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Labor Supply after Transition: Evidence from the Czech Republic*

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Abstract
We extend the scarce evidence on the labor supply in post-transition countries by estimating the wage elasticity of labor force participation in the Czech Republic. Using household income survey data, we find that a one-percent rise in the gross wage increases the probability of working by 0.16 and 0.02 percentage points for women and men, respectively. Taking into account the tax and benefit system, these semi-elasticities fall to 0.06 for women and 0.01 for men. We interpret the difference between the estimates from the two specifications as a summary measure of the welfare system disincentives. The estimated wage elasticities lie at the lower end of the range of values reported for mature market economies. This finding is consistent with the stylized fact that the labor supply in countries with high labor force participation rates, such as the Czech Republic, tends to be less sensitive to wages.

1. Introduction

Labor markets in post-Communist countries resemble those in mature market economies. Returns to human capital, gender discrimination, unemployment duration, matching functions, and wage curves have been estimated for markets in transition[1] and have been found to be comparable to those documented for standard market economies. However, evidence on labor supply behavior during and after transition is scarce[2] and a comparison with standard findings from market economies is lacking.

This paper investigates labor supply behavior in the Czech Republic in 2002 13 years after the change of political regime. Using household income survey data, we estimate the wage elasticity of labor force participation using two different definitions of wage: the gross wage, ignoring the tax and benefit system, and the effective net wage, which takes into account taxes paid and benefits received. A comparison of

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[1] See, for example, Orazem and Vodopivec (1997), Münich, Svejnar, and Terrell (2005b), and Münich, Svejnar, and Terrell (2005a) on returns to human capital; Hunt (2002), Jolliffe (2002), Adamchik and Bedi (2003), Jurajda (2003), Jurajda (2005), and Jurajda and Harmgart (2007) on gender discrimination; Ham, Svejnar, and Terrell (1998) and Ham, Svejnar, and Terrell (1999) on unemployment duration; Münich and Svejnar (2007) on unemployment flows and the Beveridge curve; Galuščák and Münich (2005) on the wage curve; and Galuščák and Münich (2007) on the matching function.

the two specifications illustrates the impact of taxes and benefits on the labor supply decision. We interpret the difference between the two estimates of the wage elasticity of labor force participation as an indicator of welfare system disincentives. We consider this behavior-based measure, which reflects the actual distortionary effect of government policies on labor supply, to be a more accurate tool for policy evaluation than the (ex ante) make-work-pay indicators reported by international organizations.[3]

We find that a one-percent rise in the gross wage increases the probability of working by 0.16 and 0.02 percentage point for women and men, respectively. When we substitute the gross wage with the effective net wage, these semi-elasticities[4] fall to 0.06 for women and 0.01 for men. Under both specifications and for both genders, the wage sensitivity of labor force participation decreases with earnings. The gross wage elasticity in the top wage quintile is lower, by 47 percent for women and by 85 percent for men, than the elasticity in the bottom wage quintile; the corresponding differences for the net effective wage are similar: 83 percent for men and 41 percent for women.

Our estimates of the wage semi-elasticities of labor force participation are at the lower end of the range of values documented for mature market economies. The small size of the estimates is consistent with the recent empirical evidence (see Blau and Kahn, 2007, and Alesina, Ichino and Karabarbounis, 2011) that the labor supply in countries with high labor force participation rates, such as the 81.6 percent for women and 94.8 percent for men in the Czech Republic in 2005, tends to be less sensitive to wages. We therefore expect a limited response of the labor supply to wages also in other post-transition countries, which have retained high labor force participation rates since the Communist period.[5]

The estimated effects of other determinants of labor force participation, such as marital status or presence of children, are also in line with the results documented in the standard literature. While other income (defined as the sum of the non-labor income of the individual and other household income, after tax and excluding social benefits), other economic activity in the household (defined as the presence of economically active members other than the analyzed individual and her spouse), and disability reduce the labor force participation of both genders, being married and having young children has an adverse effect only on women's decision to work.

[2] We found only two papers that estimate the wage elasticity of the labor supply in transition countries – Chase (1995) in the Czech and Slovak Republics and Saget (1999) in Hungary. They focus on the early stage of transition and find rather unexpected values (compared to the estimates for mature market economies in the 1990s). While Saget (1999) documents a rather high (1.81) wage elasticity of labor force participation of Hungarian married women, Chase (1995) estimates an extremely low (zero) elasticity of labor force participation of Czech married women. Blau and Kahn (2007) report that the corresponding values for the US in 1990 lie between 0.41 and 0.44. We discuss the two papers in more detail in the next section.

[3] The average and marginal effective tax rates, net replacement ratios, and welfare traps are the most popular among the make-work-pay indicators. See, for example, OECD (2004).

[4] While wage elasticity is defined as the percentage change in the probability of supplying work in response to a one-percent rise in wages, wage semi-elasticity describes the absolute change (in percentage points) of the probability of supplying work in response to a one-percent rise in wages.

[5] In many Communist countries, labor force participation was obligatory and encouraged both ideologically and by arrangements such as free provision of child care. Although gradual withdrawal from the labor market occurred during the transition from planned to market economies, the labor force participation rates in many European post-Communist countries remain high when compared to mature market economies (see *Table 7*).

The paper is organized as follows. The next section summarizes the stylized facts about labor supply in mature market and transition economies. We then present the theoretical framework for the labor supply decision, our econometric model of labor force participation, and a brief description of our data. Our main results, their interpretation, and policy implications are summarized next, followed by the conclusion.

2. Labor Supply in Mature Market and Transition Economies

The vast empirical research on labor supply in mature market economies[6] has produced many estimates of wage elasticity that span relatively broad intervals. The values typically range from 0 to 0.12 for men and from 0.05 to 2 for women (see, for example, tables 1 and 2 in Blundell and MaCurdy, 1999). Female labor supply – especially of married women and women with children – is almost always found to be more wage sensitive than that of men. While most of these estimates are based on a full labor supply model of supply of hours of work, some studies, such as ours, focus only on labor force participation, a binary decision whether to work. Most papers estimate wage elasticity with gross wages, but there is also extensive literature which takes tax and benefit systems into account.[7,8]

Among the estimates for mature market economies, the most comparable, in terms of method, time period, and focus, with our gross wage specification are in Blau and Kahn (2007). They find that the wage semi-elasticity of labor force participation of married women in the US fell from roughly 0.43 to 0.29 between 1990 and 2000.[9]

In contrast with the substantial labor supply literature in mature market economies, research on labor supply behavior in countries after the transition from planned to market economies is scarce. To our knowledge, there are only two papers which directly estimate the wage elasticity of labor supply in transition countries: Saget (1999) (for Hungary) and Chase (1995) (for the Czech and Slovak Republics).[10] Similar to this work, the two studies focus on labor force participation rather than the supply of hours worked. Their estimates come from the early phases of transition and their scope is limited to the labor supply behavior of married women. Both papers specify labor force participation as a function of the gross wage, ignoring income taxes and social benefits.

[6] Killingsworth (1983) and Blundell and MaCurdy (1999) provide comprehensive surveys of models, methods, and findings.

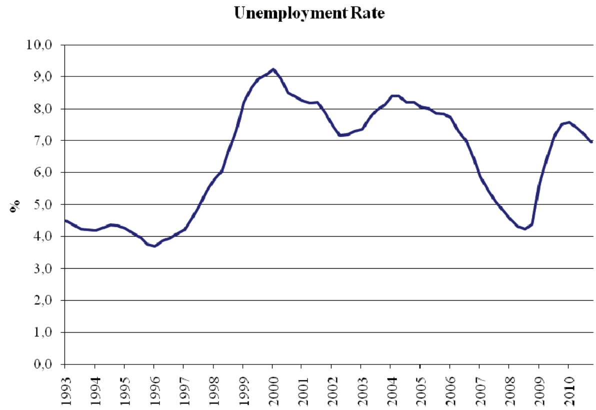
[7] See, for example, the Special Issue on Taxation and Labor Supply in Industrial Countries of the Journal of Human Resources, 25(3), Summer 1990. A comprehensive overview of the literature that estimates the effect of taxes and benefits on labor supply can be also found in Hausman (1985) and Moffitt (2002).

[8] Recent literature estimates the wage sensitivity of labor supply using natural experiments such as changes in labor market policies. Although these methods are almost certainly superior to simple estimation based on cross-sectional variation, neither panel data nor natural experiments isolated from the rest of the changes are available in the Czech Republic or other transition countries.

[9] The wage semi-elasticities reported in Blau and Kahn (2007), table 6, range across the four alternative specifications they estimate between 0.41 and 0.44 in 1990 and between 0.27 and 0.30 in 2000.

[10] Bonin and Euwals (2005) also explore the labor force participation of married women in East and West Germany during the 1990s, after the German reunification, and use earnings as one of its determinants. However, they do not focus on wage elasticity and only mention the significant and positive relationship they find between participation and wages (without presenting the marginal effects or calculating the elasticities).

Figure 1 The Unemployment Rate in the Czech Republic (Percent)



Source: Aggregate unemployment rate of total population aged 15 years and above. Czech Statistical Office, seasonally adjusted.

Saget (1999) estimates a labor force participation model with a relatively small sample of 720 prime-aged (24 to 54 years old) married women using data from 1992. Women on maternity leave and unemployed women are excluded from the sample, which prevents direct comparison with the existing literature, which typically leaves these two groups in the sample. Based on her estimation, Saget finds the wage elasticity of labor force participation of Hungarian married women in 1992 to be 1.81,[11] a value which is much higher than, for example, the roughly 0.75 implied by the estimates of Blau and Kahn (2007) for the US in 1990.[12]

Chase (1995) compares the labor force participation of Czech and Slovak married women (between 20 and 69 years of age) before (in 1984) and after (in 1993) the change of political regime and the division of Czechoslovakia. In the specification that uses only the predicted own and husband's earnings in the labor force participation equation, which is the most comparable to our analysis here, Chase finds that the wage semi-elasticity of labor force participation changed from 0.54 to zero[13] for the Czech and from 0.49 to 0.63 for the Slovak married women between the two years.[14]

[11] The value of 1.81 seems also hard to reconcile with another representation of Saget's findings that "a one forint increase in the predicted wage [of a representative woman who earns 80 Ft per hour, i.e., a 1.25 percent increase in wages] […] is estimated to increase the probability of her working by 3.6 per cent," p. 589 (which at the average participation rate of 75 percent corresponds to an elasticity of 3.8). The marginal effect corresponding to 1.81 elasticity and a 75 percent participation rate on the other hand is 1.36.

[12] Blau and Kahn (2007) estimate that the wage semi-elasticity of participation is roughly 0.43, which, combined with a participation rate of 57.5 percent, implies an elasticity of 0.75 = 0.43/0.575.

[13] The estimated value (which is actually negative, −0.13) is insignificant at the 10 percent level. Similar to Saget (1999), however, standard errors do not seem to be corrected for the presence of predicted variables in the second-stage probit estimation.

[14] The only exception to the wage inelastic labor supply behavior of Czech married women in 1993 that Chase finds when he repeats his estimation for samples stratified by age is the wage elasticity of over 50 year olds, which is positive, significant, and relatively large (0.7).

In 1993, four years after the change of political regime, both the Czech and Slovak Republics were still undergoing reforms and structural changes as a part of the transition process from planned to market economies. At that time, the phenomenon of unemployment had not yet emerged in the Czech Republic as a noticeable labor market problem (the unemployment rate was only 4.3 percent in 1993). Compared to other transition economies, the Czech Republic had one of the lowest unemployment rates during the first phase of its transition. However, in the second half of the 1990s, when the country entered its first recession, which induced further restructuralization, unemployment rose from 4 percent in 1996 to almost 9 percent in 2000, as illustrated in *Figure 1*.[15] We therefore expect the labor supply behavior and the values of the wage elasticity of labor force participation in the Czech Republic in the new steady-state path of the post-transition period to differ substantially from those during the turbulent years of the early phases of transition, as documented in Chase (1995).

3. Model of Labor Supply Decision

The theoretical framework of our analysis is the standard static model of labor supply.[16] An individual maximizes her utility

$$\max_{\{c,h\}} u(c,h)$$

$$\text{subject to} \qquad c = wh + T(wh, y, X) + y, \quad 0 \le h \le H$$

where u is a utility function which depends positively on consumption c and negatively on the number of hours h of work.

The individual consumes the sum of her total earnings $w \times h$, her non-labor income and other household income y (pre-tax and without social transfers), and the transfers she gets minus the taxes she pays, as determined by function $T(\cdot)$. The parametrization of T is given by the tax and benefit system, where the amount of taxes and transfers depends on the level of various types of individual and household income, as well as on the demographic characteristics (X) of the household. Working hours are restricted to range from zero to a maximum amount H, so that H-h is the number of hours of leisure.

The maximization problem can be solved in two stages: first, the choice of the optimal number of hours conditional on working, and second, the optimal decision whether to work. The solution to the first stage is given by the first order condition in which the optimal number of hours of work h^* (subject to $0 < h \le H$) solves the equation

$$(1-\tau^h)w = -\frac{\frac{\partial u(c,h)}{\partial h}}{\frac{\partial u(c,h)}{\partial c}}$$

[15] See, for example, Svejnar (2002) for the development of the Czech labor market in the context of other transition countries.

[16] The notation is based on a modified version of the model in Eissa, Kleven, and Kreiner (2004), extended to capture the household structure and to include the individual's non-labor and other household income. Fixed costs of working are omitted as they are not fundamental to the basic idea of the model. The flexible form of our econometric model, however, allows for the presence of the fixed costs of working.

where $\tau^h = \frac{\partial T(wh, y, X)}{\partial wh}$ is the effective marginal tax rate of working an additional hour, which includes both the direct marginal tax rate and the reduction in benefits due to the increased earnings. The solution to the second stage is determined by comparing the utility of working and that of not working. An individual will work if the former exceeds the latter:

$$u(h^*, c^*) \geq u(0, c_0)$$

Optimal consumption if the individual does not work (c_0) equals the benefits she receives if not working plus her non-labor and other household income:

$$c_0 = T(0, y, X) + y$$

Optimal consumption if working is the individual's total labor, non-labor, and other household income plus net transfers (benefits received minus taxes paid). It may be expressed as

$$c^* = wh^* + T(wh^*, y, X) + y = c_0 + (1-\tau)wh^*$$

where
$$\tau = \frac{T(0, y, X) - T(wh^*, y, X)}{wh^*}$$

is the effective *marginal tax rate of transition from not working to working*.

The optimal number of hours of work h^{**} is therefore given by

$$h^{**} = h^* \qquad \text{if: } u(h^*, c^*) \geq u(0, c_0)$$
$$h^{**} = 0 \qquad \text{otherwise}$$

h^{**}, which is a function of all the parameters of the model, fully describes the individual's labor supply.

As described above, the labor supply decision consists of two parts. The first is the labor force participation decision, or the decision at the extensive margin, which is the decision to supply labor at all. The second is the choice of the number of hours of work (conditional on the decision to work), also referred to as the decision at the intensive margin. A change in the parameters may induce individuals to move along the intensive margin (adjust the number of hours of work supplied) or to cross the extensive margin (stop or start working).

As we estimate a model of the labor force participation decision, we limit our focus to the extensive margin only. We do so for the following reasons. First, in most occupations, people cannot choose the number of hours of work freely, but rather have them specified as part of their contract. People therefore mostly have control over the hours of work supplied only in the long run, when they choose the type of job. Second, different occupations are often characterized by different hours and wage combinations.[17] If individuals choose their hours of work and their pay jointly, when choosing their jobs, a consistent estimation of the labor supply of hours worked requires that two separate equations for hours and wage are estimated simultaneously

[17] For example, consulting jobs typically pay a high per hour wage but require long working hours, while the opposite is true of some jobs in the public sector.

(such as in Moffitt, 1984). Third, previous research suggests that hours of work are typically over-reported and suffer from substantial measurement error.[18]

Fourth, the wage elasticity of labor supply seems to be much higher at the extensive rather than at the intensive margin (see Heckman, 1993), so that the largest impact of any changes in wages is expected to be on entry to or exit from the labor market. We therefore choose the labor force participation decision as our specification of labor supply, as the one that is less affected by the listed estimation problems and also the one that is more relevant from a policy perspective.

4. Econometric Model

4.1 Labor Force Participation Decision

Let LFP_i denote an indicator that equals one if individual i decides to supply her labor on the market and zero otherwise. The theory suggests that LFP_i depends on the effective net wage (the gross wage net of the explicit and implicit taxes implied by the effective marginal tax rate of transition from not working to working), the individual's non-labor income and other household income,[19] household characteristics (X_i) and other factors that reflect individual preferences, and the cost of working, among others:

$$LFP_i = f\left((1-\tau_i)w_i, y_i, X_i, ...\right)$$

In order to estimate the effect of the wage on the labor force participation decision, we approximate the optimal number of hours of work h^{**} by the following equation:

$$h_i^{**} = \alpha\, ln\left((1-\tau_i)w_i\right) + X_i{}'\beta + \varepsilon_i$$

where $(1-\tau_i)w_i$ is the effective net wage, X_i is a vector of all other variables that affect her decision to work, and ε_i is an error term assumed to be independent and normally distributed across individuals, $\varepsilon_i \approx N\left(0, \sigma_\varepsilon^2\right)$.

The probability that individual i supplies her labor is given by

$$\Pr(LFP_i = 1) = \Pr\left(h_i^{**} > 0\right) = \Pr\left(\alpha \ln\left((1-\tau_i)w_i\right) + X_i{}'\beta + \varepsilon_i > 0\right)$$

Given our assumptions about the error term ε_i, the labor force participation decision, as described by LFP_i, can be estimated by a standard probit model:

$$\Pr\left(LFP_i = 1 \,|\, (1-\tau_i)w_i, X\right) = \Phi\left(\alpha \ln\left((1-\tau_i)w_i\right) + X_i{}'\beta\right)$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function. As the model is non-linear, the impact of the right-hand side variables has to be expressed in terms of the marginal effects evaluated at different values of the independent variables.[20]

We follow the standard approach in the literature and define $LFP = 1$ for individuals who are working and for those who do not have a job but are seeking

[18] See Bound, Brown, Duncan, and Rodgers (1989) and Juster and Stafford (1991) for the evidence on misreporting.

[19] If utility is linear in c, the individual's non-labor and other household income (y), which does not depend on working, cancels out.

[20] See, for example, Baltagi (2002), p. 339.

employment, and $LFP = 0$ for those who neither work, nor wish to work (the so--called inactive). This corresponds to the standard definition of the labor force as the sum of the employed and the unemployed.[21] The assumption is that, in contrast to the inactive, the unemployed do not work only due to demand constraints, as no jobs are available.[22]

Although standard, this assumption somewhat limits the relevance of our findings for policy: it is both the supply and demand sides of the labor market that need to be in focus for employment-enhancing policies. There is no guarantee that any policy-induced increase in labor supply will be met by a corresponding increase in labor demand (that additional individuals interested in working will find a job).[23]

Even if we limit our focus to labor supply defined as desired employment, we have to bear in mind that labor force participation may be affected by the demand side conditions not only through the market wage, but also through the shortage of jobs. The discouraged workers desire to work, but (because of an unsuccessful job search) have stopped seeking employment, and therefore are not classified as supplying their work. In our estimation, we proxy the differences between the constraints on the demand side by regional indicators and local unemployment.

The key variable in the model is the individual's wage; the main parameter of interest is α. As the wage enters the equation in logarithm, the marginal effect corresponding to the coefficient α of the wage on the probability of supplying labor is the *wage semi-elasticity of labor force participation*. The wage elasticity can be calculated by dividing the semi-elasticity by the probability of labor force participation or by the labor force participation rate.

We estimate two specifications of this model. In the first, we use gross monthly earnings as the wage variable, and in the second, we replace them with the effective net monthly wage, which takes into account taxes and benefits. We interpret the difference between the results from the two specifications as an indicator of the welfare system disincentives.

The construction of the wage variable is described in detail in the next section. Other right-hand side variables include other income, other economic activity in the household, and binary indicators of marital status, presence of children of different ages, education, and disability.

Previous findings suggest that the effects of the wage as well as the other right-hand side variables on the decision to work are often very distinct for women

[21] The standard ILO definition of unemployment requires two other conditions to be met besides the expressed desire to work: availability to start working and active job search.

[22] The labor supply decision of the unemployed is not straightforward. The job search literature tends to regard the unemployed and the inactive as one group of non-employed, with the inactive characterized by a very high reservation wage. Moreover, in particular in most of Europe, where unemployment benefits and their duration are high and the eligibility criteria for receiving them are not as strict, it is often believed that many of the unemployed (in particular the long-term unemployed) do not in effect supply their work but instead only rely on government support.

[23] In a related paper (Bičáková, Slačálek, and Slavík, 2006), which evaluates the fiscal effects of personal income tax reforms in the Czech Republic in 2006, we estimate the probability of working, where the employed are contrasted with the non-employed, who include both the unemployed and the inactive. The reason for this specification is that we are mostly interested in the probability of employment, i.e., in both the labor supply reaction to the changes in taxes as well as to what extent it is constrained by labor demand.

and men.[24] Following the literature surveyed above, we estimate the model separately by gender.

4.2 Prediction of Gross Wages

The econometric specification presented above uses information on wages, whether actual or potential, for all individuals. However, potential wages for those who do not work are not observed. We use the standard Heckman (1979) model to estimate the wage equation on the sample of workers, taking into account selection to employment. We specify a system of wage and selection equations, allowing for the correlation between the two error terms. The system is estimated jointly by maximum likelihood as a bivariate probit model.[25] Again, the estimation is done separately by gender. The bias-corrected estimated wage equation is used to predict the gross hourly wage for everybody in our sample.

We then transform the predicted gross hourly wage into full-time equivalent gross monthly wages,[26] assuming 40 hours of work per week and 4.3 weeks per month.[27] In the estimation of the labor force participation model, we use the two specifications mentioned above: the first with the predicted full-time equivalent gross monthly wage, and the second with the effective net wage, which is the predicted full-time equivalent gross monthly wage net of any taxes and transfers. We describe the method for the construction of effective net wages in the next section.

Our econometric model requires at least one exclusion restriction for identification of the wage equation and one exclusion restriction for identification of labor force participation.[28] We use standard demographic characteristics such as marital status, children, household composition, and other income (excluding social transfers) as the variables affecting the probability of working, but exclude them from the wage equation, as they are unlikely to have an impact on an individual's current wage. Dummy variables for regions and the degree of urbanization of the residence[29] are assumed to affect the wage levels but not the probability of supplying labor.[30]

[24] In particular, the presence of children typically has a positive (but often insignificant) effect on the labor supply of men, while it has a highly significant and negative effect on the labor supply of women. See, for example, Bičáková et al. (2006).

[25] The specification of the two equations of the Heckman model is available from the authors upon request.

[26] The predicted gross monthly earnings that fell below the Czech statutory minimum wage in 2002 (36 individuals, or 0.5 percent of the predicted wages) were set to the level of the minimum wage of CZK 5,700.

[27] To construct the net monthly earnings of non-workers, we need to assume how many hours they would work. We also need this information to be able to determine into which tax bracket they would fall. Given that part-time employment opportunities in the Czech Republic are still rather limited and most of the employed in the sample work full time (40 hours per week), we simply assume that if non-workers were to start working, they would work full time. (The share of individuals working part time, i.e., less than 35 hours a week, among the individuals with valid weekly hours information is 6.72 percent for women and 1.45 percent for men in our sample.)

[28] The exclusion restrictions require that at least one right-hand side variable is unique to each of the two equations, i.e., is present in one equation and not in the other.

[29] In addition, when we control for the wage in the labor force participation equation, we find that age is no longer significant. We therefore exclude age from the final model and use it as an additional exclusion restriction.

[30] Both sets of exclusion restrictions were tested by the simple procedure of including them one at a time in the equation from which they are excluded and checking their significance with *t* statistics.

Finally, the standard errors (of the coefficients and of the marginal effects) from the model of labor force participation are bootstrapped to account for the fact that we are using a predicted wage variable in the estimation.

4.3 Construction of Effective Net Wages

The effective net wage is then constructed from the gross wage as

$$ENW_i = (1-\tau_i)\times GW_i$$

where GW_i denotes the predicted gross monthly wage of the individual i. τ_i is the individual-specific effective marginal tax rate of the transition from not-working to working, defined as[31]

$$\tau = 1 - \frac{NW + \left(SB_{work} - SB_{nonwork}\right)}{GW}$$

where NW is the predicted gross monthly wage net of any taxes or social contributions such as mandatory health and social insurance, SB_{work} are social benefits if working, and $SB_{nonwork}$ are social benefits if not working. As the social benefits often depend on household composition and typically target entire households rather than individuals, we include the total social transfers at the household level in SB_{work} and $SB_{nonwork}$. The structure of the benefit system implies that an individual's decision to work will affect the social transfers received by the entire household. The model implies that this reduction will be one of the factors considered in the individual's labor supply decision.

4.4 Tax and Benefit System

This subsection briefly describes the Czech system of personal income taxes and social benefits in effect in 2002, the year when the data were collected. The personal tax scheme was stepwise with four tax brackets. Tax rates for the four subsequent income brackets were 15%, 20%, 25%, and 32%. The part of income that falls into the lower bracket(s) was taxed at the corresponding lower tax rate(s); only the part that exceeds the lower bracket(s) was taxed at the higher tax rate(s). Tax rates are applied to a tax base, defined as the sum of various income categories (e.g., wages, rental, and entrepreneurial incomes) minus allowances for non-taxable items and deductibles. The main social benefits consisted of five components: parental allowance, child benefits, housing benefits, social supplements, and social assistance.

The detailed scheme of taxes and social benefits that we use for the construction of the effective marginal tax rate and effective net wages is summarized in *Table 1*.[32]

Taxes were computed using the parameters of the tax system displayed in the top panel of the table. Net labor income was calculated by subtracting taxes and employee contributions to health and social insurance from gross income. For each individual, we construct two alternative values of the total household-level social

[31] Constructing the effective net wage may be problematic in highly de-motivating benefit systems, where the effective marginal tax rate may be greater than one for some individuals. There are 126 such cases in our sample. We retain them in the estimation but topcode the value of τ_i for these observations at 0.99.

[32] *Table 1* is adapted from table 1 of Galuščák and Pavel (2005). For details of the Czech tax and benefit system, see also Jurajda and Zubrický (2005).

Table 1 Summary of the Czech System of Taxes and Social Benefits, 2002

Item	Amount (%/CZK per Month)
Social Security Contributions	%
	12.5
Tax Allowances	CZK per Month
Person	3170
Spouse*	1810
Dependent Child	1960
Income Tax (CZK per Month)	%
0–9100	15
9101–18200	20
18201–27600	25
27601 and more	32
Parental Allowance**	CZK per Month
Child below 4 Years	$1.1 \times MLS_i$
Child Benefits (CZK per Month)	
$I_1 < 1.1 \times MLS_{tot}$	$0.32 \times MLS_{ch}$
$1.1 \times MLS_{tot} < I1 < 1.8 \times MLS_{tot}$	$0.28 \times MLS_{ch}$
$1.8 \times MLS_{tot} < I1 < 3 \times MLS_{tot}$	$0.14 \times MLS_{ch}$
Housing Benefit (CZK per Month)	
$I_2 < MLS_{tot}$	$MLS_{hh} - MLS_{hh}/1.6$
$MLS_{tot} < I2 < 1.6 \times MLS_{tot}$	$MLS_{hh} - (MLS_{hh} \times I2)/(1.6 \times MLS_f)$
Social Supplement (CZK per Month)	
$I_2 < MLS_{tot}$	$MLS_{ch} - MLS_{ch}/1.6$
$MLS_{tot} < I2 < 1.6 \times MLS_{tot}$	$MLS_{ch} - (MLS_{ch} \times I_2)/(1.6 \times MLS_f)$
Social Assistance (CZK per Month)	
$I_3 < MLS_{tot}$	$MLS_{tot} - I_3$
Minimum Living Standard (MLS)	CZK per Month
Adults (MLSi)	2320
Dependent Children (MLS_{ch})	
Below 6 Years	1690
6–10 Years	1890
10–15 Years	2230
15–26 Years	2450
Household (MLS_{hh})	
1 Member	1780
2 Members	2320
3 or 4 Members	2880
5 and More Members	3230

Notes: Adapted from table 1 of Galuščák and Pavel (2005). The mean and median gross wage in our estimation sample are 16001 CZK and 14697 CZK, respectively, for men and 12599 CZK and 11076, respectively, for women. MLS_{tot}: total minimum living standard of the household – the sum of the individual parts of each member (MLS_i/MLS_{ch}) and the household part (MLS_{hh}). *: spouse is inactive or earning less than the basic tax allowance per person; **: the allowance is provided if the individual earns less than MLS_i. Benefits are not subject to taxes. I_1: net earnings of both spouses + unemployment benefits + parental allowance. $I_2 = I_1$ +child benefits. $I_3 = I_2$ +housing benefit + social supplement.

benefits conditional on whether she works. The middle panel shows how the five components of social benefits were calculated depending on the level of net income, the definition of which varies across the benefits, and on the various minimum living standards (which are defined in the bottom panel and determined by the composition of the household).

5. Data

The data come from the Czech Household Income Survey (Mikrocensus) for the year 2002 collected by the Czech Statistical Office. The survey was conducted between February 28 and March 25, 2003 and covers 19,003 individuals in 7,973 households.

For our estimation, we select only the individuals who are 25–54 years old. Students, the self-employed, and fully disabled individuals are excluded. In all these cases, as well as for the very young and the very old, the labor supply decision is more complex than the theoretical and econometric models which are used here can capture. Given these restrictions, the estimation sample consists of 6,767 individuals – 3,094 men and 3,673 women – living in 3,518 households. As the estimation is done separately for women and men, we split and describe our sample by gender.

Table 2 summarizes the basic characteristics of the most relevant variables. The female and male labor force participation rates in our sample are 84 and 98 percent, respectively. The proportion of the unemployed is comparable for the two genders: 4.3 percent for women and 4.4 percent for men.[33]

Other income, defined as the sum of the non-labor income of the individual and other household income (after tax and excluding social benefits), varies substantially and is 543 Czech korunas (CZK) per month for households in which women live and CZK 482 for households in which men live, on average.[34]

The mean age is slightly less than 40 years for both genders. About half of the respondents (56 percent of women and 48 percent of men) have higher education, defined as having completed secondary education. Almost 70 percent of men and women in our sample are married. The children variables are binary indicators of the presence of children of a particular age in the household.[35] The distribution of the presence of children of different ages is fairly similar for women and men. A typical household has about three members. Other economic activity in the household is defined as the presence of economically active members other than the analyzed individual and her spouse.

[33] The aggregate unemployment rate for the whole population older than 25 years was 6.1 percent overall (9.0 percent for women and 4.7 percent for men) in 2002. The rates for the two genders are much more similar in our sample than usually documented by aggregate statistics because of the exclusion of the self-employed, who are more likely to be men, which reduces the measured unemployment rate of men relative to women.

[34] The distribution of other income is highly skewed: 2,038 individuals (30%) have no other income and 75% have less than CZK 135 per month.

[35] Children can be linked to their parents only for household heads and their spouse. As we are using all individuals in the household to increase our sample size, we are limited to the use of the information about the presence of children in the household. This may be adequate information, as child care may be provided by other members of the household and therefore affects their labor supply as well.

Table 2 Estimation Sample Summary Statistics

	Men		Women	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Labor Force Participation	0.98	0.14	0.84	0.37
Unemployed	0.04	0.20	0.04	0.20
Other Income*	482	2,784	543	2,267
Age	39.5	8.9	39.3	8.9
Higher Education	0.48	0.50	0.56	0.50
Married	0.66	0.47	0.69	0.46
Children < 2 Years	0.10	0.30	0.11	0.31
Children 3–5 Years	0.11	0.31	0.11	0.32
Children 6–9 Years	0.15	0.36	0.17	0.38
Children 10–15 Years	0.25	0.43	0.30	0.46
No. Hh Members	3.11	1.22	3.18	1.13
Other Ec Act in Hh	0.31	0.63	0.40	0.64
Partly Disabled	0.02	0.15	0.02	0.15
Sample Size	3,094		3,673	

Notes: * Other income is the sum of the non-labor income of the individual and other household income (after tax and excluding social benefits) in 2002 CZK. Other economically active members in the household ("Other Ec Act in Hh") are all the household members (excluding the head and, if present, the spouse) who currently work.

Women are somewhat more likely to live in households with other economically active members (40 percent of households) than men (30 percent of households). About 2 percent of individuals of both genders are partly disabled.

6. Results

The results from the first stage of our estimation, the Heckman model of the system of wage and selection equations, used for the prediction of gross hourly wages, are in line with our prior expectations and with the evidence from the literature for standard market economies.[36] Wages increase with age and education. The degree of urbanization of the residence also leads to a higher wage, as does living in Prague. On the contrary, disability significantly reduces the wage level. While the results for the wage equation are fairly similar by gender, the selection equation shows more substantial differences between men and women. In particular, the effect of the presence of children is negative and large for women, while it is not significant for men. The effect of being married is negative for women but positive for men. Otherwise, the probability of selection into employment increases for both genders with age and education, and decreases with other income, other economic activity in the household, and for the partly disabled.

The marginal effects from the estimated probit model of labor force participation are presented in *Tables 3* and *4*. Although mean marginal effects would be preferable, the effects presented in these two tables are calculated at the means of the variables.[37] We use this convention here in order to simplify the calculation of

[36] The full sets of estimates from the Heckman model are available from the authors upon request.

[37] The marginal effects of binary right-hand-side variables are computed as a discrete change in the predicted probability, induced by the value of the variable changing from 0 to 1.

Table 3 Marginal Effects – Men

Variable	Gross Wage		Effective Net	
	Marg Eff	(Std Error)	Marg Eff	(Std Error)
Log Wage	0.0219	(0.0207)	0.0085**	(0.0018)
Other Income	−0.0088*	(0.0039)	−0.0076*	(0.0032)
Marriedd	0.0064	(0.0042)	0.0019	(0.0032)
Higher Education[d]	0.0042	(0.0079)	0.0028	(0.0028)
Other Ec Act in Hh	−0.0040*	(0.0018)	−0.0061**	(0.0017)
Children <2 Years[d]	0.0036	(0.0039)	0.0063**	(0.0024)
Children 3–5 Years[d]	−0.0083	(0.0072)	−0.0036	(0.0059)
Children 6–9 Years[d]	−0.0019	(0.0047)	0.0007	(0.0035)
Children 10–15 Years[d]	0.0019	(0.0038)	0.0039	(0.0030)
Partly Disabled[d]	−0.1973†	(0.1129)	−0.1698**	(0.0500)
N	3094		3094	
Log-likelihood	−222.122		−205.291	
$\chi^2_{(10)}$	163.36		197.02	

Notes: Marginal effects evaluated at the means of variables. [d]: A discrete change of the dummy variable from 0 to 1. {†,*,**} = statistical significance at {10, 5, 1} percent. Bootstrapped standard errors, 500 replications.

Table 4 Marginal Effects – Women

Variable	Gross Wage		Effective Net Wage	
	Marg Eff	(Std Error)	Marg Eff	(Std Error)
Log Wage	0.1616**	(0.0539)	0.0550**	(0.0063)
Other Income	−0.0608**	(0.0234)	−0.0418†	(0.0216)
Marriedd	−0.0284*	(0.0111)	−0.0419**	(0.0100)
Higher Education[d]	−0.0256	(0.0225)	−0.0150	(0.0109)
Other Ec Act in Hh	−0.0930**	(0.0074)	−0.1020**	(0.0077)
Children <2 Years[d]	−0.5848**	(0.0300)	−0.5461**	(0.0322)
Children 3–5 Years[d]	−0.3672**	(0.0274)	−0.3538**	(0.0285)
Children 6–9 Years[d]	−0.0564**	(0.0165)	−0.0418**	(0.0146)
Children 10–15 Years[d]	−0.0274*	(0.0128)	−0.0139	(0.0120)
Partly Disabled[d]	−0.4981**	(0.0712)	−0.4738**	(0.0687)
N	3673		3673	
Log-likelihood	−923.349		−864.713	
$\chi^2_{(10)}$	1407.28		1524.56	

Notes: Marginal effects evaluated at the means of variables. [d]: A discrete change of the dummy variable from 0 to 1. {†,*,**} = statistical significance at {10, 5, 1} percent. Bootstrapped standard errors, 500 replications.

the bootstrapped standard errors. For a subset of results, we later show the mean marginal effects, i.e., the means of the marginal effects evaluated for each individual for comparison. The results do not seem to differ substantially with the method employed.

The two tables show the results for men and women respectively and compare the specification with the gross wage and with the effective net wage. Exploring the fit of the model based on two standard measures – pseudo-R^2 and χ^2 statistics of the Wald test of all coefficients (except for the constant) being equal to zero – suggests that for both the male and female sample, the specification with the effective net wage performs better than the one with the gross wage.

The wage semi-elasticity of probability of supplying labor – the key parameter of interest – is given in the first rows of the two tables.[38]

The wage semi-elasticity of labor supply is substantially larger for women than for men (in both specifications). While the gross wage has no significant effect on the male labor force participation decision (even at the 10 percent level), its effect is highly significant for women and implies that a one percent increase in the gross monthly wage increases the probability of supplying labor by 0.16 percentage point for a woman with the average characteristics in the sample. The corresponding elasticities,[39] calculated by dividing these numbers by the predicted probability of labor force participation at the means of the variables, are 0.0221 and 0.1766 for men and women, respectively.[40]

Focusing on the second specification, the semi-elasticities of labor force participation to the effective net wage are about one-third as large as to the gross wage: a one percent rise in the effective net wage increases the probability of supplying labor by about 0.06 percentage point for women and by less than 0.01 percentage point for men, but both effects are significant at the 1 percent level. The corresponding wage elasticities are 0.0086 and 0.0595 for men and women, respectively.

We conjecture that the gross wage elasticities are greater than the effective net wage elasticities mainly because the effective net wage is distributed among individuals more unevenly.[41] This result follows because the marginal effective tax rate that we use to construct the effective net wage takes into account both actual income taxes and social contributions and implicit taxation (the reduction in social transfers associated with wage increases).[42]

[38] The wage semi-elasticity of labor force participation η is defined as

$$\eta = \frac{\partial\, Pr\,(LFP=1)}{\partial W} \times W$$

and is therefore equal to the marginal effect of the wage on the probability of supplying labor, i.e.,

$$MFX = \frac{\partial \Pr(LFP=1)}{\partial \ln(W)} = \alpha \times \Phi\left(\alpha \ln(W) + X\beta\right)$$

where $\varphi(\bullet)$ is the standard normal probability density function. The estimated effect can be interpreted as follows: a one percent rise in wage increases the probability of supplying labor by 0.01 × MFX (or the labor force participation rate from LFP% to [LFP + MFX]%).

[39] Wage elasticity is given by $\varepsilon = \frac{\partial \Pr(LFP=1)}{\partial W} \times \frac{W}{\Pr(LFP=1)}$ and can therefore be calculated as

$$\varepsilon = \frac{\eta}{\Pr(LFP=1)}$$

using the estimated value of η and the predicted value of Pr(LFP = 1) evaluated at the means of the variables.

[40] These elasticities are close to the wage semi-elasticities reported in *Tables 3* and *4* because the predicted participation rates are close to 1 (99.1 and 91.5 percent for men and women, respectively).

[41] Intuitively, the estimated elasticities are proportional to the covariance of employment with the wage and are inversely related to the variance of the wage (think a linear version of our probability model). While the first term happens to be similar for both specifications, the higher variance of the effective net wage leads to a lower value of the estimated elasticity than in the model with the gross wage.

Table 5 Marginal Effects by Wage and Gender – Gross Wages

Wage Quintile	Men Wage (CZK)	MFX	Women Wage (CZK)	MFX
Q1	Below 12,430	0.0787	Below 8,949	0.1891**
Q2	Below 13,204	0.0328	Below 9,732	0.1406**
Q3	Below 15,772	0.0289	Below 12,531	0.1553**
Q4	Below 17,142	0.0141	Below 13,534	0.1428**
Q5	Above 17,142	0.0118	Above 13,534	0.1011**
All		0.0313		0.1431**

Notes: Averages of individual-specific marginal effects in each quintile. {†,*,**} = statistical significance at {10, 5, 1} percent.

Table 6 Marginal Effects by Wage and Gender – Effective Net Wage

Wage Quintile	Men Wage (CZK)	MFX	Women Wage (CZK)	MFX
Q1	Below 12,430	0.0338**	Below 8,949	0.0638**
Q2	Below 13,204	0.0137**	Below 9,732	0.0468**
Q3	Below 15,772	0.0128*	Below 12,531	0.0539**
Q4	Below 17,142	0.0062†	Below 13,534	0.0500**
Q5	Above 17,142	0.0057†	Above 13,534	0.0375**
All		0.0136*		0.0497**

Notes: Averages of individual-specific marginal effects in each quintile. {†,*,**} = statistical significance at {10, 5, 1} percent.

As we have so far evaluated the marginal effects at the means of the variables, they only represent the response of an individual with average characteristics. We next explore in *Tables 5* and *6* how the estimated wage semi-elasticities vary across the different wage levels. The marginal effects in these two tables are computed as the within-quintile and overall averages of the marginal effects evaluated for each individual. Comparing the overall marginal effects in the bottom lines of these two tables with the marginal effects in *Tables 3* and *4* suggests that our main results are reasonably invariant to whether the effects are evaluated at the means or whether mean marginal effects are computed.[43]

In agreement with previous literature, the results show that wage semi-elasticity decreases with wage level. This is true for both specifications and both genders, the only exception being women in the second quintile, who tend to be somewhat less responsive to the wage than those in the third and fourth quintile. The values are, however, very close, and the differences across these quintiles are insignificant.

The cross-quintile differences are substantially more pronounced for men than for women. The semi-elasticity of labor force participation of men with respect to the effective net wage is significant at 1 percent in the first quintile and is almost six

[42] The variance of the effective net wage $ENW = NW + SB_{work} - SB_{nonwork}$ is higher than that of the gross wage primarily due to the social benefits SB_{work} and especially $SB_{nonwork}$, which vary substantially across people. The distribution of simple after-tax wages, however, is (as in most countries) naturally more compressed than that of gross wages, due to the redistributive character of the Czech tax system.

[43] The former, however, allow us to obtain the correct standard errors through simple bootstrapping methods, which is why we choose to present these in the first two tables. The significance in the other two tables is only approximate.

times greater than the wage semi-elasticity in the fifth quintile, which is moreover only weakly significant. A one percent increase in the effective net wage raises the labor force participation of men in the first quintile by 3.38 percentage points, almost three times more than the overall average marginal effect. The effect of the gross wage on the probability of supplying labor is insignificant for each quintile. The wage-elasticity of women is distributed more equally across the quintiles, with the size in the first quintile being less than twice the size in the fifth quintile. While the gross wage semi-elasticity ranges from 0.19 in the first quintile to 0.10 in the fifth, the range for the effective net wage elasticity is between 0.06 and 0.04.

We interpret the difference between the two estimated elasticities as an indicator of the welfare system disincentives. This behavior-based measure suggests that in the presence of taxes and benefits, more substantial changes in the gross wage are required to induce the same increase in labor force participation compared to the case with no welfare system.

Measured as the difference between the marginal effects for the gross and the effective net wage specifications, the welfare system disincentives are greater for women than for men and vary only little with wages. The marginal effect of the effective net wage on labor force participation is lower than the effect of the gross wage by 65 and 57 percent for women and men, respectively. The disincentives vary between 52 and 57 percent for men and between 63 and 67 percent for women across the five wage quintiles and tend to be a bit lower for the rich.

Based on the comparison of the results from the two specifications, we conclude that the Czech welfare system in 2002 reduces the labor supply response of men and women to the market wage by 39 percent and 34 percent, respectively.

The estimated effects of other determinants of labor force participation are also in line with the results documented in the standard literature, which suggests that labor supply behavior in the post-transition Czech Republic is comparable to that in mature market economies.

Both other income and other economic activity in the household capture other sources of non-social income, alternative to the income from the individual's labor supply. Their coefficients therefore measure the income effect on labor supply and are both negative and significant in line with economic theory.

Once we control for the wage levels, education has no effect on labor force participation for both specifications and for both genders. This result is not surprising, as wages are highly correlated with education.[44] Partial disability substantially decreases the probability of supplying labor, with the size of the effect for women (decreasing the participation probability by almost 0.5) being more than twice that for men.

Children have no effect on whether men supply labor, but they substantially reduce the labor force participation probability of women. The size of the effect sharply declines with children's age.[45] Similar to the effect of the presence of children, marital status has no effect on men, but reduces the labor force participation of women.

[44] The same holds for age and age squared, which we decided to leave out of the final model of labor force participation as an additional exclusion restriction.

[45] The fact that the presence of children below 2 years of age increases male labor force participation for the effective net wage specification most likely captures the need for other sources of income when women stay at home with their very young children.

Table 7 Pre-and Post-Transition Participation Rates (Percent)

Country	Men		Women	
	1988	2005	1988	2005
Czech Republic	97.0	94.8	93.1	81.6
Slovakia	96.9	93.2	88.8	82.5
Russia	96.2	92.5	91.7	86.3
EU 15*	94.0	92.6	61.7	75.4
United States	93.6	90.7	72.7	76.7

Notes: Participation rates (ratios of economically active to total population) for individuals between 25 and 54 years of age.

Sources: Economically Active Population Estimates and Projections, International Labour Organization, http://laborsta.ilo.org/. * OECD Labor Force Statistics from OECDStatsExtracts.

The sign and significance of the marginal effects of variables other than the wage seem to be fairly similar across the two specifications for both women and men.

Finally, in order to make our estimates directly comparable to the values estimated in the two previous studies of the labor force participation of married women in Hungary and in the Czech and Slovak Republics (Saget, 1999, and Chase, 1995, respectively), we restrict our sample to married women and repeat our analysis. Although the estimated wage elasticity slightly increases, in line with the documented evidence that the labor supply of married women is typically more wage sensitive than that of single women, the results do not substantially change. While the gross wage semi-elasticity increases from 0.1616 to 0.1758, the effective net wage semi-elasticity changes from 0.0550 to 0.0566.[46]

7. International Context and Policy Implications

In many Communist countries – including Czechoslovakia, East Germany, and the Soviet Union – labor force participation was obligatory.[47] Although a gradual withdrawal from the labor market occurred during the transition from planned to market economies,[48] the labor force participation rates in many European post-Communist countries, in particular among women, remain high when compared to the mature market economies of the EU15 or the US (see *Table 7*).[49]

The low estimates of the wage elasticity of the labor supply in the Czech Republic are consistent with the evidence documented for mature market economies that labor force participation and the wage sensitivity of labor supply are inversely related (see Blau and Kahn, 2007, and Alesina, Ichino and Karabarbounis, 2011). We therefore expect a weak response of labor supply to wages also in other post-transi-

[46] The full estimation results for the subsample of married women are available from the authors upon request.

[47] Interestingly, this was not the case in other Communist countries, such as Poland and Hungary. However, the female labor force participation rates in these countries were still fairly high according to the ILO statistics (around 80 percent), compared to Western Europe.

[48] There are a few studies, such as Bonin and Euwals (2005), that try to disentangle whether this was due to a change in supply (some people stopped working once the choice became available) or demand (obsolete human capital left many people jobless, some of whom left the labor force).

[49] Bonin and Euwals (2005) reports that the female participation rates in East Germany were over 80 percent before the change of regime in 1989.

tion countries, which have retained high labor force participation rates since the Communist period.

Our findings suggest that changes in taxes or benefits resulting in changes of the effective net wage will have the greatest impact on individuals at the bottom of the wage distribution and also on women (rather than on men).[50]

Policy measures aimed at enhancing labor supply should therefore primarily target these groups and focus on income taxes in the lowest tax brackets and on the potential disincentives of out-of-work benefits and benefits for low-income families.

8. Conclusion

We provide one of the first estimates of labor supply using post-transition Czech data. We construct a measure of the effective net wage, which takes into account the tax and benefit system, and estimate the wage elasticity of labor force participation in the Czech Republic using the gross and the effective net wage.

While our analysis is subject to many limitations, a number of conclusions emerge clearly and robustly. We find that a one percent rise in the effective net wage increases the male labor force participation rate by 0.01 percentage point and the female labor force participation rate by 0.06 percentage point. The effective net wage semi-elasticity of the probability of labor supply decreases with wage, in particular for men. The wage elasticities of labor force participation of men and women in the bottom 20 percent of the wage distribution are 0.034 and 0.064 percentage points, respectively. Tax and benefit policies aimed at enhancing labor force participation should thus primarily target low wage individuals and also women rather than men.

When we replace the effective net wage with the gross wage, the corresponding semi-elasticities are 0.16 for women and 0.02 (but insignificant) for men. We interpret the difference between the two estimated elasticities as a behavior-based measure that is an indicator of the welfare system disincentives and conclude that the Czech tax and benefit system in 2002 reduced the labor supply response of women to the market wage by 65 percent and that of men by 57 percent.

While our qualitative results are in line with previous research, suggesting that labor supply behavior in the post-transition Czech Republic is comparable to that in mature market economies, the estimated effects are relatively small. This result is consistent with the recent empirical evidence that the labor supply in countries with high labor force participation rates, such as the Czech Republic, tends to be less sensitive to wages. We therefore expect a limited response of the labor supply to wages also in other post-transition countries, which have retained high labor force participation rates since the Communist period.

[50] For example, Alesina, Ichino and Karabarbounis (2011) argue for gender-specific taxation: because the labor supply of women is more responsive to wages, the optimal income tax rates (other things being equal), which minimize the dead-weight loss, are lower for women than for men.

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