, therefore, the elasticities of labour supply is very limited.[1] Knowledge regarding the elasticities of labour supply has high political and, therefore, high academic importance. The previous literature mainly considers labour supply elasticities to indicate the magnitude of the efficiency cost of income taxation or determine the employment impact of reforms in redistributive tax-benefit systems (Evers et al. 2008). Nevertheless, labour supply elasticities are also highly relevant for integration policy.

The participation rate is an indicator of the success of labour market integration, whereas labour supply elasticities indicate the extent to which a population group is responsive to financial incentives. A high own-wage elasticity observed with a low participation rate indicates the potential to increase labour participation and, therefore, is an important mechanism for the labour market integration of migrants. Previous studies generally find that married women have the largest own-wage elasticities and that men have smaller own-wage elasticities. As reviewed by Steiber and Haas (2012), on average, men's employment behaviour is very stable across the life course; most men work full-time. Women's life course trajectories are much more heterogeneous due to child birth or other household responsibilities. Women have better possibilities to adjust their hours of work in response to changing economic conditions depending on the extent to which women can outsource tasks, such as housework and child care. Preferences may also differ between men and women such that wage functions much more as an incentive for women than men because it is more socially accepted for women than men to stay at home. On the one hand, a low own-wage elasticity can be the result of a high participation rate (particularly among men). On the other hand, among migrant women with low participation rates, a low own-wage elasticity may be the result of problems with labour market integration. Own-wage elasticities are not the only important factor for evaluating the responses of female migrants to financial incentives. By considering cross-wage elasticities, family-level dynamics are emphasized. Some studies explain the negative cross-wage elasticities of women by traditional gender roles (Blau and Kahn 2007). One may argue that women in couples with traditional gender roles may not work or work for a low number of hours when the partner's income is high enough to maintain (the preferred) living conditions. However, in general, such women are not very sensitive to wages, resulting in a low negative cross-wage elasticity. A high negative cross-wage elasticity may result from a perfectly symmetric labour supply with the need or preference to maintain a certain amount of household income. This may also be the case among migrants, especially shortly after arrival, because of the need to make a living while investing in country-specific human capital. Nevertheless, migrant women with a low linkage to the labour market may not be sensitive to their own and their partner's wage.

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[1] The study defines the uncompensated elasticities of labour supply as the percentage change in the participation rate (extensive margin)/hours worked (intensive margin) that results from a 1 percent change in the own hourly wage (own-wage elasticity)/the partner's hourly wage (cross-wage elasticity).

The aim of this study is to evaluate the labour supply responses of migrant women to financial incentives. Based on a static model and data obtained from the German Socio-Economic Panel (GSOEP) from 1984 to 2015, the study estimates uncompensated[2] own- and cross-wage elasticities at the extensive and intensive margins. In addition to women's elasticities, as a point of reference, the analysis estimates men's elasticities. This study estimates separate models for Western, non-Western and second-generation migrants and natives.[3] Within the main specification of individuals living with a partner, the analysis estimates additional elasticities at the extensive margin for mixed couples consisting of a migrant and a native individual. Furthermore, this study estimates models of individuals who live together with a partner and individuals who live with no partner separately.

The results show that female migrants who live with a partner have lower own- and cross-wage elasticities than respective female natives and that the elasticities of non-Western female migrants are insignificant. An inverse u-shape relationship appears to exist between the participation rate and wage sensitivity. On the one hand, parallel to labour market integration, the results indicate that the time since migration increases the own-wage elasticities of female migrants. Among non-Western female migrants, their low labour market integration appears to be the reason for the insignificant elasticities. The elasticities of non-Western female migrants who were involved in the country-specific educational system due to their low age at the time of migration are significant. On the other hand, female natives' elasticities were lower in the last years as they became more attached to the labour market and elasticities became more similar to men's elasticities.

This study contributes to the literature in the following ways. First, to the best of the author's knowledge, no previous study focused on female migrants' labour supply elasticities in the debate regarding their labour market integration. Only a few studies estimate the labour supply elasticities of different migrant groups separately (for example, De Boer 2018). Second, the remarkably large GSOEP allows a broad examination of several subgroups and the investigation of different migrant groups and living constellations. Several studies compare the labour supply elasticities of the entire female and male populations in different countries (see Evers et al. 2008; Bargain et al. 2014; Bargain and Peichl 2016). As described by De Boer (2018), many studies pool subgroups due to the low number of observations. Third, to reduce possible bias from endogeneity and measurement errors, the analysis applies a weighted least squares estimation of the group means weighted by the group size. Following Devereux (2004), an error-in-variables estimator corrects for

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[2] As reviewed by Blundell and MaCurdy (1998), studies generally focus on the uncompensated wage elasticity of the Marshallian supply function, which maximizes utility subject to a given budget constraint. In contrast, the Hicksian supply function defines the compensated wage elasticity by minimizing the budget given a constant utility. For examples, studies have used the compensated wage elasticity to measure the substitution and income effect of labour supply due to the introduction of a wage subsidy that shifts workers into a higher tax bracket and fully taxes the income increase associated with the subsidy.

[3] In the following, the term 'natives' refers to native-born individuals with no migration background, while native-born migrants are excluded from this group and referred to as 'second-generation migrants'.

bias possibly resulting from a small group size. Finally, the analysis applies several robustness checks and either confirms the results or shows the impact of different assumptions concerning the selection, imputation of missing wages, weighting, sample, taxation or existence of children.

This paper is organized as follows. Section 2 presents the theoretical considerations of a household labour supply model. Section 3 introduces the data set and provides the descriptive results. Section 4 introduces the estimation strategy, while Sect. 5 presents the multivariate results. Finally, Sect. 6 concludes the paper.

2 Theoretical Considerations

The analysis interprets the labour supply coefficients in terms of the standard static unitary model of family labour supply. After introducing the model, I discuss the possible outcomes of the labour supply elasticities of female and male migrants and natives within the theoretical framework.

As emphasized by Blundell and MaCurdy (1998), the household context adds several important dimensions to the labour supply model. Wage changes not only have individual consequences but can also change the balance between men and women in the family labour supply. Assuming that a household consists of two working-age individuals, the household maximizes a unitary utility function by choosing the best bundle of leisure time for the man L_1, leisure time for the woman L_2 and household consumption C as follows:

$$U(L_1, L_2, C, X) \tag{1}$$

where X is a vector of household attributes, such as the existence of children. The household maximizes the family utility subject to the budget constraint as follows:

$$C + W_1 L_1 + W_2 L_2 = nlY + W_1 T_1 + W_2 T_2 \tag{2}$$

where W_1 and W_2 are the net hourly wage rates that determine the opportunity costs of leisure.[4] T_1 plus T_2 is the total time available to the household, and nlY is the non-labour income. The model pools the household income as follows:

$$nlY + W_1(T_1 - L_1) + W_2(T_2 - L_2) = C \tag{3}$$

The joint optimizing framework determines the allocation rule. The unitary model allows the direct utilization of consumer theory, recovers the preferences of each spouse from observed behaviour and provides a framework for the interpretation of the empirical results.

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[4] The main specification of the estimation uses net wages because gross wages capture the impact of the tax and transfer system along with the behavioural adjustments of individuals (Haan 2005). Therefore, the theoretical model abstracts from non-linear taxes, which would lead to a non-linear budget due to the different marginal tax rates in the various income brackets combined with the existence of non-linear income (Blundell and MaCurdy 1998).

Comparable to general utility models, the family labour supply model assumes that the first derivative of the utility index with respect to the leisure time should *ceteris paribus* be positive for both spouses. For some individuals with a very high preference for work, the marginal utility of leisure may also be negative. The model further assumes that the second derivative is negative (Steiner and Wrohlich 2004). Cahuc and Zylberberg (2004) present the decomposition of the effect of a wage increase into a substitution and an income effect at the individual level, where the individual has utility from leisure and consumption. The total effect on leisure determines the labour supply elasticity. Men usually work full-time, and increasing the working time due to wage changes will not result in high income increases. Therefore, men's wage elasticities are often found to be very small. The own wage elasticities of men can also be negative when the income effect leads to a large increase in leisure time. Because women often work part time and have lower participation rates than men, their income can increase much more when they increase their working time. Therefore, women's wage elasticities are usually higher than men's elasticities. On the one hand, due to their potential to increase participation, the lower labour market integration of female migrants may lead to high own-wage elasticity; on the other hand, labour market barriers may prevent female migrants' elasticities from being as high as female natives' wage elasticities.

The cross-substitution effect between two spouses' leisure time is theoretically ambiguous. The labour supply (at the extensive or intensive margins) of women, who are secondary earners in the family, is likely negatively affected by their spouse's wages in terms of securing living expenses or maintaining a preferred income due to traditional gender roles. When gender roles are traditional and the husband's earnings are high enough, the female cross-wage elasticity may be negative but low, indicating a general low sensitivity to financial incentives. Higher negative cross-wage elasticities may occur due to a perfect symmetric labour supply to secure living expenses or maintain a preferred income. This situation may apply to migrants, especially shortly after migration, for several possible reasons, including the need to invest in country-specific human capital. Finally, Bargain et al. (2014) explain positive cross-wage elasticities (at the intensive margin) with complementarity such that spouses enjoy spending leisure time together.

3 Data and Descriptive Statistics

The analysis uses data from the GSOEP from 1984 to 2015 to estimate wage elasticities. The GSOEP is an ongoing representative panel survey of persons older than 16 years who live in German households. The panel study started in 1984 in West Germany and included the Eastern Germany part since 1990. The GSOEP contains detailed information regarding employment behaviour and socio-demographic variables over time (Wagner et al. 2007). The data supplying institute continuously adjusts the GSOEP questionnaires according to new developments in society, and almost yearly, new samples are drawn to adequately represent developments, such as migration flows, and reduce the negative effects of survey-related panel attrition. The number of participants per year increased from 12,290 in 1984 to 27,183

in 2015. In 1998, 2013 and 2015, the GSOEP increased the sample size by adding approximately 3000 additional migrants per sample (see also Fig. 2 in the Appendix) (Bohmann and Giesselmann 2018).

The analysis restricts the sample to persons aged between 21 and 60 years. The sample excludes individuals who are in vocational training or who work as interns because in these cases, the number of working hours are usually fixed. The sample also excludes individuals in education who are not employed because other financial resources appear to exist to cover living expenses. Furthermore, the sample excludes individuals who are self-employed because their work arrangements can highly differ from those of white- or blue-collar workers and civil servants.

In the GSOEP, a distinction between long-term (more than 1 year) unemployment ("ALGII") and unemployable ("Sozialgeld")[5] benefits is not possible; therefore, the sample excludes unemployed persons who receive social benefits when they are not registered as unemployed due to maternal leave or a disability. For the estimation of elasticities at the intensive margin, regarding the hours worked, all individuals with zero working hours were removed from the sample. Regarding the total elasticity and sub-elasticity at the extensive margin, the analysis includes individuals not participating with or without unemployment benefits. One may argue that individuals who are involuntarily unemployed should not be considered in the estimation of wage elasticities. Similar to other studies (e.g., Bargain et al. 2014), the analysis does not differentiate between voluntarily and involuntarily unemployed individuals. We do not consider (such as by analysing job search behaviour) whether an individual is unemployed and receives benefits because she or he did not find a job or whether his or her reservation wage is too high for the available jobs/would be too high for any job. Because this group is important for estimating wage elasticities, the sample includes the entire group of registered unemployed individuals. Comparable to non-participating women, the analysis imputes the wages of unemployed individuals using the wages of employed individuals with similar characteristics. The section regarding the specification describes this method and discusses its impact on the results.

After these exclusions, approximately 63% of the respondents remained in the sample, resulting in a full sample of 53,635 individuals and 331,050 observations. The average share of first- and second-generation migrants in the sample is 29%, the share of women is 52% and the share of persons who live with a partner is 77%. The highest share of migrants, i.e., 45%, originates from a country in Europe (including the former Yugoslavia), 22% of migrants originate from Asia, the Middle East or Turkey, 11% of migrants originate from the former USSR and 19% of the considered migrants were born in Germany. On average, each native individual appears seven times in the data. Western and second-generation migrants and non-Western male

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[5] The German labour market reforms in 2005 (the so-called "Hartz reforms") introduced the special social benefit "Sozialgeld". Subsequently, individuals with a disability either received "Sozialgeld" managed by employment agencies or "Sozialhilfe" managed by social security offices. The intention was to supervise individuals with a disability who live with an individual who receives long-term unemployment benefits by a single institution.

migrants appear five times, while non-Western female migrants appear six times (see also Tables 1 and 8). Table 1 compares the main characteristics of (first- and second-generation) migrants and natives in 2015. Table 8 in the Appendix further differentiates among migrants with a Western origin (born in Europe outside Germany, a high-income country outside Europe or the former USSR), a non-Western origin (born in Asia, the Middle East, Africa or Central-/South America) and a German origin (second-generation migrants).

Regarding the variables used in the estimation, the tables compare the sample means, the standard deviations and the number of observed individuals in 2015. The final two rows show the total number of person-year observations during the 1984–2015 period and the average number of observed years per individual in each group. As emphasized in the introduction, the differences in the participation rates between female migrants and natives (18 percentage points) are much higher than the differences between male migrants and natives (five percentage points). On average, female migrants work less hours and receive a lower wage than female natives. The participation rate, number of working hours and average wage indicate that second-generation migrants are better integrated than Western migrants (including migrants from the former USSR), while Western migrants are better integrated than non-Western migrants (see Table 8 in the Appendix). Sixteen to seventeen percent of female and male migrants and 8–9% of female and male natives live in households with at least one child younger than 3 years. The share of persons who live in households with a partner does not vary much between migrants and natives (for the development of the share over the observation period, see also Fig. 3 in the Appendix).

The share of individuals with no educational degree is significantly higher among migrants than among natives (see Table 1). On average, 20% of Western migrants (including persons from the former USSR) and almost 36% of non-Western migrants have no educational degree (see Table 8 in the Appendix). Although most migrants migrated to Germany at an age at which educational biographies are not necessarily finalized,[6] a high share of migrants (those with no educational degree) have not invested in further country-specific human capital. For many men, the occupational skills that they gained in their home countries "on-the-job" without receiving educational degrees (see Brücker et al. 2016) enable them to participate in the labour market. For women, domestic responsibilities may be a barrier to investing in education.

As shown in Fig. 4 in the Appendix, the participation rates of female migrants differ by educational degree much more than those of female natives. Therefore, the low participation rate of non-Western female migrants is related to their high share with no educational degree. Figure 1a displays the women's participation rates by their migration status, and Fig. 1b displays the men's rates by their migration status. The participation rates of women differ much more by the migration status

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[6] The average age at the time of migration declined from approximately 25 years in 1984 (influenced by the guest worker generation) to 13 years in 2012 (influenced by migrants who migrated to Germany as children or for education). Due to the inclusion of new GSOEP samples in 2013 and 2015 of migrants who migrated to Germany after 1994, the average age has sharply increased since 2013 to 26 years in 2015.
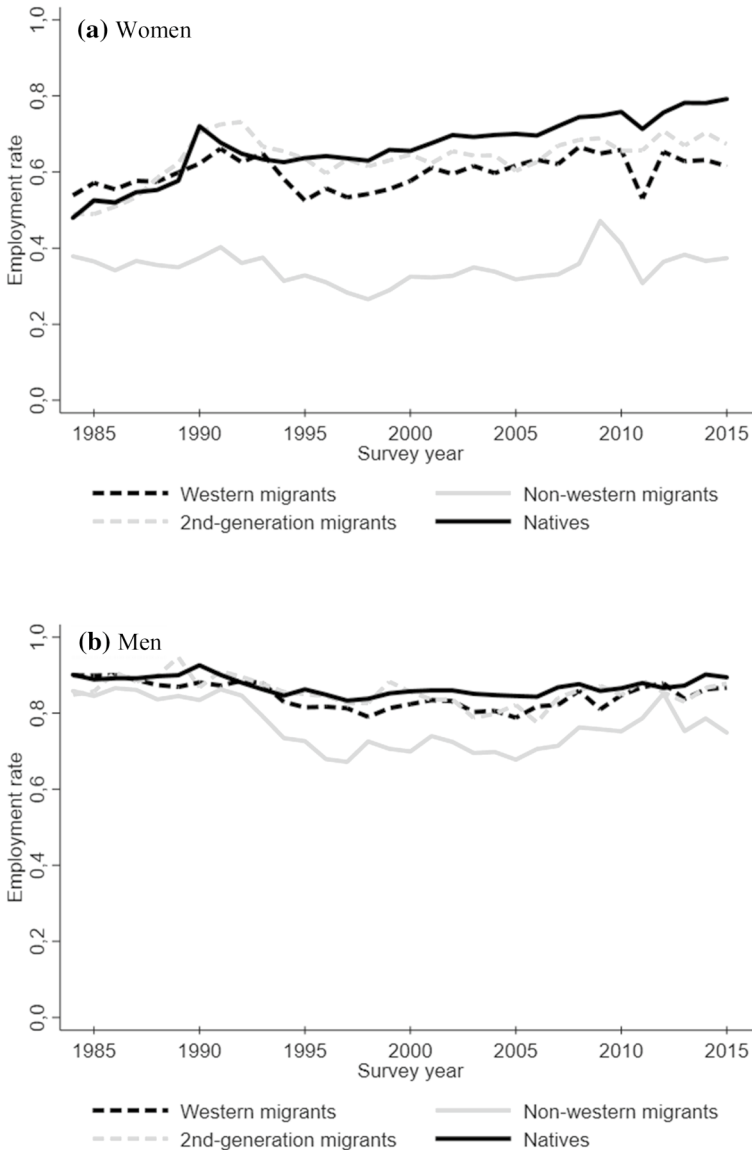
Fig. 1 Participation rates by survey year, gender and migration background. *Source*: GSOEP, 1984–2015

than those of men. Figure 1a also shows that in contrast to the participation rates of migrant women, the participation rates of native-born women have increased since 2000. The participation rates of second-generation female migrants are lower than the participation rates of female natives, but they display a similar trend. As further suggested by the indicators displayed in Tables 1 and 8, the integration problem of female migrants is less serious among second-generation migrants. Integration problems appear to decrease for the following generations of migrants.

Table 1 Descriptive statistics of the variables used in the estimation by gender and migration status. *Source*: GSOEP, 2015, only employable individuals

Variable	1st- or 2nd-generation migrants						Natives					
	Women			Men			Women			Men		
	Mean/share	SD	N	Mean/share	SD	N	Mean/share	SD	N	Mean/share	SD	N
Participation rate	0.61	0.49	2453	0.85	0.36	2393	0.79	0.41	5106	0.90	0.30	4623
Number of working hours	29.74	13.83	1778	41.47	10.51	2078	31.21	12.53	4405	43.20	10.09	4202
Net wage per hour[1]	8.55	4.48	1764	10.62	8.50	2067	9.63	4.91	4390	12.58	8.66	4190
Partner net wage per hour[1]	11.38	8.54	1696	8.78	5.00	1124	13.30	9.26	3254	9.41	4.77	2808
East (including Berlin)	0.09	0.29	2783	0.10	0.29	2481	0.28	0.45	5601	0.28	0.45	4756
Age	39.19	9.62	2783	39.78	9.79	2481	44.14	9.67	5601	44.63	9.90	4756
Educational degree												
No educational degree	0.22	0.41	2783	0.23	0.42	2481	0.09	0.28	5601	0.06	0.25	5601
Vocational degree	0.52	0.50	2783	0.53	0.50	2481	0.67	0.47	5601	0.66	0.47	5601
University degree	0.27	0.44	2783	0.24	0.43	2481	0.25	0.43	5601	0.28	0.45	4756
Non-labour income per person[1]	405.38	527.85	2662	372.84	447.87	2375	411.52	573.58	5357	390.23	783.18	4559
Good health	0.85	0.36	2781	0.88	0.33	2481	0.84	0.37	5601	0.87	0.34	4755
Children younger than 3 years	0.16	0.36	2783	0.17	0.38	2481	0.08	0.27	5601	0.09	0.29	4756
Living with a partner	0.73	0.45	2783	0.78	0.41	2481	0.68	0.47	5601	0.77	0.42	4756
First-generation migrants	0.77	0.42	2783	0.77	0.42	2481	0.00	0.00	5601	0.00	0.00	4756
Second-generation migrants	0.23	0.42	2783	0.23	0.42	2481	0.00	0.00	5601	0.00	0.00	4756
Number of observations, 1984–2015	–	–	40,203	–	–	37,841	–	–	133,443	–	–	119,563
Average number of obs. per person	5			5			7			7		

[1]The consumer price index of 2010 deflates all earning values used in this study

4 Estimation Strategy

Keane (2011) summarizes several econometric problems that arise when estimating labour supply elasticities. In addition to the unobserved wages of non-participants, measurement errors (usually included in micro data) may lead to an underestimation of labour supply elasticities, and an upwards bias can result due to unobserved characteristics, such as one's preference for work. To reduce potential bias, the analysis applies an instrumental grouping approach. This approach applies weighted least squares estimations of the group means weighted by the group size (see Deaton 1985; Angrist 1991; Blundell et al. 1998; Blundell and MaCurdy 1998). Angrist and Pischke (2008) emphasize that the procedure is equivalent to two-stage least squares (2SLS) using group indicators as instruments. 2SLS estimators can typically be constructed from an underlying set of Wald estimators (by using single binary instruments). Instead of using age (or education/region/year) as an instrument, the interacted indicator variables of age, education, region and year-groups function as instruments (represented by vector M). Consider the first-stage regression of the individual wage on M. Since the first stage is saturated, the fitted values will be the sample conditional mean wages of the age-education-region-year groups, repeated N (cell size) times per group. Therefore, the second-stage slope estimate is the same as the weighted least squares estimation of the grouped equation, which is weighted in the analysis by the cell size N (Angrist and Pischke 2008). Tests can examine the correlation between the instruments and the variable to be instrumented; in contrast, as emphasized by Wooldridge (2013), we cannot test but must prove the assumption of exogeneity according to economic or behavioural theory. Using age or education as single instruments does not fulfil this requirement of exogeneity because these variables might be correlated with unobservable characteristics. However, when grouping the data by age, education and region, we can assume that the wage averages are independent from individual characteristics, such as preference or motivation (and measurement error). Blundell et al. (1998) define assumptions for exclusion restrictions that result due to grouping. Group (and time) effects can control for selection into employment (due to unobservable characteristics).

The analysis estimates the elasticities of migrant and native women and men who live with and without a partner. The analysis bases the grouping on year (in periods of three-year averages), region (in two groups), age (grouped) and individual and partner (when one exists) educational level (none/vocational/university). The approach multiplies each mean by the square root of the number of observations per group. This weighting attempts to correct for heteroscedasticity, although we are unsure that the error variance is proportional to the inverse of the group size (Verbeek 2012).

This study estimates functions for women as presented in (4) for the extensive and (5) for the intensive margins or the total elasticity. At the extensive margin, individuals only have the following two choices: to work or not to work. At the intensive margin, workers choose how many hours to work. The total elasticity summarizes both margins and considers individuals who choose their number of working hours or decide not to work with $h_{fit} = 0$.

$$e_{fit} = \alpha_0 + \alpha_1 w_{fit} + \alpha_2 w_{mit} + \alpha_3 Z_{fit} + \mu_{fit} + v + \varepsilon_{fit} \tag{4}$$

$$h_{fit} = \alpha_0 + \alpha_1 w_{fit} + \alpha_2 w_{mit} + \alpha_3 Z_{fit} + \mu_{fit} + v + \varepsilon_{fit} \tag{5}$$

Here f refers to a woman, m refers to her partner (if one exists), i refers to the group to which the woman belongs, and t indexes time. e_{fit} represents the female average participation rate in group i during period t. h_{fit} represents the average actual monthly hours worked by the woman. w_{fit} represents the log of the woman's own net wage rate per hour, and w_{mit} is the log of her partner's net wage rate (if she has a partner). This approach uses the main demographic characteristics with years and region to cluster the data, while Z_{it} represents a vector of the remaining control variables. The vector contains the net non-labour income *per* person in the household (the analysis scales the value at 100 for the estimation), an indicator variable of an own-evaluated good health status and an indicator variable of the existence of children below 3 years of age in the household. Furthermore, the estimation considers (3 year) period indicators and regional indicator variables (whether the region is in the Eastern German area) to control for time fixed effects (v) and regional fixed effects (μ_{fit}). Finally, ε_{fit} is the disturbance term.

When grouping the data as previously described, α_1 represents the individual-wage effect, and α_2 represents the cross-wage effect. The analysis estimates linear-log models and calculates uncompensated elasticities at the average hours worked or average participation rate of the respective groups. Hence, we regress the hours worked/participation rate on the log wage and divide the resulting coefficient by the average number of hours worked/participation rate of the respective group. The main specification uses net wages because gross wages capture the impact of the tax and transfer system along with the behavioural adjustments of individuals (Haan 2005). The net wage elasticity indicates the percentage response in hours of work or the participation rate due to a 1% change in net hourly wages. Because the equation estimates the variables in levels, it measures a causal relation between a wage change and a change in the labour supply by considering individuals with different wage-hours or wage-participation combinations. For example, Steiner and Wrohlich (2004) use the 2002 wave of the GSOEP to estimate labour supply effects.

In 21% of all observations, individuals do not participate and do not receive any social assistance (75% are female). Additionally, in 3% of all observations, individuals are registered as unemployed and receive unemployment benefits.[7] In these groups, no wage observations exist. The literature assumes that compared to non-participating individuals, observed workers have relatively high preferences for work. Regarding the total own-wage elasticity and sub-elasticity at the extensive margin, which consider participants and non-participants, the estimated wages of non-participants based on the observed wages of the participants are upward biased. The estimated own-wage elasticities on the intensive margin, which considers only

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[7] The results do not change much when excluding the three percent of observations of individuals who are registered as unemployed and receive unemployment benefits. The results of this robustness check are not included in the study but are available upon request.

participants, are downwards biased (Keane 2011). On the one hand, the vast literature following Heckman (1976, 1980) proposes a practical two-step solution that treats the selection problem as an omitted variable problem when estimating the elasticities at the intensive margin or the wages of non-participants for the total elasticity or sub-elasticity at the extensive margin. On the other hand, this method has received much criticism (see Nelson 1984; Winship and Mare 1992; Nawata 1994). To correct for selection bias, variables serving as good predictors of the selection circumstance for participation that do not influence the outcome variable of how much to work (intensive margin) or how much to earn (total elasticity or sub-elasticity at the extensive margin) are needed. When a high correlation exists between the error terms of the selection and the outcome equation,[8] the same factors mainly determine the decision of either the number of hours worked and the decision to participate or the wage and the decision to participate. Puhani (2000) emphasizes that in the case of a high correlation between the two error terms, the two-step Heckman procedure is particularly inefficient and not superior to OLS. Therefore, the main specification in this study does not apply a correction in Heckman's sense. As proposed by Devereux (2004), regarding the total elasticities and sub-elasticities at the extensive margin, the approach imputes the wages of non-participants by non-parametrically assigning the mean wages of individuals with the same observed characteristics (based on the age group, educational group, region, year, gender and existence of a migration background). The robustness checks test whether and how different assumptions concerning the imputation of missing wages and the selection bias influence the results.

In contrast to yearly and regional dummies, the estimation model does not include group indicators. Deaton (1985) emphasizes that the problem in this context in groups with a low number of observations is that the sample cohort means do not equal the true cohort means but will contain sampling errors. On the one hand, with more groups, the bias decreases due to measurement error and unobserved variables, which also ensures exogeneity. On the other hand, with a higher number of groups, bias is more relevant due to the small group size. Because the grouping approach is similar to 2SLS estimators that use interacted group indicators as an instrument, the first-stage regression of the individual wage on the interacted indicator variables provides information regarding whether the used instruments are significantly correlated with the individual wage or whether a weak instrument problem exists. The first-stage regressions did not indicate that such a problem exists.

Despite positive test results, especially among migrants, many groups only have a low number of observations. Among the non-Western migrants (excluding persons from the former USSR), more than 30% of the groups have less than ten observations (the analysis excludes groups with fewer than five observations). Following Devereux (2004), to address possible bias, the analysis implements an

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[8] Based on a full maximum likelihood Heckman selection model, the correlation between the error terms of the wage equation and the participation equation is 0.99. The correlation between the error terms of the hours worked equation and the participation equation is 0.67.

errors-in-variables estimator that is approximately unbiased in finite samples. The Appendix provides the details of the errors-in-variables estimator. The analysis applies the results only to the specification that uses the errors-in-variables weighted least squares estimator.

5 Results

This section presents the estimation results of the labour supply elasticities of migrants and natives while differentiating among Western, non-Western and second-generation migrants. The discussion focuses on the elasticities of women, while men's elasticities serve as a point of reference. Section 5.1 presents the estimates of the main specification of individuals with and without a partner. The following tables show the total elasticities and sub-elasticities at the extensive and intensive margins calculated from the coefficients, while the Appendix provides the full estimation results without calculating the elasticities. Section 5.2 discusses the results of various robustness checks, while the Appendix presents the respective tables.

5.1 Main Results

Table 2a shows the total net wage elasticities of female and male migrants and natives who live together with a partner (with the same migration status) in one household. Table 2b differentiates among Western, non-Western and second-generation migrants who live together with a partner with the same migration status and provides the elasticities of migrants with a native spouse and natives with a migrant spouse separately. Based on the regression of the hours worked on the log wage, the resulting coefficients are divided by the average hours worked per group to calculate the elasticities.

All uncompensated total own-wage elasticities shown in Table 2a are statistically significant. The elasticities of the women are higher than those of the men. The coefficient 0.4 of the migrant women indicates that after controlling for various aspects, migrant women with a wage higher than the average by 10% have a 4% higher number of hours worked. Female natives with a wage higher by 10% have a 10% higher number of hours worked. Hence, female migrants have lower responses than female natives. As shown in Table 2b, Western and second-generation migrant women have lower own-wage elasticities than female natives; among non-Western migrant women, the elasticity is insignificant. Among female migrants with a native spouse, the elasticity is also insignificant, while among female natives with a migrant spouse, the elasticity is lower than that of female natives living with a native partner. Although more female and male migrants than natives in Germany are married, the share of individuals who live with a partner does not substantially differ by the migration background as shown in Table 1. Figure 3 in the Appendix further shows that the shares are also quite stable over the observation period. Therefore, the elasticities do not differ by migration background due to selection into the group

Table 2 Total wage elasticities[1,2] of individuals living (a, b) with a partner, (c) without a partner

(a)

	Migrants		Natives	
	Women	Men	Women	Men
Own wage	0.399***	0.220***	0.988***	0.204***
	(0.069)	(0.024)	(0.059)	(0.017)
Spouse's wage	−0.094*	0.042*	−0.779***	−0.019
	(0.057)	(0.022)	(0.045)	(0.018)
Average hours worked (zero hours included)	72.055	154.583	88.609	161.219
N[3]	971	934	585	571
Obs[4]	31	30	168	153

(b)

	Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men
Own wage	0.285**	0.225***	0.051	0.350***	0.476***	0.249***
	(0.112)	(0.041)	(0.237)	(0.057)	(0.104)	(0.039)
Spouse's wage	0.169*	0.037	0.173	−0.062	−0.133*	0.078**
	(0.098)	(0.038)	(0.203)	(0.051)	(0.075)	(0.037)
Average hours worked (zero hours included)	76.487	154.286	44.315	137.268	79.009	170.541
N[3]	316	307	200	200	229	205
Obs[4]	47	46	33	34	20	19

	Migrants with native spouses		Natives with migrant spouses	
	Women	Men	Women	Men
Own wage	0.109	0.127**	0.532***	0.273***
	(0.117)	(0.054)	(0.090)	(0.037)
Spouse's wage	−0.122	0.018	−0.207**	0.019
	(0.096)	(0.046)	(0.091)	(0.040)
Average hours worked (zero hours included)	83.360	155.858	83.298	171.458
N[3]	226	222	249	207
Obs[4]	17	14	14	17

(c)

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men

Table 2 (continued)

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Own wage	0.286***	0.355***	0.131***	0.183***	0.262***	0.204***	0.512***	0.497***	0.155**	0.465***
	(0.032)	(0.030)	(0.045)	(0.030)	(0.038)	(0.038)	(0.097)	(0.082)	(0.076)	(0.061)
Average hours worked (zero hours included)	108.664	130.831	114.356	139.807	111.885	135.322	97.814	119.957	112.444	133.128
N[3]	315	302	236	231	141	122	76	73	98	107
Obs[4]	26	26	131	121	29	29	15	19	29	27

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1] Elasticities are calculated at the sample means of the hours worked in the respective group

[2] All specifications include regional and time indicators

[3] Number of groups

[4] Average number of observations per group

of individuals who live with a partner. The elasticities of men are smaller and more concentrated. Among the men, the own-wage elasticity of the migrants is slightly higher than that of the natives. The difference from native men is higher among non-Western migrant men than other groups of migrant men. Among male migrants with a native spouse and male natives with a migrant spouse, the elasticities are highly similar to those of males living with a partner with the same migration or non-migration background.

As a second indicator, Table 2a and b display the uncompensated total cross-wage elasticity. In Table 2a, the cross-wage elasticity is statistically significant negative among female migrants and natives with a high value for female natives and a very low value for female migrants. In Table 2b, the cross-wage elasticity is also significant and negative among 2nd-generation female migrants and female natives with a migrant spouse. Negative cross-wage elasticity may result due to a perfectly symmetric labour supply between a couple resulting from the need to cover living expenses or the preference to maintain a certain status. Female migrants are less sensitive to not only their own but also their partners' wage. Among male migrants, the cross-wage elasticity shown in Table 2a is significant and positive but very low, suggesting that male and female leisure is complementary (van Soest 1995). The same applies to Western female migrants and 2nd-generation male migrants (Table 2b). Assortative mating is a possible explanation for the positive cross-wage elasticity. Blossfeld and Timm (2003) provide evidence of a high correlation between education and social attributes within couples in most countries. Assortative mating often results in a similar labour supply behaviour between couples. As several studies suggest, in all cases, the cross-wage sensitivity has significantly smaller coefficients than the own-wage sensitivity (Blau and Kahn 2007; Devereux 2004; Killingsworth 1983; van Soest 1995).

Table 2c shows the total own-wage elasticities of individuals who live without a partner. The elasticities are more even between single women and men, and the significant estimates lay in a narrow range; among migrants in general, natives and second-generation migrants, the elasticities of women are even lower than those of men. In contrast to the respective women with a partner, single non-Western migrant women have a significant elasticity.

Table 9a and b in the Appendix display the full estimation results with the coefficients derived from the linear-log models not calculating the total elasticities. In most groups, the effects of the other variables on the number of hours worked are as expected. In most groups, the effect of non-labour household income is significantly negative, and the effect of a good health status is mostly positive. The effect of young children is significantly negative among women. In many cases, living in the Eastern Germany area has a positive effect on the hours worked; nevertheless, this effect is often insignificant.

Table 3a and b provide the sub-elasticities with respect to the participation rate (extensive margin), while Table 4a and b provide the sub-elasticities with respect to the hours worked excluding non-participants (intensive margin) among individuals who live with a partner (Tables a) and without a partner (Tables b). The total elasticities are very similar to those at the extensive margin and consistent with other studies, and in most cases, the extensive margin dominates the intensive margin (Bargain et al. 2014; de Boer 2018). The differences across the subgroups are similar at the extensive and intensive margins

Table 3 Wage elasticities with respect to participation[1,2] of individuals living (a) with a partner, (b) without a partner

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
(a)										
Own wage	0.505***	0.242***	0.694***	0.151***	0.468***	0.201***	0.096	0.371***	0.359***	0.169***
	(0.065)	(0.023)	(0.044)	(0.015)	(0.081)	(0.034)	(0.170)	(0.051)	(0.084)	(0.032)
Spouse's wage	−0.142**	0.021	−0.396***	0.005	−0.064	0.036	0.113	−0.099**	−0.031	0.133***
	(0.055)	(0.021)	(0.034)	(0.016)	(0.072)	(0.032)	(0.154)	(0.047)	(0.061)	(0.030)
Average participation rate	0.512	0.842	0.606	0.846	0.568	0.849	0.370	0.779	0.578	0.898
N[3]	849	779	593	580	368	343	252	231	229	205
Obs[4]	36	36	172	157	49	49	30	33	20	19
(b)										
Own wage	0.283***	0.316***	0.175***	0.204***	0.245***	0.190***	0.390***	0.440***	0.281***	0.406***
	(0.026)	(0.026)	(0.033)	(0.027)	(0.034)	(0.033)	(0.079)	(0.073)	(0.056)	(0.050)
Average participation rate	0.705	0.752	0.701	0.769	0.717	0.781	0.654	0.704	0.728	0.752
N[3]	344	316	257	246	154	128	84	82	106	106
Obs[4]	24	25	120	114	27	28	14	17	27	27

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1]Elasticities are calculated at the sample means of the participation rate in the respective group

[2]All specifications include regional and time indicators

[3]Number of groups

[4]Average number of observations per group

and comparable to the total elasticity. The responses of women with a partner are higher than the responses of respective men. The responses of female migrants with a partner are lower than those of respective female natives. This finding holds among Western and second-generation female migrants with a partner. Among non-Western female migrants with a partner, the responses are insignificant. Among men with a partner, the responses of migrants are higher than those of natives, and non-Western migrant men exhibit the highest responses. Among individuals without a partner, the own-wage elasticities at the extensive and intensive margin are also very similar to the total elasticities with lower differences between men and women and between migrants and natives than among individuals with a partner. The cross-wage elasticities at the extensive margin (Table 3a) are very similar to the total cross-wage elasticities. At the intensive margin (Table 4a), most groups have a significant and positive but low cross-wage elasticity, except for female natives and 2nd-generation migrants, who have an insignificant coefficient.

Some basic results of this study are similar to the findings of previous studies. The extensive margin dominates the intensive margin, and the own-wage elasticities of women with a partner are higher than those of respective men. The values correspond to the intervals reported in other studies. Bargain et al. (2014) compare compensated and uncompensated labour supply elasticities across 17 European countries and the US and show that the estimates of married women range between 0.2 and 0.6 (and those of men are smaller and more concentrated). The own-wage elasticity in this study is very high for female natives and lower for female migrants. Blundell and MaCurdy (1998) and Evers et al. (2008) report the elasticities of women, and some estimates are larger than 2. Table 5 compares the total own-wage elasticities of women who live with a partner between the 1985–2009 and 2010–2015 periods and shows that the own-wage elasticity of female migrants increased while that of female natives decreased from the first to the second period.[9] Similar to the decrease in the own-wage elasticity of female natives, many studies provide evidence of a decrease in the own-wage elasticity of women over the last decades. Bargain and Peichl (2016) discuss whether smaller elasticities in more recent periods exist due to an increase in female labour market attachment over time or general changes in work preferences. Blau and Kahn (2007) suggest that rising participation rates, increasing divorce rates and increasing career orientations of married women are reasons explaining why women's labour supply has become less sensitive to the own wage. Concerning the data used in this study, it may be relevant that until 1990, the GSOEP only includes individuals from Western Germany, which has always been more traditional, showing lower female labour force participation than the former Eastern Germany. The literature often associates a higher female labour force participation with lower own-wage elasticities, i.e., elasticities that become more comparable to men's own-wage elasticities.

By summarizing the own-wage elasticities reported in different studies from 1900 to 1980, Goldin (1990) shows that the relationship between women's participation rate and their wage elasticity is not positive in all parts of the participation rate. The elasticities were small in approximately 1900, increased with women's educational

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[9] The coefficients are not perfectly comparable to those of the main results because the analysis groups the data of the results in Table 5 only by two periods instead of three-year averages. The estimation does not control for year fixed effects.

Table 4 Wage elasticities with respect to hours worked[1,2] of individuals living (a) with a partner, (b) without a partner

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
(a)										
Own wage	0.228***	0.198***	0.408***	0.028**	0.204***	0.226***	0.022	0.254***	0.237***	0.214***
	(0.032)	(0.012)	(0.031)	(0.011)	(0.069)	(0.026)	(0.102)	(0.026)	(0.055)	(0.029)
Spouse's wage	0.147***	0.083***	−0.418	0.047***	0.197***	0.102***	0.476***	0.086***	0.001	0.035
	(0.028)	(0.012)	(0.026)	(0.013)	(0.063)	(0.024)	(0.088)	(0.024)	(0.042)	(0.028)
Average hours worked	128.210	183.291	139.580	189.845	129.711	179.231	120.572	174.556	127.774	189.614
N[3]	1178	1140	580	569	312	307	189	199	220	205
Obs[4]	28	28	169	153	47	46	35	34	20	19
(b)										
Own wage	0.388***	0.236***	0.259***	0.326***	0.440***	0.338***	0.392***	0.335***	0.201***	0.270***
	(0.021)	(0.021)	(0.018)	(0.020)	(0.026)	(0.032)	(0.065)	(0.055)	(0.044)	(0.031)
Average hours worked	151.011	183.412	158.739	175.072	153.150	175.408	144.670	171.042	152.850	177.462
N[3]	315	230	236	301	141	122	76	73	98	106
Obs[4]	26	122	131	26	29	29	15	19	29	27

***Significant at $p<0.01$; **significant at $p<0.05$; *significant at $p<0.1$

[1] Elasticities are calculated at the sample means of hours worked in the respective group

[2] All specifications include regional and time indicators

[3] Number of groups

[4] Average number of observations per group

Table 5 Total wage elasticities[1,2] of women living with a partner

	Migrants				Natives
	Western	Non-Western	2nd-generation	1st- and 2nd-generation	
1984–2009	0.452**	0.098	0.386*	0.669***	1.099***
	(2.207)	(0.249)	(1.903)	(4.119)	(6.796)
2010–2016	0.879***	0.490	0.747***	0.824***	0.973***
	(0.240)	(0.345)	(0.226)	(0.159)	(0.125)

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1]Elasticities are calculated at the sample means of the hours worked in the respective group

[2]All specifications include regional and time indicators

attainment until 1950, and subsequently decreased. Because female participation rates continuously increased during this time, there appears to be an inverse u-shape relationship to elasticities. The increase in the own-wage elasticities of migrant women shown in Table 5 from one period to the other period may be comparable to the increase in women's elasticities in the early 1990th. Because 70% of first-generation migrants in the data migrated to Germany before 1980, the female migrants during the first period were in Germany for an average shorter period of time and, therefore, are less attached to the labour market than female migrants during the second period. Table 6 displays the total own-wage elasticities of first-generation migrants who live with a partner by years since migration categories and suggests that the time since migration is a main determinant of the increasing elasticity.[10] During the first 10 years after arrival, the own-wage elasticity is insignificant among all groups of female migrants. Among the whole group of 1st-generation female migrants and Western female migrants, the coefficients display an increasing trend among migrants who lived in Germany for more than 10 years, although the trend is not linear with a higher value in the second category than the third category. In the fourth category of 31 years and more, the own wage elasticity of 1st-generation migrants is even higher than that of female natives (Tables 2a). Hence, female migrants' own-wage elasticities are not in all cases lower than those of female natives but highly depend on the status of labour market integration.

Another major result of this study is the insignificant own-wage elasticities of non-Western female migrants who live with a partner. In Table 6, regarding the second category of eleven to 20 years since migration, the own-wage elasticity is also

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[10] The coefficients are not perfectly comparable to those of the main results because the analysis groups the data by additional variables (by the years since migration categorical variable in Table 6 and the migration cohort indicator variable in the following Table 7). This grouping results in a higher number of groups with a lower number of observations per group and leads to more specific coefficients on the one hand and a higher possible bias on the other hand. A smaller number of observations per group also leads to a higher probability that the control variables do not vary within a group and, therefore, drop out of the estimation, especially in the case of the indicator variable related to living in Eastern Germany. The share of migrants living in Eastern Germany is much lower than that living in Western Germany.

Table 6 Total own-wage elasticities[1,2] of female migrants living with a partner

	1st-generation migrants	Western	Non-Western
0–10 years	0.051	−0.038	−1.361
	(0.309)	(0.270)	(0.707)
11–20 years	0.848***	0.526**	0.749***
	(0.182)	(0.212)	(0.284)
21–30 years	0.578***	0.345**	0.677
	(0.217)	(0.166)	(0.530)
31+ years	1.253***	0.937***	0.457
	(0.307)	(0.254)	(0.623)

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1]Elasticities are calculated at the sample means of the hours worked in the respective group

[2]All specifications include regional and time indicators

significant among non-Western migrants but is insignificant among the migrants in the other categories. On the one hand, this finding demonstrates that the own-wage elasticity of non-Western female migrants is not in all cases insignificant. On the other hand, due to the panel structure of the data, it is difficult to explain the significance with cohort effects. Since 66% of non-Western female migrants migrated to Germany before 1980 and almost 100% of these migrants migrated from Turkey, most non-Western female migrants—determining insignificant elasticities in this group—migrated as family migrants of Turkish guest workers.

The central hypothesis in this study is that problems related to labour market integration, especially during the first years after migration, lead to a low wage sensitivity among migrants compared to natives. These problems may be especially high among non-Western female migrants predominantly from Turkey, which is a Muslim country, due to cultural differences from Germans (and female Western migrants with significant elasticities). Problems associated with labour market integration among non-white and Muslim women are well documented in the literature. Khoudja and Fleischmann (2015) show that the predicted negative effects of traditional gender role attitudes and religiosity contribute to the explanation of ethnic differences in female labour force participation. Khattab and Hussein (2018) depict the disadvantages faced by Muslim women in the labour market. Zaiceva and Zimmermann (2014) provide evidence suggesting that non-white women spend significantly more time on religious activities and food management than white women, and the authors draw a connection to the low labour market participation of ethnic minority women. Although the results of the natives show that participation has no positive effect on elasticities at all parts of the participation rate, further analysis shows that labour market integration influences own-wage elasticities also among non-Western female migrants.

Table 7 shows that the own-wage elasticities of non-Western female migrants who migrated to Germany at an age of 16 years or below are significant in

Table 7 Total own-wage elasticities[1,2] of female migrants living with a partner

	1st-generation migrants	Western	Non-Western
16 years or younger at the time of migration	0.856*** (0.222)	0.517** (0.231)	0.776* (0.460)
Older than 16 years at the time of migration	0.569*** (0.075)	0.460*** (0.100)	− 0.009 (0.205)

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1]Elasticities are calculated at the sample means of the hours worked in the respective group

[2]All specifications include regional and time indicators

contrast to those of the group of non-Western female migrants who migrated at an older age. The group of so-called 'academic nationals', who were not born in Germany but received some education in Germany due to their age, is comparable to first-generation migrants. Table 2a shows that among Western and non-Western second-generation migrants, the own-wage elasticities are significant. Knowledge regarding the German educational system and possibly the existence of a German educational degree have a high impact on labour market integration and probably influence own-wage elasticities.

As a further result of this study, among women, the own-wage elasticities of migrants with a native spouse are insignificant, and the own-wage elasticities of natives with a migrant spouse are lower than those of natives with a native spouse. Among men, the elasticities do not vary much between mixed couples and couples with two migrant or two native spouses. The respective spouse appears to influence women's responses much more than men's responses. The cross-wage elasticities confirm this conclusion, although there are differences in terms of whether the response is to the partner's origin or the partner's wage. In most cases, the cross-wage elasticities are higher than those of men or only significant among women. Surveys have suggested that women's labour supply is considerably more sensitive to the partner's wage than men's labour supply is sensitive to the partner's wage (see Blau and Kahn 2007). The significant negative cross-wage elasticities of female natives are higher than those of female migrants. A high negative cross-wage elasticity may result due to a perfectly symmetric labour supply between a couple resulting from the need to cover living expenses or the preference to maintain a certain status. On the one hand, this situation could be a possible reason for the very high negative cross-wage elasticity of female natives. On the other hand, female migrants appear to be on average less sensitive not only to their own but also to their partner's wage than female natives.

5.2 Robustness Checks

The literature shows great variation in the magnitude of labour-supply elasticities. Meta-analyses suggest that determinants, such as the estimation method, model specification or family situation, are the main sources of variation (Evers et al. 2008). In the following, various robustness checks are performed to test whether issues concerning selection, the method of wage imputation, the estimation technique, the sample, taxation or the existence of children have a significant impact on the main results of this study. Except for the first robustness check, we apply the total elasticities, and we apply elasticities only to individuals who live with a partner. The Appendix displays the results.

The analysis of the intensive margin only includes individuals with a positive number of hours worked and does not consider non-participants. The first robustness check tests whether the results of the intensive margin significantly vary when including the inverse mill ratio of the probability to participate in the equation on hours worked.[11] As shown in Table 10a in the Appendix, the elasticities do not vary much from the main results of the intensive margin (Table 4a).

Regarding the total elasticities and sub-elasticity at the extensive margin, the analysis imputes the wages of non-participants by assigning them the predicted wages of employed individuals with the same observed characteristics. The robustness check estimates the potential wages by using a standard Heckman regression.[12] The results of the total elasticities (Table 10b in the Appendix) do not vary much from the main results (Table 2a, b). As Devereux (2004) emphasizes, the results have to be similar since using the available grouping variables either to impute wages non-parametrically as a mean of the group or by adding any function of these variables to the wage equation as a selection correction makes no difference.

A main critique of assigning non-participants the predicted wages of similarly employed individuals is that non-participants are likely to have lower wages than participants with the same characteristics. Therefore, two robustness checks repeat the imputation of the total elasticities by using the tenth or 25th percentile of the wages of the participants in their group (see Tables 11a and b in the Appendix). Although the results do not vary much regarding of whether the tenth or 25th percentile is used, comparable to Devereux (2004), the wage elasticities depend on the method of wage imputation, especially in the groups with low participation rates.

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[11] The selection equation includes a variable related to belonging to a church as an exclusion restriction. Non-participation concerns mostly women, and belonging to a church or a religious community may be correlated with traditional gender-role behaviour following the male breadwinner/female homemaker family model. In contrast, one can argue that this variable does not influence the number of working hours, although among more traditional women, the probability of working a lower number of hours may also be higher than that among less traditional-oriented women.

[12] Comparable to the intensive margin, the selection equation related to participation used for the wage estimation, includes a variable related to belonging to a church as an exclusion restriction. One can argue that the variable does not influence the wage, although among more traditional women, the probability to invest in a career for higher earnings may be lower than that among less traditional-oriented women.

The own- and cross-wage elasticities of female migrants are much higher compared to the main results. The own-wage elasticities of female migrants are comparable to those of female natives. When we assume that non-participating migrant women have much lower wages than participating women, non-participating migrant women respond more strongly to their own and partner's wage increases. However, one can only draw assumptions concerning the part of the wage distribution to which the non-participants belong.

Another robustness check examines the sample-specific determinants. The grouping strategy controls for the main socio-demographic characteristics and human capital variables, and the regression controls for additional variables. To examine whether the analysis controls for all relevant sample specific factors, Table 12 (in the Appendix) displays the coefficients by using the GSOEP sample weights instead of the group size to compute the weighted variables. The wage elasticities are similar to the elasticities presented in Table 2a, b. Hence, the variables used for the grouping and estimation are sufficient or at least contain all variables considered in the GSOEP sample weighting.

Individuals may still be in education until the age of 25 years, and women may not work until they are 60. Individuals younger than 25 and older than 60 may bias the results of the labour supply elasticities. Therefore, the robustness check in Table 13 in the Appendix repeats the results of Table 2a and b by considering only individuals aged between 25 and 55 years. The results are very similar to the results presented in Table 2a and b. Because persons in vocational training or general education are excluded from the sample, the average size of the groups and number of groups do not significantly decrease.

A further robustness check replaces post-tax with pre-tax wage rates to calculate the own- and cross-wage elasticities (see Table 14 in the Appendix). The results are very similar to the results in Table 2a and b and, therefore, indicate that taxation does not have a significant impact on labour supply elasticities.

Finally, a robustness check tests whether the existence of young children in the household influences the labour supply elasticities of women who live with a partner. Table 15 shows the elasticities of women who live with a partner and at least one child below the age of 11 years separately by the four migration-specific groups. For additional differentiation by child age, the number of mothers in the sample is too low. In contrast to the main results, the elasticity of non-Western female migrants is significant. The own-wage elasticities of mothers of young children are higher than those of women in general (Table 2a–c). This finding is consistent with the results reported by De Boer (2018), who simulates the elasticities of couples with and without children separately to show that the subgroups differ in responses to financial incentives. He emphasizes that the differences in elasticities are primarily driven by differences in participation rates. The percentage change resulting from a 1% change in wage is large with a low average number of hours worked, such as among mothers of young children. The analysis in this study derives the total

elasticities by dividing the estimated coefficients by the average hours worked in the respective group. As a third value in addition to elasticity and the standard error, the table shows estimated coefficients without calculated elasticities. Here it is possible to compare responses independent from the average hours worked in the groups. The estimated coefficients are all slightly higher than those in the main results (see Table 9a). Comparable to the main results, the own-wage responses of migrants are lower than those of natives. The cross-wage elasticities are significant and negative among mothers in the whole group of migrants and natives, and comparable to the main results, the value of natives is higher than that of migrants.

6 Conclusion

The problem of the imperfect labour market integration of migrants especially applies to female migrants, especially women with a non-Western origin. Although the literature associates migration with positive individual effects because otherwise, the migrants would not have moved (Greenwood 1975), several studies have shown that on average, family migration has negative effects on women's labour market performance. Nevertheless, the literature regarding migrant women's responses to wages, which are not linearly connected to participation, is very limited. By using the GSOEP data from 1984 to 2015, the analysis in this study estimates the own- and cross-wage elasticities of women and men with and without a migration background. To address the bias resulting from measurement errors and the endogeneity of the earning variables, the estimation approach groups the data and applies a weighted least squares estimation based on the group means weighted by the group size. An error-in-variables estimator corrects for bias possibly resulting from the small group size.

The results show that female migrants who live with a partner have lower own- and cross-wage elasticities than respective female natives. Further analysis reveals an inverse u-shaped relationship between participation and wage sensitivity. On the one hand, parallel to their labour market integration, the time since migration increases women's own-wage elasticities. Among non-Western female migrants, the own-wage elasticity is insignificant in the main results possibly due to high problems of labour market integration. Among non-Western female migrants who migrated to Germany at an age below 16 and, therefore, were involved in the educational system comparable to second-generation migrants, the elasticities are significant. On the other hand, female natives' own-wage elasticities before 2009, when they had lower participation rates, are higher than those after 2009. The literature explains the converging of women's elasticities to men's elasticities by rising participation rates, increasing divorce rates and increasing career orientation of married women.

Labour supply elasticities are an important indicator of the potential to increase labour supply and, therefore, highly relevant for integration policy. Increasing female migrants' participation rates is a main aim in Germany as in other industrial countries. This study finds as a main result that relative to natives, female migrants have lower or insignificant wage responses. To increase participation, it is important to identify the barriers to flexible wage responses and implement mechanisms to remove these barriers. Shauman and Noonan (2007) show that in addition to structural gender inequality, the negative effects of migration on women' labour market performance are due to their higher probability of having a secondary role in family migration decisions. Women usually take over a higher workload in child care than men, which may further increase due to the circumstance of being a tied mover. To support female migrants, especially during the first years after migration, it is important to increase the supply of childcare. Boll and Lagemann (2019) focus on the impact of several childcare expansions on maternal employment and show a positive relationship between the childcare coverage rate and the intensive margin of maternal employment. Since 2013, in Germany, all mothers have the legal right to claim public child care for children aged 1 year or older. However, the authors show that in 2017, the demand was approximately 13 percentage points higher than the supply in Western Germany and 7 percentage points higher than the supply in Eastern Germany.

The literature discusses the negative effects of traditional gender role attitudes and religiosity on female migrants' labour force participation (Khoudja and Fleischmann 2015; Khattab and Hussein 2018; Zaiceva and Zimmermann 2014). Cultural aspects may also be relevant for the low or insignificant own- and cross-wage elasticity of migrants. In addition to a general low labour market attachment, cultural aspects may create barriers to using childcare. In many migrants' home countries, especially Muslim countries, the use of external public child care is uncommon, which may lead to concerns and hinder a flexible reaction to wage incentives. Information regarding institutional child care provision in Germany by counselling centres or in the form of experiences of other female migrants could reduce concerns. Barriers may also exist in bureaucratic terms; thus, the provision of information and support in finding a child care slot is important to enhance access to child care. In many German regions, it is important to apply for a slot in a preferred child care facility well in advance, sometimes before the child's birth.

Studies usually estimate the labour supply elasticities of the entire female and male population of one country, whereas the large data set used in this study enables the analysis of the heterogeneity in labour supply responses of different demographic groups. Nevertheless, due to the low number of observations, it was not

possible to differentiate simultaneously between mothers with very young and older children and between different migration groups, representing an interesting venue for future research. The differences in the own-wage elasticities of migrant groups by origin also suggest that major differences exist based on the migration reason, such as family migrants in contrast to economic migrants or refugees. Unfortunately, the migration reason was only available for a small share of the migrants in the dataset.[13] Further research investigating different socio-demographic groups is of high relevance to enhance the understanding of labour supply. As Borjas (2016) emphasizes, there are almost as many estimates of labour supply elasticity as there are empirical studies; nevertheless, most studies confirm certain factors, such as higher own-wage elasticities of women than men. The results of this study note that a group with a low participation rate, such as non-Western migrant women, does not necessarily have significant elasticities.

Appendix

Tables

See Tables 8. 9, 10, 11, 12, 13, 14 and 15.

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[13] The respondents who participated in the IAB-SOEP migration sample and, therefore, answered additional migration-specific questions.

Table 8 Descriptive statistics of the variables used in the estimation by gender only among migrants *Source:* GSOEP, 2015, only employable migrants

| Variable | Western migrants | | | | | | Non-Western migrants | | | | | | 2nd-generation migrants | | | | | |
| | Women | | | Men | | | Women | | | Men | | | Women | | | Men | | |
	Mean/share	SD	N	Mean/share	SD	N	Mean/Share	SD	N	Mean/share	SD	N	Mean/share	SD	N	Mean/share	SD	N
Participation rate	0.64	0.48	1481	0.86	0.34	1384	0.42	0.49	403	0.76	0.43	459	0.67	0.47	569	0.88	0.33	550
Working hours	29.62	13.88	1132	41.91	9.92	1214	27.26	13.80	208	39.26	12.46	370	31.21	13.57	438	42.05	10.10	494
Net wage per hour[1]	8.30	4.43	1121	10.35	8.63	1210	8.17	4.65	206	9.21	4.46	366	9.39	4.41	437	12.31	10.09	491
Partner net wage per hour[1]	10.97	8.39	1099	8.21	4.21	718	11.36	6.78	258	9.29	5.47	153	12.71	9.99	339	10.09	6.32	253
East (including Berlin)	0.10	0.30	1696	0.09	0.29	1423	0.06	0.23	450	0.07	0.25	489	0.09	0.29	637	0.12	0.33	569
Age	39.37	9.66	1696	40.17	9.66	1423	39.17	8.57	450	40.32	9.18	489	38.72	10.21	637	38.37	10.47	569
Educational degree																		
No educational degree	0.19	0.40	1696	0.21	0.41	1423	0.37	0.48	450	0.36	0.48	489	0.16	0.37	637	0.17	0.37	569
Vocational degree	0.52	0.50	1696	0.55	0.50	1423	0.36	0.48	450	0.41	0.49	489	0.62	0.49	637	0.59	0.49	569
University degree	0.29	0.45	1696	0.24	0.42	1423	0.28	0.45	450	0.24	0.43	489	0.22	0.41	637	0.25	0.43	569

Table 8 (continued)

Variable	Western migrants						Non-Western migrants						2nd-generation migrants					
	Women			Men			Women			Men			Women			Men		
	Mean/share	SD	N	Mean/share	SD	N	Mean/Share	SD	N	Mean/share	SD	N	Mean/share	SD	N	Mean/share	SD	N
Non-labour income p.c.[1]	370.88	540.38	1636	341.92	409.80	1374	449.15	411.19	419	384.46	371.03	459	468.14	557.25	607	441.37	574.65	542
Good health	0.86	0.35	1696	0.89	0.32	1423	0.81	0.40	448	0.84	0.37	489	0.85	0.36	637	0.88	0.32	569
Living with a partner	0.76	0.43	1696	0.82	0.38	1423	0.79	0.41	450	0.80	0.40	489	0.61	0.49	637	0.67	0.47	569
Children younger than three years	0.16	0.36	1696	0.18	0.38	1423	0.19	0.40	450	0.20	0.40	489	0.13	0.33	637	0.13	0.34	569
Number of observations, 1984–2015			22,898			21,017			9452			9548			7853			7276
Average number of obs. per person			5			5			6			5			5			5

[1]The consumer price index in 2010 deflates all earning values used in this study

Table 9 Full estimation results of the main specification—total elasticity of individuals living (a) with a partner[1], (b) without a partner[1]

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants		Migrants with a native spouse		Natives with a migrant spouse	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
(a)														
Constant	−22.503	−36.334**	−356.272***	−190.622***	7.281	−31.467	182.725***	−5.204	−171.098***	−137.579***	7.764	−14.984	−104.690***	−109.758***
	(21.211)	(15.971)	(43.487)	(25.284)	(30.407)	(27.740)	(36.789)	(30.422)	(45.517)	(40.998)	(39.371)	(34.706)	(33.509)	(29.160)
Own wage	28.766***	34.042***	87.580***	32.879***	21.816**	34.777***	2.270	48.011***	37.607***	42.523***	9.046	19.737**	44.274***	46.757***
	(4.937)	(3.646)	(5.209)	(2.699)	(8.580)	(6.342)	(10.490)	(7.889)	(8.207)	(6.717)	(9.761)	(8.406)	(7.499)	(6.266)
Spouse's wage	−6.784*	6.416*	−69.032***	−3.054	12.960*	5.743	7.666	−8.503	−10.543*	13.364**	−10.138	2.875	−17.258	3.311
	(4.123)	(3.344)	(3.985)	(2.888)	(7.494)	(5.896)	(9.002)	(7.054)	(5.929)	(6.361)	(8.036)	(7.244)	(7.558)	(6.876)
Non-labour household income per person[4]	−15.913***	−73.007***	−34.770***	−74.900***	−24.340***	−60.519***	−6.225*	−84.235***	3.339	−76.420***	−7.122	−26.89**	−31.810***	−37.074***
	(2.986)	(4.284)	(4.253)	(3.799)	(6.435)	(6.769)	(3.442)	(8.523)	(8.827)	(11.809)	(5.597)	(11.363)	(8.639)	(8.690)
Good health	58.605***	105.443***	109.229***	146.91***	30.645***	100.271***	19.054	98.788***	52.212***	72.080***	94.784***	139.469***	68.854***	81.765***
	(7.998)	(6.427)	(10.195)	(6.070)	(11.810)	(10.976)	(13.019)	(14.644)	(15.860)	(11.938)	(18.660)	(15.270)	(14.308)	(12.711)
Children younger than 3 years	−79.678***	−2.601	−66.452***	−20.252***	−81.140***	2.771	−31.879***	6.836	−42.999***	−1.828	−52.623***	−3.687	−61.201***	17.097*
	(5.088)	(3.992)	(6.726)	(4.546)	(7.048)	(6.634)	(8.473)	(8.392)	(10.445)	(8.434)	(13.819)	(12.609)	(12.005)	(9.648)
East	66.707***	5.460	181.575***	44.917***	27.568	−67.466***	−45.681	−11.947	115.654***	14.007	9.984	−22.898	88.643***	64.135***
	(17.088)	(12.961)	(24.625)	(14.763)	(28.187)	(24.363)	(56.576)	(69.606)	(26.445)	(17.730)	(28.663)	(31.418)	(30.190)	(20.063)
1987–1989	6.764	28.632	141.643**	114.251***	14.723	15.006	−46.923	35.713	69.058	123.555***	−13.570	−9.210	73.425**	80.758**
	(26.029)	(19.031)	(57.793)	(33.728)	(35.558)	(32.028)	(40.830)	(33.330)	(57.969)	(55.730)	(47.994)	(34.447)	(34.854)	(34.154)
1990–1992	49.334*	48.008**	248.078***	222.748***	52.401	47.711	−57.027	20.836	169.822***	147.200***	60.729	27.494	58.919*	53.012
	(25.562)	(18.698)	(51.616)	(30.128)	(35.892)	(32.017)	(40.887)	(33.665)	(56.796)	(49.315)	(45.898)	(34.039)	(33.826)	(32.400)

Table 9 (continued)

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants		Migrants with a native spouse		Natives with a migrant spouse	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
1993–1995	29.562	−2.776	235.221***	77.803***	2.792	−1.818	−106.759***	−57.169*	151.041***	169.049***	52.017	−31.084	26.588	3.947
	(25.427)	(18.466)	(51.449)	(29.809)	(34.702)	(30.936)	(40.947)	(33.812)	(57.025)	(48.454)	(46.001)	(34.306)	(34.410)	(31.750)
1996–1998	−13.071	−13.390	249.456***	77.434***	−45.136	−19.498	−151.432***	−100.106***	107.778**	144.442***	24.991	−27.954	39.261	35.093
	(24.654)	(18.157)	(51.534)	(29.892)	(33.486)	(30.462)	(40.825)	(33.215)	(52.246)	(45.667)	(47.418)	(35.355)	(35.144)	(32.215)
1999–2001	−12.099	−6.208	254.641***	85.167***	−29.303	−20.773	−141.865***	−77.052**	89.422*	127.877***	9.709	−23.647	53.372	20.200
	(23.527)	(17.706)	(51.599)	(29.989)	(33.027)	(29.973)	(39.777)	(32.999)	(50.658)	(44.433)	(42.484)	(34.701)	(34.539)	(30.543)
2002–2004	8.050	−1.847	310.268***	69.546**	−23.539	−15.037	−150.259***	−100.907***	82.992**	108.736**	73.681*	−10.667	60.742*	−0.154
	(23.861)	(17.755)	(51.762)	(30.515)	(33.627)	(30.147)	(41.614)	(34.141)	(50.269)	(44.388)	(44.576)	(35.587)	(35.980)	(31.081)
2005–2007	−1.739	−5.238	303.196***	72.772**	−33.895	−17.719	−135.254***	−78.384*	96.811*	119.118***	37.985	−19.821	83.309**	38.237
	(23.807)	(17.990)	(51.807)	(30.297)	(34.176)	(30.645)	(41.127)	(34.183)	(49.937)	(43.848)	(42.990)	(37.159)	(35.952)	(30.726)
2008–2010	17.225	27.620	350.145***	108.762***	−25.887	11.284	−117.63***	−21.484	110.322**	151.711***	68.518	−4.566	96.405***	88.086***
	(24.130)	(18.166)	(52.412)	(30.280)	(35.006)	(31.028)	(41.200)	(34.738)	(49.731)	(44.180)	(45.151)	(37.584)	(38.280)	(31.846)
2011–2013	19.996	34.126**	333.227***	110.502***	−26.944	43.547	−146.047***	−14.975	118.18**	136.105***	122.140***	−1.710	128.305***	54.173*
	(22.784)	(16.944)	(52.197)	(30.380)	(32.612)	(28.637)	(38.916)	(31.606)	(49.781)	(43.845)	(43.595)	(34.599)	(35.230)	(29.924)
2014–2016	27.590	29.912*	361.254***	135.452***	−8.328	39.346	−112.278***	−3.664	111.698**	117.269***	119.980***	18.841	116.774***	51.718*
	(22.630)	(17.006)	(52.640)	(30.603)	(32.533)	(28.558)	(38.609)	(32.724)	(49.561)	(43.897)	(42.235)	(35.334)	(33.475)	(30.048)
Average hours worked (zero hours included)	72.055	154.583	88.609	161.219	76.487	154.286	44.315	137.268	79.009	170.541	83.360	155.858	83.298	171.458

Table 9 (continued)

	Migrants		Natives		Western migrants		2nd-generation migrants		Non-Western migrants		Migrants with a native spouse		Natives with a migrant spouse	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
N[2]	971	934	585	571	316	307	229	205	200	200	226	222	249	207
Obs[3]	31	30	168	153	47	46	20	19	33	34	17	14	14	17

(b)

	Migrants (Men)	Natives (Men)	Western migrants – Women	Western migrants – Men	Non-Western migrants – Women	Non-Western migrants – Men	2nd-generation migrants (Men)	Migrants with a native spouse (Women)	Natives with a migrant spouse – Women	Natives with a migrant spouse – Men
Constant	−43.549	−72.883**	−287.723***	−89.099*	−18.899	42.672	−73.836	−86.308	−200.690***	−161.639**
	(33.016)	(28.698)	(70.602)	(50.193)	(47.529)	(43.341)	(79.304)	(55.666)	(66.243)	(73.421)
Own wage	31.096***	46.460***	14.934***	25.634***	29.330***	27.630***	50.090***	59.564***	17.391**	61.901***
	(3.481)	(3.913)	(5.114)	(4.183)	(4.283)	(5.078)	(9.517)	(9.869)	(8.499)	(8.075)
Non-labour household income per person[4]	−16.569***	−31.156***	−28.687***	−40.987***	−25.694***	−33.981***	−4.343	−41.580***	−14.089*	−42.209***
	(5.321)	(3.746)	(6.590)	(4.307)	(7.743)	(5.160)	(14.434)	(14.033)	(8.424)	(7.204)
Good health	98.565***	86.150***	157.175***	141.653***	104.707***	114.159***	57.505***	68.919***	131.483***	66.737***
	(8.508)	(8.876)	(14.317)	(12.015)	(10.246)	(11.584)	(20.538)	(19.323)	(20.331)	(17.860)
Children younger than 3 years	−69.544***	12.372	−140.477***	17.899	−96.812***	83.471*	−6.268	41.756	−217.103***	−4.578
	(19.104)	(20.427)	(37.037)	(50.185)	(28.277)	(44.778)	(37.396)	(45.609)	(50.517)	(44.055)
East	63.285***	−22.37	12.213	−50.152*	95.683***	−40.855	−247.382**	−118.65	19.438	−24.466
	(21.711)	(18.475)	(35.591)	(27.115)	(33.818)	(28.457)	(124.183)	(72.484)	(33.525)	(27.835)
1987–1989	25	70.031**	167.746*	98.042	−9.721	56.100	−9	−26	231.223**	246.171***
	(39.754)	(33.316)	(87.276)	(64.312)	(49.293)	(41.123)	(73.152)	(51.519)	(90.717)	(92.392)
1990–1992	44.021	65.419**	255.395***	137.874**	48.726	34.524	26.801	22.562	250.604***	205.954**
	(39.144)	(31.574)	(77.584)	(57.224)	(48.990)	(41.542)	(75.700)	(45.298)	(93.340)	(87.847)
1993–1995	−5.015	8.763	151.545*	72.188	43.910	−0.899	−122.042*	−63.248	167.511*	115.507
	(38.150)	(31.234)	(77.631)	(57.598)	(48.110)	(40.226)	(68.668)	(49.561)	(93.072)	(81.922)
1996–1998	−24.736	−25.664	105.417	47.635	−12.877	−54.770	−31.998	−99.335*	108.327	81.994

Table 9 (continued)

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
1999–2001	−15.920 (37.098)	−17.440 (30.592)	86.81 (77.365)	20.005 (57.242)	−40.100 (46.485)	−51.823 (38.950)	1.538 (76.601)	−71.792 (57.031)	165.406** (82.384)	78.330 (79.528)
2002–2004	−37.793 (35.197)	−26.146 (28.827)	56.309 (77.937)	−4.114 (57.065)	−38.260 (44.204)	−53.730 (37.757)	17.442 (74.969)	−73.340 (48.090)	123.770 (76.445)	59.348 (78.062)
2005–2007	−40.258 (35.451)	−15.705 (29.441)	57.016 (77.626)	−9.129 (58.019)	−46.293 (46.082)	−62.369 (39.395)	−41.92 (80.407)	−48.103 (50.308)	141.275* (77.353)	57.907 (76.721)
2008–2010	−28.593 (35.027)	−8.490 (30.098)	106.357 (78.041)	49.793 (57.469)	−39.569 (44.535)	−128.216*** (41.847)	−48.581 (79.186)	−76.175 (58.224)	145.129** (74.415)	114.548 (76.375)
2011–2013	−94.112*** (35.677)	−21.529 (29.735)	8.896 (77.297)	−14.151 (57.363)	−139.064*** (45.310)	−76.571** (42.006)	−120.949* (80.634)	−46.804 (57.084)	133.200* (73.625)	43.385 (76.056)
2014–2016	−106.313*** (33.255)	−7.741 (27.312)	107.294 (79.439)	19.530 (57.422)	−123.804*** (43.920)	−74.569** (36.266)	−169.466** (67.122)	−47.820 (42.770)	108.917 (75.361)	72.723 (76.086)
Average hours worked (zero hours included)	108.664 (33.683)	130.831 (27.265)	114.356 (78.488)	139.807 (57.592)	111.885 (43.781)	135.322 (35.760)	97.814 (69.165)	119.957 (44.694)	112.444 (75.265)	133.128 (76.510)
N^2	315	302	236	231	141	122	76	73	98	107
Obs[3]	26	26	131	121	29	29	15	19	29	27

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1] All specifications include regional and time indicators

[2] Number of groups

[3] Average number of observations per group

[4] Scaled at 100 for the estimation

Table 10 (a) Wage elasticities with respect to hours worked[1,2] of individuals living with a partner—estimation based on the heckman selection model. (b) Total wage elasticities[1,2] of individuals living with a partner—imputed wages based on the heckman selection model

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
(a)										
Own wage	0.237***	0.189***	0.463***	0.067***	0.164***	0.183***	−0.066	0.195***	0.222***	0.232***
	(0.038)	(0.015)	(0.032)	(0.011)	(0.059)	(0.025)	(0.088)	(0.022)	(0.056)	(0.027)
Spouse's wage	0.102***	0.076***	−0.442***	0.020	0.086	0.070***	0.446***	0.081***	0.017	0.024
	(0.035)	(0.014)	(0.025)	(0.012)	(0.056)	(0.024)	(0.084)	(0.021)	(0.043)	(0.026)
N[3]	818	778	588	578	356	343	242	230	220	205
Obs[4]	37	36	174	158	51	49	31	33	20	19
(b)										
Own wage	0.664***	0.276***	0.907***	0.172***	0.559***	0.198***	0.155	0.371***	0.564***	0.272***
	(0.071)	(0.027)	(0.060)	(0.018)	(0.087)	(0.043)	(0.186)	(0.053)	(0.108)	(0.040)
Spouse's wage	−0.257	0.005	−0.808	−0.002	−0.144	0.033	0.122	−0.109	−0.182	0.069*
	(0.063)	(0.025)	(0.049)	(0.019)	(0.082)	(0.040)	(0.177)	(0.050)	(0.077)	(0.037)
N[3]	853	779	593	580	370	343	253	231	230	205
Obs[4]	36	36	172	157	49	49	30	33	20	19

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1] Elasticities are calculated at the sample means of hours worked in the respective group

[2] All specifications include regional and time indicators

[3] Number of groups

[4] Average number of observations per group

Table 11 Total wage elasticities[1,2] of individuals living with a partner—imputed wages: (a) 10th percentile, (b) 25th percentile

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
(a)										
Own wage	0.909***	0.356***	0.948***	0.227***	0.757***	0.306***	0.780***	0.459***	0.697***	0.281***
	(0.055)	(0.024)	(0.033)	(0.014)	(0.073)	(0.040)	(0.147)	(0.045)	(0.080)	(0.038)
Spouse's wage	−0.306***	−0.039*	−0.702***	−0.037**	−0.205***	−0.028	−0.214*	−0.117***	−0.211***	0.041
	(0.049)	(0.023)	(0.031)	(0.016)	(0.067)	(0.036)	(0.128)	(0.042)	(0.067)	(0.038)
N[3]	849	779	593	580	368	343	252	231	229	205
Obs[4]	36	36	172	157	49	49	30	33	20	19
(b)										
Own wage	0.894***	0.325***	1.059***	0.217***	0.744***	0.259***	0.672***	0.430***	0.651***	0.278***
	(0.064)	(0.025)	(0.042)	(0.015)	(0.085)	(0.041)	(0.175)	(0.049)	(0.092)	(0.039)
Spouse's wage	−0.315***	−0.022	−0.766***	−0.029*	−0.223***	−0.003	−0.160	−0.117***	−0.178**	0.051
	(0.054)	(0.024)	(0.035)	(0.017)	(0.075)	(0.038)	(0.142)	(0.045)	(0.069)	(0.038)
N[3]	849	779	593	580	368	343	252	231	229	205
Obs[4]	36	36	172	157	49	49	30	33	20	19

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1] Elasticities are calculated at the sample means of hours worked in the respective group

[2] All specifications include regional and time indicators

[3] Number of groups

[4] Average number of observations per group

Table 12 Total wage elasticities[1,2] of individuals living with a partner—SOEP weights

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Own wage	0.471***	0.213***	0.915***	0.182***	0.344***	0.091**	0.022	0.356***	0.345***	0.233***
	(0.076)	(0.028)	(0.058)	(0.017)	(0.096)	(0.042)	(0.210)	(0.060)	(0.107)	(0.038)
Spouse's wage	−0.183***	0.012	−0.844***	−0.012	−0.038	0.080**	0.171	−0.154***	−0.151*	0.077**
	(0.064)	(0.026)	(0.045)	(0.019)	(0.084)	(0.038)	(0.182)	(0.052)	(0.080)	(0.036)
N[3]	849	779	593	580	368	343	252	231	229	205
Obs[4]	36	36	172	157	49	49	30	33	20	19

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1] Elasticities are calculated at the sample means of hours worked in the respective group

[2] All specifications include regional and time indicators

[3] Number of groups

[4] Average number of observations per group

Table 13 Total wage elasticities[1,2] of individuals living with a partner aged 25–55

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Own wage	0.587***	0.267**	0.983***	0.156***	0.367***	0.219***	0.065	0.336***	0.384***	0.287***
	(0.079)	(0.114)	(0.057)	(0.016)	(0.101)	(0.038)	(0.216)	(0.051)	(0.107)	(0.036)
Spouse's wage	−0.156**	0.028	−0.793***	0.022	0.011	0.067*	0.313	−0.057	−0.140*	0.038
	(0.068)	(0.025)	(0.042)	(0.017)	(0.088)	(0.036)	(0.192)	(0.049)	(0.081)	(0.034)
N[3]	775	726	576	562	351	321	227	219	197	186
Obs[4]	33	33	150	137	45	45	29	30	19	18

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1] Elasticities are calculated at the sample means of hours worked in the respective group

[2] All specifications include regional and time indicators

[3] Number of groups

[4] Average number of observations per group

Table 14 Total wage elasticities[1,2] of individuals living with a partner—gross instead of net wages

	Migrants		Natives		Western migrants		Non-Western migrants		2nd-generation migrants	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Own wage	0.682***	0.255**	0.902***	0.184***	0.557***	0.181***	0.441***	0.325***	0.499***	0.250***
	(0.060)	(0.023)	(0.055)	(0.017)	(0.082)	(0.036)	(0.165)	(0.047)	(0.088)	(0.036)
Spouse's wage	−0.348***	−0.01	−0.824***	−0.025	−0.219**	0.024	−0.160	−0.106**	−0.183**	0.046
	(0.062)	(0.025)	(0.048)	(0.019)	(0.088)	(0.039)	(0.178)	(0.050)	(0.075)	(0.039)
N[3]	849	779	593	580	368	343	252	231	229	205
Obs[4]	36	36	172	157	49	49	30	33	20	19

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1]Elasticities are calculated at the sample means of hours worked in the respective group

[2]All specifications include regional and time indicators

[3]Number of groups

[4]Average number of observations per group

Table 15 Total wage elasticities[1,2] of women living with a partner and child(ren) below 11 years

	Migrants	Natives	Western migrants	Non-Western migrants	2nd-generation migrants
Own wage	0.822***	1.143***	0.513***	0.459*	0.853***
	(0.119)	(0.085)	(0.170)	(0.278)	(0.186)
Estimated coefficient	39.816	80.359	29.364	15.901	42.933
Spouse's wage	−0.182*	−1.010***	−0.086	0.301	−0.202
	(0.104)	(0.064)	(0.154)	(0.248)	(0.137)
Estimated coefficient	−8.798	−70.956	−4.915	10.424	−10.179
Average hours worked	48.435	70.280	57.238	34.619	50.328
N[3]	528	440	235	167	126
Obs[4]	28	81	33	28	18

***Significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.1$

[1]Elasticities are calculated at the sample means of hours worked in the respective group

[2]All specifications include regional and time indicators

[3]Number of groups

[4]Average number of observations per group

Figures

See Figs. 2, 3 and 4.

Errors-in-Variables Estimator

When y* refers to the population average participation rate (sub-elasticity at the extensive margin)/average hours worked (total elasticity or sub-elasticity at the intensive margin), x* refers to the labour supply determinants of one group, and x and y are the respective sample means with $y* = x* + e$ as the regression at the level of the population means, Eq. (6) displays the sampling error structure as follows:

$$\bar{y} = y^* + u$$

$$\bar{x} = x^* + v$$

$$\begin{pmatrix} \bar{y} \\ \bar{x} \end{pmatrix} \sim N \begin{pmatrix} y^* & \sigma_{00} & \sigma' \\ x^* & \sigma & \Sigma \end{pmatrix} \tag{6}$$

N is defined as the number of groups, and k is defined as the number of right-hand side variables. Deaton (1985) derives an unbiased errors-in-variables estimator (7) for the estimation of models in levels that is approximately unbiased and consistent as the number of groups reaches infinity.
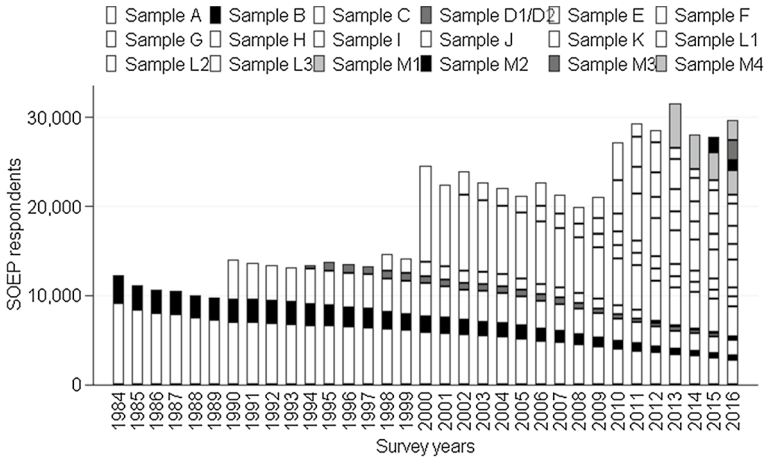
Fig. 2 Development of different SOEP samples (1984–2015) of persons older than 17 years

Note: A 1984 Starting-Sample (West),   **B 1984 Migration (until 1983, West)**,
         C 1990 Starting-Sample (East),   **D 1994/5 Migration (1984-92/94 West)**,
         E 1998 Sample increase,   F 2000 Sample increase,
         G 2002 High-Income,   H 2006 Sample increase,
         I 2009 Innovation sample,   J 2011 Sample increase,
         K 2012 Sample increase,   L1 2010 Birth cohorts (2007-2010),
         L2 2010 Types of families (lowinc),   L3 2011 Types of families (single parent),
         M1 2013 Migration (1995-2010),   **M2 2015 Migration (2009-2015)**

Source: Bohmann and Giesselmann (2018).
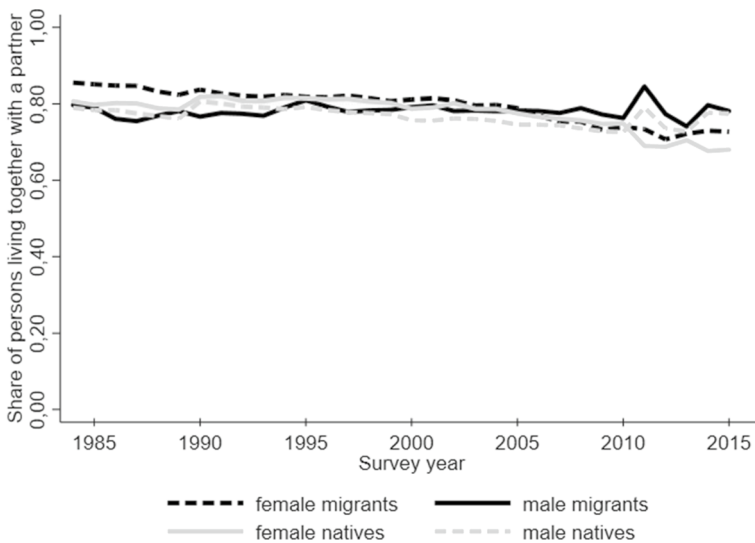
Fig. 2 (continued)

Fig. 3 Share of persons living with a partner (b) by gender and migration background over the observation period. *Source*: GSEOP, 1984–2015
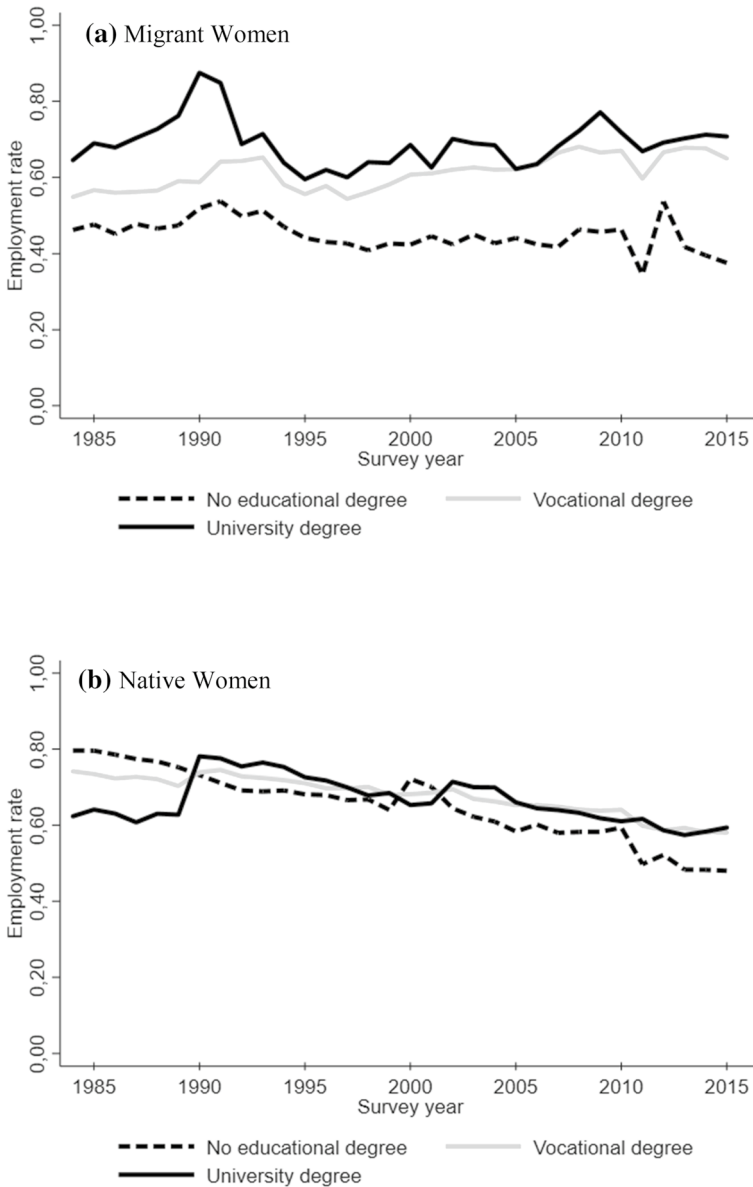
Fig. 4 Participation rates by survey year, gender, migration background and educational degree. *Source*: GSOEP, 1984–2015

$$\beta^{EiVE} = (\bar{x'} * \bar{x} - ((N-k-1) * \hat{\Sigma}))^{-1}(\bar{x'} * y - ((N-k-1) * (\hat{\sigma})) \tag{7}$$

For the sub-elasticity at the extensive margin, the measurement errors of the participation rate are assumed to be uncorrelated with the measurement errors of the explanatory variables. Accordingly, $\hat{\sigma}$ and the last term equal zero. For the total

elasticity and the sub-elasticity at the intensive margin, the wage is the only explanatory variable, and the potential measurement error may be correlated with the measurement error in the hours variable because the analysis calculates the wage per hour by dividing the monthly income by the actual weekly hours worked multiplied by (52/12). In cells with few observations, reported errors will induce a spurious correlation between the wage and hours worked (Devereux 2003). Deaton (1985) suggests using the sample to derive the estimates of the sampling variances and covariances for the correction procedure. The approach uses bootstrapping methods to estimate the covariance between an individual's wage and hours worked ($\hat{\sigma}$). $\hat{\Sigma}$ represents the variances of the x variables within the groups in each year. $\hat{\sigma}$ and $\hat{\Sigma}$ are the weighted averages across groups and years and are divided by the average number of observations per group.

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