

Did the Minimum Wage Increase in 2001 Reduce Tax Evasion In Hungary?

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First draft: May, 2006. This version: July, 2006

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Abstract

This study investigates whether the increase in the Hungarian minimum wage in 2001 reduced underreporting of earnings by employed labour. The predictions of the theory developed in Tonin (2006) are tested using Household Budget Survey data. A difference-in-difference approach is used to show that those earning between the old and the new minimum wage experienced a decline in their food consumption compared to a control group.

JEL codes: H26, H31, J38

Keywords: Minimum Wage, Tax Evasion

1 Introduction

The purpose of this paper is to test the theory developed in Tonin (2006), i.e. whether the minimum wage is an instrument to increase compliance with fiscal regulation by employed labour in an economy where there is underreporting of earnings. The massive increase in the minimum wage that took place in Hungary in 2001 is an ideal event to test such a prediction. The method used is to compare income and consumption for the same households before and after the increase in the minimum wage.

The analysis suggests that indeed households with employees affected by the minimum wage hike experienced a drop in consumption compared to similar but unaffected households.

The following section provides a sketch of the theory and the specific proposition that is going to be tested. Section 3 reviews the previous empirical literature on underreporting by employed labour. Thereafter, the Hungarian context is analyzed, looking at the minimum wage, the fiscal environment and the relevance of the informal economy. Section 5 outlines the model. A description of the data and of the main variable follows. Next, results are presented. The last section concludes.

2 An outline of the theory¹

A worker with productivity y_i is employed by a firm that pays a gross wage² w_i . The net take home pay for the worker is given by:

$$I_i = w_i(1 - t)$$

where t is the tax wedge, including social security contributions, personal income tax and any other payroll tax. The firm profit is given by:

$$\pi_i = y_i - w_i$$

Firms maximize profits, while workers maximize net take home pay. Free entry of firms is assumed. In an economy without tax evasion the gross wage of a worker would equal productivity, $w_i = y_i$, thus $I_i = w_i(1 - t)$ and $\pi_i = 0$.

In this economy, however, firms can decide to report to fiscal authorities an amount x_i that may differ from y_i . In particular, if $x_i = 0$ then firms are completely underground, while $x_i \in (0, y_i)$ implies underreporting of earnings. Firms are subject to an audit with probability

¹In this section the main assumptions of the theory developed in Tonin (2006) are presented and the theoretical prediction that is going to be tested in this paper derived. Details and further results can be found in Tonin (2006.)

²Labour cost is assumed to be equivalent to gross wage.

γ . Detection technology is assumed to be imperfect, so that the tax authority may discover none or part of true evasion in case of auditing. The parameter $\theta > 1$ captures the fine that has to be paid in case of detection.

In Tonin (2006) it is shown that, given a simple detection technology and provided that enforcement is effective enough so that there is no complete evasion, every firm report a fraction of its true product, i.e. $x_i = (1 - \alpha)y_i$ where $\alpha \equiv \frac{1}{\gamma\theta}$.

The introduction of a minimum wage $\bar{w}$ in this economy constrains the behavior of firms, that need to report at least $\bar{w}$ if they want to be not completely underground, i.e. $x_i \in \{0\} \cup [\bar{w}, y_i]$. The introduction of the minimum wage divides the workforce into three categories:

1. Workers operating completely underground, i.e. $x_i = 0$, whose income is: $I = y_i(1 - \frac{1}{2\alpha}t)$
2. Workers whose official earnings are exactly equal to the minimum wage, i.e. $x_i = \bar{w}$, whose true income is: $I = y_i - \bar{w}t - \frac{1}{2\alpha y_i}t(y_i - \bar{w})^2$
3. Workers officially earning more than the minimum wage, i.e. $x_i > \bar{w}$, whose true income is: $I = y_i(1 - t) + \frac{1}{2}\alpha y_i t$

The distribution of the workforce across these three categories is investigated in Tonin (2006). Here we are interested in the effect of an increase in the minimum wage on the income of different types of workers. In period $t = 1$ the minimum wage is $\bar{w}_1$, increasing to $\bar{w}_2 > \bar{w}_1$ in period $t = 2$. Below we characterize the change in income due to the minimum wage hike, $\Delta I = I_2 - I_1$, where I_2 is income at time $t = 2$ and I_1 is income at time $t = 1$.

1. Workers operating completely underground in period 1, i.e. $x_{i,1} = 0$, continue to operate underground after the minimum wage hike, i.e. $x_{i,2} = 0$. Thus their income is unchanged, $\Delta I = 0$.
2. Workers whose official earnings are exactly equal to the minimum wage in period 1, i.e. $x_{i,1} = \bar{w}_1$, may either experience an increase in officially declared earnings to $x_{i,2} = \bar{w}_2$ or a decrease to $x_{i,2} = 0$. The income change in the two cases is given by:

$$(a) \ x_{i,2} = \bar{w}_2: \Delta I = -\frac{1}{2\alpha y}t(\bar{w}_2 - \bar{w}_1)[\bar{w}_2 + \bar{w}_1 - 2y(1 - \alpha)] < 0$$

3.

³This is due to the fact that workers in this situation have productivity y_i s.t. $(1 - \alpha)y_i \leq \bar{w}_1 < \bar{w}_2$, see Tonin (2006) for details

$$(b) \ x_{i,2} = 0: \Delta I = \frac{t}{2\alpha y} \bar{w}_1 [\bar{w}_1 - 2y(1 - \alpha)] < 0 \quad ^4.$$

In both cases workers of this type experience a decline in income.

3. Workers whose official earnings in period 1 are above the new minimum wage, i.e. $x_{i,1} > \bar{w}_2$, experience no change in the officially declared income, $x_{i,1} = x_{i,2} > \bar{w}_2$, and true income, $\Delta I = 0$. Workers with official earnings in period 1 between the old and new minimum wage, $\bar{w}_1 < x_{i,1} < \bar{w}_2$, may either experience an increase in officially declared earnings to $x_{i,2} = \bar{w}_2$ or a decrease to $x_{i,2} = 0$. The income change in the two cases is given by:

$$(a) \ x_{i,2} = \bar{w}_2: \Delta I = -\frac{t}{2y\alpha} [y(1 - \alpha) - \bar{w}_2]^2 = -\frac{t}{2y\alpha} [x_{i,1} - \bar{w}_2]^2 < 0$$

$$(b) \ x_{i,2} = 0: \Delta I = -\frac{yt}{2\alpha} (1 - \alpha)^2 < 0$$

Notice that for those declaring $\bar{w}_2$ at time 2 the decline in income ΔI increases as the distance between the declared income at time 1 and $\bar{w}_2$ increases. In case 3.a this distance equals $d = \bar{w}_2 - x_{i,1}$, thus $\Delta I = -\frac{t}{2y\alpha} d^2 \Rightarrow \frac{\partial \Delta I}{\partial d} = -\frac{t}{2y\alpha} 2d < 0$. Thus, a worker who was declaring at time 1 marginally above the minimum wage $\bar{w}_1$ and increases its declaration to $\bar{w}_2$ experience a larger income decline than a worker also declaring $\bar{w}_2$ at time 2 but whose declared income at time 1 was higher. The income decline is even larger for workers who were declaring the minimum wage at time 1.

The model thus predicts the following:

Proposition 1 *Workers whose official earnings in period 1 are between the old and the new minimum wage, i.e. $\bar{w}_1 \leq x_{i,1} < \bar{w}_2$, experience a decline in income, $\Delta I < 0$, as a result of the increase in minimum wage from $\bar{w}_1$ to $\bar{w}_2 > \bar{w}_1$. Other workers are unaffected.*

Proposition 2 *The decline in income increases with the distance between $\bar{w}_2$ and the declared income at time 1 for those workers who declared between the old and the new minimum wage at time 1 and increased their declared income at time 2 to $\bar{w}_2$.*

⁴This is due to the fact that workers in this situation have productivity y_i s.t. $\begin{cases} y_i > \bar{w}_1 & \text{if } \alpha \leq \frac{1}{2} \\ y_i > \frac{\bar{w}_1}{2(1-\alpha)} & \text{if } \alpha > \frac{1}{2} \end{cases}$, see Tonin (2006) for details.

3 Previous work on underreporting

There are different methods to estimate the size of the informal economy. The use of income and consumption data has been pioneered by Pissarides and Weber (1989.) They study underreporting by self-employed in UK in the year 1982 by assuming that expenditure on food is reported correctly by all income groups, while income is correctly reported by employees, but underreported by self-employed. Food expenditures equations are estimated and then inverted. They distinguish between reported income, that is observed, true income and permanent income, that is what is relevant for consumption decisions. Lyssiottou et al. (2004) use a demand system approach to take into account preference heterogeneity. They also focus on tax evasion by self-employed.

Underreporting by employees is instead investigated by Bernotaite and Piskunova (2005), who use the methodology developed by Pissarides and Weber to study underreporting by private sector employees in Latvia in 2003. They use as control group, assumed to correctly report income, public sector employees. Their finding is that private sector employees true income is 20%-90% higher than their reported income, depending on specification. The same is done by Besim and Jenkins (2005) for North Cyprus.

Some evidence related to the issue of underreporting and minimum wage comes from Banyté and Mauricas (2005.) They conducted a survey of Lithuanian hotels and restaurants in 2004 about the impact of the minimum wage increase that took place in that year (from 450 LTL to 500 LTL, 11.30% real increase) and the planned further increase in 2005 to 600 LTL. For the companies that participated in the survey the minimum wage is very binding, as 75% of them employed at least 50% of their employees at the minimum wage, while many employed the whole workforce at the minimum wage. The vast majority of respondents did not report any change in the number of employees, number of working hours or number of qualified employees employed as a result of the minimum wage increase in 2004. Also wages of employees earning more than the minimum, investment and prices basically remained unchanged. Interestingly, the majority of managers interviewed strongly agreed with the planned further increase in the minimum wage as far as this would not increase the tax burden. A way to interpret such a response is that compensation effectively paid to employees is already above the minimum wage and a minimum wage hike not boosting fiscal payments would thus not constitute a labour cost increase.

4 The Hungarian context

Taxation on labour is quite heavy in Hungary and the degree of informality is relatively high, with evidence of underreporting of earnings taking place. The minimum wage was increased significantly in 2001 and 2002, with the effect of considerably increasing absolute payments to fiscal authorities due by a minimum wage worker.

This section provides details about the minimum wage, taxation on employed labour and the informal economy in Hungary.

4.1 The minimum wage

In Hungary the mandatory minimum wage is fixed by the government, with the agreement of social partners. However, the government retains the power to determine unilaterally the minimum wage in case no agreement is reached. The centre-right government in power between 1998-2002 indeed set the minimum wage one-sidedly. The statutory minimum wage covers all employment contracts. The weakness of bargaining at company and, especially, sectoral level makes the role of the national minimum wage very relevant (Koltay, 2002).

The minimum wage relates to gross monthly earnings net of overtime pay, shift pay and bonuses for full-time employment. For part-timers it is proportionally lower, but part-timers account for only a small portion of all employees⁵; only 3.6% in 2001-2 according to Eurostat data, one of the lowest rate in the European Union⁶.

Hungary experienced a massive increase in the minimum wage. The statutory minimum increased from 25,500 HUF in 2000 (98 EUR or 90 USD using the average exchange rate for the corresponding year) to 40,000 HUF in 2001 (156 EUR, 140 USD), followed by a further increase in 2002 to 50,000 HUF (206 EUR, 194 USD.) The relevance of these increases clearly appears in figure 1.

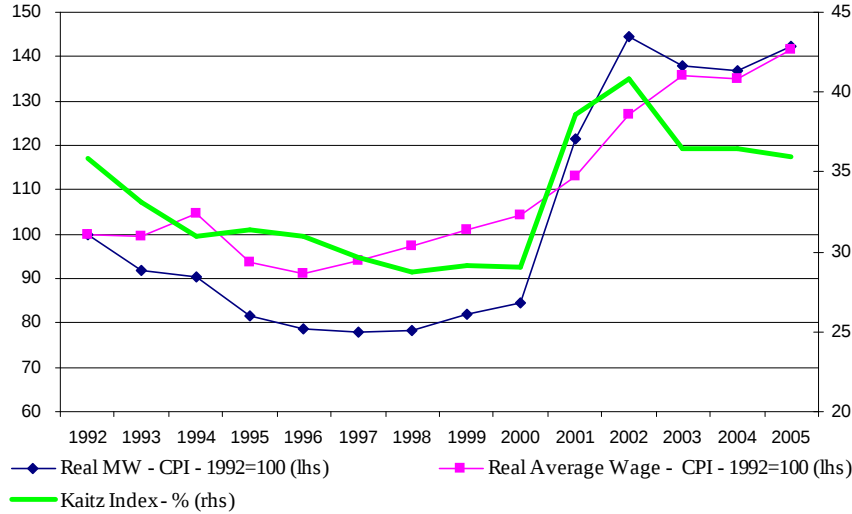
The share of full-time employees paid 95%-105% of minimum wage in firms employing more than 5 workers jumped from 5% in 2000 to 12.1% in 2001 and 17.3% in 2002 (Kertesi and Köllő, 2003.)

In their study on the labour market impact of the 2001 minimum wage rise Kertesi and Köllő (2003) find a high level of compliance with minimum wage regulation, with only minor spillovers on the wage dis-

⁵The low relevance of part-time employment is attributed, on the supply side, to low earnings and, on the demand side, to the relatively higher labour cost compared to full-time employment, mainly as a result of a flat-rate health care contribution (Frey, 2005)

⁶According to LFS, only 2.6% of earners regularly worked less than 30 hours a week in 2002, while payroll data indicate that only 2.4% of respondent companies' total employees worked part-time in September 2002 (EO-NEF, 2003.)

Figure 1: Wage Dynamics in Hungary 1992-2005



tribution. They compare the jobloss risk of workers earning between 90-110% of the minimum wage in 2001, the treatment group, to that of workers earning between 110-125%, the control group, and find a small but significant effect on the quarterly outflow into unemployment⁷. They find no effect on the flow from employment to non-participation.

They also find a 7-8% drop in the job finding probability of low-wage unemployed, defined as those receiving lower than average unemployment benefits, relative to unskilled as a whole, defined as those with less than secondary education.

The conclusion of the study is that “despite the brutal price shock the immediate effect did not seem dramatic”.

4.2 The fiscal environment

Taxation on labour is relatively high in Hungary, also for low paid workers. In the period 2000-2002 the tax wedge on a single person without children earning 2/3 of the average production wage was at around 46%, one of the highest in Europe, with marginal rates above 55% (OECD, 2001 and 2002, see figure 4.2.)

Following parliamentary elections in April, 2002, the new Socialist-

⁷For a 25 years old male with five years of tenure, for instance, the estimated quarterly flow is 0.243% for the treated and at 0.119% for the control group. At average age and tenure of the control group (40, 7.33) the figures are 0.0168% for the treated and 0.0068% for the control. The average age and tenure of the treatment group is not very different at 39.2 and 6.67 respectively.

Tax rate on low wage earners: Tax wedge on labour cost

%	1996	1997	1998	1999	2000	2001	2002	2003	2004
Average rate in %									
Hungary	46.8	47.8	47.4	48.2	46.2	45.8	46	41	41.5
EU - 25	39.7	40.1	39.4	38.6	38.1	37.2	37.1	37.4	36.4
EU - 15	39.7	40	39.3	38.5	37.9	37	36.9	37.2	36.3
United States	29.2	29.2	29.1	29.2	29	27.4	27.3	27.1	27.3
Marginal rate in %									
Hungary	..	59.8	58.6	56.3	56.3	55.6	55.4	55.3	54.7
United States	..	34.9	34.9	34.9	34.6	34.5	34.3	34.1	34.1

Single persons without children earning 67% of the APW.

Source: EUROSTAT; OECD

led government introduced a major package of income policy measures due to take force on September, 1 2002. The main points were the elimination of personal income tax for minimum wage workers and a substantial increase in public service employee's pay.

The abolition of personal income tax on earnings up to the minimum wage took place by an increase in the tax allowance to which low-income employees are entitled. Public service employees' pay increased by an average of 50%, but the benefits were mainly concentrated on the higher part of the wage distribution, as the measure was intended to reestablish wage differentials across different qualifications after the compression due to the minimum wage increases (Neumann et al., 2002.)

Workers earnings the minimum wage increased their monthly payments to fiscal authorities (PIT and SSC) by almost 11,000 HUF due to the minimum wage hike in 2001. The hike in 2002 further increased payment by more than 5,000 HUF per month between January and September, while, after the reduction in PIT, monthly payment were lowered by 750 HUF compared to 2001 (see Appendix for details.)

4.3 The informal economy in Hungary

As in other transition countries, the informal economy is generally considered sizeable in Hungary. Estimates produced by Schneider (2002, 2004) using the so-called "model approach" usually put the size of the informal economy at around one quarter of official GDP for the years around 2000.

A study for the European Commission (Renooy, 2004) focused on undeclared work put the size of undeclared work at 18% of GDP in 1998. The figure is obtained through a combination of business surveys and

expert interviews. Undeclared work is concentrated mainly in small, domestically owned enterprises in agriculture, construction industry, retail trade, tourism and real estate services, with strong regional variation. The importance of “underreporting of income” is underlined.

More directly linked to the topic of this paper, in a survey ECONSTAT (1999) found that 56% of households are aware that in their neighbourhood employers are declaring to the tax authority the minimum wage, while paying additional wage unofficially.

5 The model

Reported income, $Y'_{i,t}$, is observed for household i at time t . Reported income is related to true income, $Y_{i,t}$, by the following relationship:

$$Y'_{i,t} = k_{i,t} Y_{i,t} \quad (1)$$

where $0 \leq k_{i,t} \leq 1$.

True income is related to permanent income, $Y^P_{i,t}$, by the following relationship:

$$Y_{i,t} = p_{i,t} Y^P_{i,t} \quad (2)$$

where $p_{i,t} \geq 0$.

Thus, by combining (1) and (2), we can write permanent income as:

$$\ln Y^P_{i,t} = \ln Y'_{i,t} - \ln p_{i,t} - \ln k_{i,t} \quad (3)$$

The relationship between food consumption and income is assumed to be:

$$\ln c_{i,t} = Z_{i,t} \alpha + \beta \ln Y^P_{i,t} + \varepsilon_{i,t} \quad (4)$$

where $Z_{i,t}$ is a vector of household's characteristics.

Substituting (3) into (4), we have:

$$\ln c_{i,t} = Z_{i,t} \alpha + \beta \ln Y'_{i,t} - \beta \ln p_{i,t} - \beta \ln k_{i,t} + \varepsilon_{i,t}$$

taking first differences:

$$\Delta \ln c_{i,t} = \Delta Z_{i,t} \alpha + \beta \Delta \ln Y'_{i,t} - \beta \Delta \ln p_{i,t} - \beta \Delta \ln k_{i,t} + \Delta \varepsilon_{i,t}$$

As seen in section 2, the theory suggests that as a consequence of an increase in the minimum wage those workers with official earnings before the increase between the old minimum and the new minimum experience a decrease in their true income, while the rest of the workforce is unaffected. For these workers we should expect that, as a consequence of the 2001 minimum wage increase in Hungary:

$$\beta \Delta \ln Y'_{i,t} - \beta \Delta \ln k_{i,t} \begin{cases} < 0 \text{ for the "treatment group"} \\ = 0 \text{ for the "control group"} \end{cases}$$

In particular, for workers whose official earnings increase to the new minimum after the hike there is an increase in compliance with fiscal regulation. For these workers we should expect that, as a consequence of the 2001 minimum wage increase in Hungary:

$$-\beta \Delta \ln k_{i,t} \begin{cases} < 0 \text{ for the "treatment group"} \\ = 0 \text{ for the "control group"} \end{cases}$$

In the sections below these predictions are tested.

6 Data and sample

The data for this study come from the Hungarian Household Budget Survey Rotation Panel⁸. The sample consists of around 10000 households. A household consists of persons forming a common income and/or consumption unit, sharing completely or partly the current costs of living

The selection of the sample is done by multistrata method using census data. In a given month during the year households keep a diary registering income and expenditures during the month and “general household characteristics” containing demographic, employment and housing data.

In subsequent interviews data on personal incomes, family income, stock of consumer durables, expenditures of significant value, are retrospectively collected for the year as a whole. One-third of the sample is rotated in each year. The two-years panels of most interest for this study contain slightly more than 3500 households (3581 for 1999-2000, 3529 for 2000-2001.) Three-years panels are also available, containing 1732 households for 1999-2001 and 1903 for 2000-02.

6.1 The main variables

In this section a brief explanation of the main variables and categories used is provided. The definition of treatment and control groups is done in the sections where the corresponding results are reported.

- "Households with constant family structure" are households where the same individuals are present for the relevant period. Restricting the analysis to this type of household reduces the sample in the

⁸The Hungarian Household Budget Survey Rotation Panel is created by the Institute of Economics, Hungarian Academy of Sciences from the original HHBS of the Hungarian Central Statistical Office. The data set is work in progress. Although the IE made effort to clean the data, it can not be held liable for any remaining error.

panel 1999-2000 from 3581 to 3181, with a loss of 400 households, for the panel 2000-2001 the loss is of 329 households, from 3529 to 3200.

- Month dummies capture the month of diary keeping. So, for instance in panel 2000-2001 there is a dummy for households that kept the diary in January 2000 and in January 2001 and a different dummy for households that kept the diary in January 2000 and in February 2001. So, potentially there are 144 month dummies. In the panels 1999-2000 and 2000-2001 around 70% of households kept the diary in the same month in both years.
- "Employees" are defined as employees for public or private enterprises, institutions, co-operatives, for private entrepreneurs or for societies (firms owned by several private entrepreneurs) with positive earnings from main activity during the year and positive months in which earnings from main activity have been realized. "Public employees" are defined as employees for public or private enterprises, institutions active in public administration and defence, compulsory social security, education, or health and social work. "Private employees" are all employees who are not public employees. The dataset contains the number of months in which earnings from the main activity have been realized during the year. If in a given year the number of months corresponds to twelve, the employee is considered to have been employed for the whole year. In some cases the analysis is restricted to this type of employees only.
- Employee characteristics dummies include three sets of "dummies", describing the labour market characteristics of employees in the households.
 1. Sectoral: the number of employees in the household working in each of the 60 branches according to two-digit ISIC (e.g. manufacture of textiles);
 2. Position: the number of employees in the household belonging to each of the 10 categories characterising the hierarchical position⁹ (e.g. skilled worker);

⁹top leader; leader; manager; employee with diploma; employee with secondary qualification; administrative employee; skilled worker; semi-skilled worker; unskilled worker; self-employed; family helper;

3. Type of employer: the number of employees in the household working for different types of employers¹⁰ (e.g. private entrepreneurs);
- Geographical dummies include a set of dummies for the 20 counties in which Hungary is divided and a set of dummies capturing whether the household place of residence is the capital, a large city, a town or a village. Note that by construction the survey includes in subsequent years only households whose place of residence did not change.
 - Income variables include household level income¹¹, the sum of net personal incomes of households' members¹², plus other components¹³. A distinction is made between three types of income. The narrowest definition does not include own production. The broadest definition also include loans and credit and cash from savings.
 - Food consumption is aggregated from very detailed consumption items. A distinction is made between food that is bought in the market and food produced at home.

7 Specification and results

The following equation is estimated:

$$y_{i,t} = \alpha_i + \gamma_T * Year + \gamma_M * Month + \beta * Year * TREAT_i + \gamma_W * W_{i,t} + \gamma_X * Year * X_i + \varepsilon_{i,t}$$

where $y_{i,t}$ is food consumption excluding own production for household i at time t . *Year* is a year dummy and *Month* is a set of month

¹⁰In 1999 the following three categories are listed: 1. public or private enterprises, institutions; 2. cooperatives, firm owned by several private entrepreneurs; 3. private entrepreneurs;

In 2000 and 2001 the following four categories are listed: 1. public or private enterprises, institutions; 2. cooperatives; 3. private entrepreneurs; 4. firm owned by several private entrepreneurs;

¹¹e.g. family allowance, income from dividends, income from agricultural sales.

¹²e.g. income from main activity, self-employment, authorship. Paid social security contributions and personal income tax are subtracted from the gross personal income to obtain net personal income.

¹³e.g. income from sales of belonging. Also, outgoing household transfers, like maintenance for child outside the household, are subtracted.

dummies as defined in (6.1). $W_{i,t}$ are time-varying controls, like household income or food from own production. X_i are time-invariant controls, like geographical dummies. The coefficient of interest is β , where the exact definition of $TREAT_i$ is provided in the following sections.

7.1 Comparing 1999-2000 with 2000-2001

In this section we test the prediction of the model expressed in Proposition 1. The analysis is done on the two two-years panels covering the years 1999-2000 and 2000-2001 respectively.

The definition of treatment and control groups is as follows. First, for each two-years panel, all employees who have been employed for the whole 24 months are identified and classified according to their wage in year 2000 and whether or not they are in the public sector. Private sector employees earning in year 2000 a wage between the minimum wage in year 2000 (25500 HUF) and the minimum wage in year 2001 (40000 HUF) are considered to be treated. As income and consumption are at household level, the variable $TREAT_i$ contains the total number of members of household i classified as treated. The regression is run on all households with at least one member employed in 2000 for a wage between the minimum wage in 2000 and 200% (150%) of the minimum wage in 2001. Therefore, the control group is households in which no member is considered treated, but with at least a member who is a private sector employee earning in 2000 between the minimum wage in 2001 and 200% (150%) of that or a public sector employee with a 2000 wage between the minimum wage in 2000 and 200% (150%) of the minimum wage in 2001.

Equation (7) is estimated for both samples. For each panel the analysis is restricted to households that kept a constant family structure during the two-year period. From Proposition 1 we should expect $\beta < 0$ in the sample 2000-2001, as, due the minimum wage hike, more fiscal revenues were extracted from the treated. Instead, if the control group has been properly chosen, we should expect $\beta = 0$ in the pre-treatment sample 1999-2000.

The analysis in the spirit of a "difference in difference in difference". However, the sample in the panel 1999-2000 does not fully coincide with the sample in the panel 2000-2001. The cohort interviewed in the years 2000-2002 is included in the 2000-2001 panel, while it is not included in the 1999-2000 panel. The opposite is true for the cohort interviewed in 1998-2000.

Additional controls included in all regressions are a household fixed effect, a year dummy and month dummies. Results controlling for employee characteristics for the year 2000 and for both employee and ge-

ographical characteristics are reported separately (see section 6.1 for details about the definition of these variables.)

Results As expected, the treatment is never significant in the pre-treatment period 1999-2000, while it is negative and significant for the treatment period 2000-2001 (see Table A).

When only time dummies are included statistical significance is achieved only when the largest reference group is considered. When employee characteristics are accounted for the effect is stronger and precisely estimated also using the smaller reference group. This is true also after controlling for the change and level of income. Due to the importance of food non acquired in the market, the analysis is done also controlling for food from own production (see Table B). Controlling for home production and geographical factors generally reduces the precision at which coefficients are estimated and their absolute value. The same is true when the smaller control group is used. Controlling for changes in income generally increases both the precision and the magnitude of the coefficients, while both are reduced when allowing changes in food consumption to vary not only with changes but also with the level of income. All in all, however, the result seems to be robust to the different specifications.

The analysis thus supports the prediction of a decline in "true" income after an increase in the minimum wage for those earning between the old and the new minimum wage before the hike. Notice that only employees who worked for the whole period are considered treated. In particular treated employee have been working for a whole year after the minimum wage increase, reducing the likelihood that the decline in income is due to increased labour market risk.

7.2 A deeper look at 2000-2001

According to the model, workers declaring between the old and new minimum wage before a minimum wage hike may decrease their compliance to zero or increase it to the new minimum wage after the hike. In any case they experience a decline in income. In this section we look specifically at the latter category of workers, those whose declared earnings were "pushed up" to the new minimum wage level. The 2000-2001 panel is used.

Two different specifications for "treatment" are considered. The first one, in line with what has been used in the previous section, is a variable counting the number of members of the household that where "pushed up". The second one considers the amount by which wages were pushed up and is thus called "continuous treatment".

Also in this case the analysis is restricted to households that kept a

constant family structure during the two-year period.

7.2.1 Dummy treatment

In this specification we consider as treated those earning in 2000 between 90% of the minimum wage in 2000 and 110% of the minimum wage in 2001, while earning in 2001 between 90% and 110% of the minimum wage in 2001.

Households are considered treated if at least one of their members is classified as private sector employee in 2001 and has earnings "pushed up" to the new minimum wage level. The variable $TREAT_i$ contains the total number of members of household i belonging to this category.

The regression is run on all households with at least one member employed in 2001 for a wage between 90% and 200% (150%) of the minimum wage in 2001.

Also in this case we should expect $\beta < 0$.

Results The coefficient is negative and significant in all specifications, i.e. using different control groups, controlling or not for employee characteristics in 2001 and for geographical characteristics, controlling or not for income level and change and for food own production (see Table C).

7.2.2 Continuous treatment

According to Proposition 2 the decline in income ΔI for those declaring $\bar{w}_2$ at time 2 increases as the distance between the declared income at time 1 and $\bar{w}_2$ increases. The effects of being "pushed up" to the 2001 minimum wage should be weaker for those who were earning marginally below that amount before its introduction, compared to the employee who were earning exactly the 2000 minimum wage and, thus, were "pushed up" much more. To take into account these differences a continuous treatment variable is used here. The variable $TREAT_i$ is defined as the sum within household i of the difference between the minimum wage in 2001 and the wage in 2000 for those who satisfied the following conditions:

- private employees in 2001
- wage in 2000 between 90% of the minimum wage in 2000 and 100% of the minimum wage in 2001
- wage in 2001 between 90%-100% of the minimum wage in 2001

Also in this case the regression is run on all households with at least one member employed in 2001 for a wage between 90% and 200% (150%) of the minimum wage in 2001.

Results The coefficient is negative and always significant when controls for employee characteristics are used (see Table D). The magnitude of the coefficient implies that being pushed up by 1 HUF corresponds to a decline by around 0.12 in food consumption compared to the reference group.

8 Conclusions

In this paper the massive minimum wage increase that took place in Hungary in the year 2001 has been exploited to investigate whether the minimum wage can be used to reduce underreporting of earnings by employed labour, as stated in the theory developed in Tonin (2006.)

Appendix A

Summary of fiscal imposition on wages 2000-2002

Social Security Contributions In the period 2000-2001 employers' contributions for pension amount to 22% of payroll, decreasing to 18% in 2002. The employer also pays health contribution corresponding to 11% of payroll and a lump-sum contribution of 3900 HUF in 2000-2001 and 4500 HUF in 2002.

Contributions for unemployment are at 3% of payroll.

Social security contributions paid by the employee are stable in the period under consideration at 8% of gross wage for pension, 3% for health care, 1.5% for unemployment.

Personal Income Tax Tax rates remain unchanged in the period 2000-2002, with the lowest bracket being taxed at 20% and the next at 30%. However, there are changes in both brackets and deductions. The upper limit for the lowest bracket is adjusted in both 2001 and 2002, so that minimum wage earners are taxed at the lowest rate, provided they have no other source of income. Moreover, the upper limit for the tax credit is increased in September 2002, so that minimum wage earners are exempt from PIT.

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Figure 2: Tax Wedge on Minimum Wage

		2000	2001	2002		
				Jan-Aug	Sep-Dec	All
	Monthly Minimum Wage	22500	40000	50000	50000	50000
PIT	PIT rate at MW	20%	20%	20%	20%	..
	PIT at MW	4500	8000	10000	10000	..
	Tax credit - Rate	10%	10%	10%	18%	..
	Tax credit * MW	2250	4000	5000	9000	..
	Tax Credit - Monthly Max	3000	3000	3000	9000	..
	Tax Credit Applicable at MW	2250	3000	3000	9000	..
	Pension Contribution Deduction	25%	25%	25%	25%	..
	Deduction*Employee Pension Rate	2%	2%	2%	2%	..
	Deduction Applicable at MW	450	800	1000	1000	..
	Net PIT at MW	1800	4200	6000	0	4000
SSC - Employees	Pension - Rate	8%	8%	8%	8%	..
	Pension - Payment	1800	3200	4000	4000	..
	Health care - Rate	3%	3%	3%	3%	..
	Health care - Payment	675	1200	1500	1500	..
	Unemployment - Rate	1.5%	1.5%	1.5%	1.5%	..
	Unemployment - Payment	337.5	600	750	750	..
	TOTAL SSC Employees Rate	12.5%	12.5%	12.5%	12.5%	..
	TOTAL SSC Employees - Payment	2812.5	5000	6250	6250	6250
	Net Take Home Pay	17888	30800	37750	43750	39750
SSC - Employers	Pension - Rate	22%	22%	18%	18%	..
	Pension - Payment	4950	8800	9000	9000	..
	Health care - Rate	11%	11%	11%	11%	..
	Health care - Payment	2475	4400	5500	5500	..
	Health care - Lump sum	3900	3900	4500	4500	..
	Unemployment - Rate	3%	3%	3%	3%	..
	Unemployment - Payment	675	1200	1500	1500	..
	TOTAL SSC Employer Rate	36%	36%	32%	32%	..
	TOTAL SSC Employer - Payment	12000	18300	20500	20500	20500
	Labour Cost	34500	58300	70500	70500	70500
	Net Take Home Pay / Labour Cost	52%	53%	54%	62%	56%
	Total tax wedge (Average Rate in %)	48%	47%	46%	38%	44%
	TOTAL PAID TAXES: PIT + SSC	16613	27500	32750	26750	30750
	Difference YY	..	10888	5250	-750	3250

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Results

Figure 3: TABLE A

Dependent variable:		Food, not own production; monthly											
		99-00	00-01	99-00	00-01	99-00	00-01	99-00	00-01	99-00	00-01	99-00	00-01
Reference group:		MW2000<Wage 2000<2* MW2001						MW2000<Wage 2000<1.5* MW2001					
Treatment		-777	-1348	-637	-1448	-562	-1141	-777	-971	-671	-1040	-584	-901
		(0.232)	(0.032)	(0.308)	(0.022)	(0.370)	(0.074)	(0.267)	(0.170)	(0.324)	(0.143)	(0.394)	(0.209)
Tot HH Income - excl.				0.06	0.02	0.05	-0.01			0.04	0.02	0.03	-0.01
Home Production		-	-	(0.001)	(0.057)	(0.006)	(0.700)	-	-	(0.011)	(0.181)	(0.153)	(0.687)
Tot HH Income - excl.						0.01	0.03					0.02	0.02
Home Production * t		-	-	-	-	(0.350)	(0.001)	-	-	-	-	(0.056)	(0.034)
R-Squared		0.2248	0.31	0.25051	0.31464	0.25415	0.32538	0.2322	0.3088	0.24656	0.311	0.2527	0.317
Additional Controls:		Year and Month dummies.											
Treatment		294	-2177	464	-2275	438	-1797	386	-1966	493	-1991	543	-1698
		(0.690)	(0.007)	(0.516)	(0.005)	(0.537)	(0.034)	(0.640)	(0.028)	(0.544)	(0.027)	(0.505)	(0.069)
Tot HH Income - excl.				0.06	0.02	0.06	-0.01			0.04	0.01	0.04	-0.01
Home Production		-	-	(0.001)	(0.132)	(0.003)	(0.615)	-	-	(0.008)	(0.425)	(0.037)	(0.618)
Tot HH Income - excl.						0.00	0.03					0.00	0.02
Home Production * t		-	-	-	-	(0.861)	(0.009)	-	-	-	-	(0.680)	(0.131)
R-Squared		0.2961	0.39	0.32333	0.3903	0.32336	0.39807	0.3284	0.4135	0.34092	0.4143	0.3411	0.418
Additional Controls:		Year and Month dummies, Employee characteristics for 2000.											
Treatment		247	-2078	424	-2173	418	-1762	406	-1682	531	-1701	596	-1511
		(0.746)	(0.013)	(0.565)	(0.009)	(0.570)	(0.040)	(0.643)	(0.070)	(0.536)	(0.067)	(0.490)	(0.112)
Tot HH Income - excl.				0.06	0.02	0.06	-0.01			0.04	0.01	0.03	-0.01
Home Production		-	-	(0.001)	(0.186)	(0.006)	(0.642)	-	-	(0.018)	(0.687)	(0.069)	(0.626)
Tot HH Income - excl.						0.00	0.03					0.01	0.02
Home Production * t		-	-	-	-	(0.965)	(0.019)	-	-	-	-	(0.575)	(0.256)
R-Squared		0.321	0.41	0.34525	0.41265	0.34525	0.41876	0.3651	0.4511	0.37629	0.4513	0.3767	0.4532
Additional Controls:		Year and Month dummies, Employee characteristics for 2000, Geographical dummies.											
Number of HH		868	820	868	820	868	820	621	586	621	586	621	586
HH treated		201	203	201	203	201	203	201	203	201	203	201	203
Fixed Effect estimation - Robust p values in brackets													
Treatment:		N. private employees with wage in 2000 between 100% of mw2000 and 100% mw2001 employed for 24 months in relevant period											
Reference group:		Households with at least one employee with wage in 2000 between 100% of mw2000 and 200% (150%) mw2001 employed for 24 months in relevant period											
NOTE:		Only Households with constant family structure											

Figure 4: TABLE B

Dependent variable:		Food, not own production; monthly											
		99-00	00-01	99-00	00-01	99-00	00-01	99-00	00-01	99-00	00-01	99-00	00-01
Reference group:		MW2000<Wage 2000<2* MW2001						MW2000<Wage 2000<1.5* MW2001					
Treatment		316	-2064	502	-2159	510	-1819	435	-1755	560	-1779	628	-1628
		(0.666)	(0.011)	(0.480)	(0.008)	(0.471)	(0.032)	(0.598)	(0.046)	(0.489)	(0.044)	(0.439)	(0.076)
Food own production; monthly		-0.08	-0.15	-0.14	-0.17	-0.14	-0.16	-0.12	-0.20	-0.16	-0.21	-0.16	-0.21
		(0.270)	(0.039)	(0.067)	(0.021)	(0.067)	(0.021)	(0.155)	(0.010)	(0.060)	(0.008)	(0.060)	(0.007)
Tot HH Income - with Home Production		-	-	0.06	0.02	0.06	0.00	-	-	0.04	0.01	0.04	0.00
				(0.000)	(0.144)	(0.003)	(0.981)			(0.006)	(0.472)	(0.033)	(0.972)
Tot HH Income - with Home Production * t		-	-	-	-	0.001	0.023	-	-	-	-	0.007	0.012
						(0.949)	(0.050)					(0.557)	(0.412)
R-Squared		0.2979	0.3935	0.32577	0.39575	0.32578	0.4001	0.3332	0.42609	0.34643	0.42672	0.3469	0.42773
Additional Controls:		Year and Month dummies, Employee characteristics for 2000.											
Treatment		264	-2005	456	-2097	476	-1793	446	-1544	587	-1562	678	-1483
		(0.727)	(0.016)	(0.534)	(0.012)	(0.515)	(0.036)	(0.609)	(0.092)	(0.492)	(0.088)	(0.430)	(0.114)
Food own production; monthly		-0.11	-0.15	-0.16	-0.17	-0.16	-0.16	-0.15	-0.19	-0.19	-0.19	-0.19	-0.19
		(0.123)	(0.046)	(0.034)	(0.026)	(0.034)	(0.029)	(0.090)	(0.016)	(0.037)	(0.014)	(0.038)	(0.014)
Tot HH Income - with Home Production		-	-	0.06	0.02	0.06	0.00	-	-	0.04	0.00	0.03	0.00
				(0.001)	(0.196)	(0.006)	(0.927)			(0.013)	(0.713)	(0.068)	(0.955)
Tot HH Income - with Home Production * t		-	-	-	-	0.002	0.022	-	-	-	-	0.010	0.007
						(0.874)	(0.067)					(0.421)	(0.626)
R-Squared		0.3246	0.4162	0.34899	0.41797	0.34902	0.4216	0.3719	0.46117	0.38355	0.46133	0.3844	0.46166
Additional Controls:		Year and Month dummies, Employee characteristics for 2000, Geographical dummies.											
Number of HH		868	820	868	820	868	820	621	586	621	586	621	586
HH treated		201	203	201	203	201	203	201	203	201	203	201	203

Fixed Effect estimation - Robust p values in brackets

Treatment: N. *private* employees with wage in 2000 between 100% of mw2000 and 100% mw2001 *employed for 24 months* in relevant periodReference group: Households with at least one employee with wage in 2000 between 100% of mw2000 and 200% (150%) mw2001 *employed for 24 months* in relevant period

NOTE: Only Households with constant family structure

Figure 5: TABLE C

Dependent variable:		Food, not own production; monthly											
Reference group:		MW2000<Wage 2000<2* MW2001						MW2000<Wage 2000<1.5* MW2001					
Treatment		-1463	-1492	-1197	-1274	-1307	-1095	-1541	-1600	-1374	-1354	-1421	-1223
		(0.011)	(0.009)	(0.039)	(0.024)	(0.020)	(0.054)	(0.016)	(0.011)	(0.031)	(0.031)	(0.023)	(0.049)
Tot HH Income - excl. Home Production		-	0.02	0.00	-	-	-	-	0.04	0.02	-	-	-
			(0.086)	(0.936)					(0.045)	(0.427)			
Tot HH Income - excl. Home Production * t		-	-	0.02	-	-	-	-	-	0.02	-	-	-
				(0.026)						(0.136)			
Food own production; monthly		-	-	-	-0.17	-0.18	-0.18	-	-	-	-0.18	-0.20	-0.21
					(0.001)	(0.000)	(0.000)				(0.005)	(0.002)	(0.001)
Tot HH Income - with Home Production		-	-	-	-	0.02	0.00	-	-	-	-	0.03	0.02
						(0.107)	(0.808)					(0.050)	(0.376)
Tot HH Income - with Home Production * t		-	-	-	-	-	0.02	-	-	-	-	-	0.02
							(0.085)						(0.157)
R-Squared		0.32	0.33	0.33	0.33	0.34	0.34	0.34	0.35	0.35	0.35	0.36	0.36
Additional Controls:		Year and Month dummies.											
Treatment		-1756	-1747	-1384	-1603	-1600	-1372	-1853	-1864	-1550	-1724	-1744	-1487
		(0.006)	(0.006)	(0.035)	(0.011)	(0.011)	(0.033)	(0.010)	(0.009)	(0.034)	(0.015)	(0.014)	(0.038)
Tot HH Income - excl. Home Production		-	0.02	-0.01	-	-	-	-	0.03	0.01	-	-	-
			(0.195)	(0.563)					(0.069)	(0.741)			
Tot HH Income - excl. Home Production * t		-	-	0.03	-	-	-	-	-	0.03	-	-	-
				(0.026)						(0.078)			
Food own production; monthly		-	-	-	-0.18	-0.19	-0.18	-	-	-	-0.18	-0.20	-0.20
					(0.000)	(0.000)	(0.000)				(0.006)	(0.003)	(0.003)
Tot HH Income - with Home Production		-	-	-	-	0.01	0.00	-	-	-	-	0.03	0.01
						(0.250)	(0.934)					(0.086)	(0.618)
Tot HH Income - with Home Production * t		-	-	-	-	-	0.02	-	-	-	-	-	0.02
							(0.145)						(0.128)
R-Squared		0.39	0.39	0.39	0.40	0.40	0.40	0.41	0.42	0.43	0.42	0.43	0.44
Additional Controls:		Year and Month dummies, Employee characteristics for 2001.											
Treatment		-1541	-1537	-1255	-1408	-1410	-1226	-1571	-1575	-1370	-1477	-1490	-1317
		(0.022)	(0.022)	(0.070)	(0.033)	(0.033)	(0.070)	(0.039)	(0.038)	(0.078)	(0.049)	(0.046)	(0.084)
Tot HH Income - excl. Home Production		-	0.01	-0.01	-	-	-	-	0.04	0.01	-	-	-
			(0.227)	(0.615)					(0.056)	(0.642)			
Tot HH Income - excl. Home Production * t		-	-	0.03	-	-	-	-	-	0.03	-	-	-
				(0.044)						(0.116)			
Food own production; monthly		-	-	-	-0.17	-0.18	-0.18	-	-	-	-0.18	-0.20	-0.20
					(0.001)	(0.001)	(0.001)				(0.006)	(0.003)	(0.003)
Tot HH Income - with Home Production		-	-	-	-	0.01	0.00	-	-	-	-	0.03	0.01
						(0.286)	(0.931)					(0.072)	(0.551)
Tot HH Income - with Home Production * t		-	-	-	-	-	0.02	-	-	-	-	-	0.02
							(0.184)						(0.182)
R-Squared		0.41	0.41	0.41	0.42	0.42	0.42	0.44	0.44	0.45	0.45	0.45	0.46
Additional Controls:		Year and Month dummies, Employee characteristics for 2001, Geographical dummies.											
Number of HH		932						675					
HH treated		172						172					

Fixed Effect estimation - Robust p values in brackets

Treatment: N. private employees in 2001 with wage in 2000 between 90% of mw2000 and 110% of mw2001 and wage in 2001 between 90%-110% mw2001

Reference group: HH with at least on employee in 2001 with wage in 2001 between 90% and 200% (150%) of mw2001

NOTE: Only Households with constant family structure

Figure 6: TABLE D

Dependent variable:		Food, not own production; monthly											
Reference group:		MW2000<Wage 2000<2* MW2001						MW2000<Wage 2000<1.5* MW2001					
Treatment		-0.10	-0.11	-0.08	-0.08	-0.09	-0.07	-0.11	-0.12	-0.10	-0.09	-0.10	-0.09
		(0.069)	(0.053)	(0.144)	(0.128)	(0.102)	(0.192)	(0.083)	(0.051)	(0.100)	(0.146)	(0.095)	(0.155)
Tot HH Income - excl. Home Production		-	0.02	0.00	-	-	-	-	0.04	0.02	-	-	-
			(0.084)	(0.904)					(0.043)	(0.441)			
Tot HH Income - excl. Home Production * t		-	-	0.02	-	-	-	-	-	0.02	-	-	-
				(0.021)						(0.117)			
Food own production; monthly		-	-	-	-0.17	-0.18	-0.18	-	-	-	-0.18	-0.21	-0.21
					(0.000)	(0.000)	(0.000)				(0.005)	(0.002)	(0.001)
Tot HH Income - with Home Production		-	-	-	-	0.02	0.00	-	-	-	-	0.04	0.02
						(0.105)	(0.841)					(0.049)	(0.393)
Tot HH Income - with Home Production * t		-	-	-	-	-	0.02	-	-	-	-	-	0.02
							(0.070)						(0.136)
R-Squared		0.32	0.32	0.33	0.33	0.33	0.34	0.34	0.35	0.35	0.35	0.36	0.36
Additional Controls:		Year and Month dummies.											
Treatment		-0.14	-0.14	-0.11	-0.12	-0.13	-0.11	-0.16	-0.17	-0.14	-0.14	-0.15	-0.13
		(0.030)	(0.028)	(0.090)	(0.049)	(0.045)	(0.090)	(0.022)	(0.017)	(0.044)	(0.035)	(0.027)	(0.053)
Tot HH Income - excl. Home Production		-	0.02	-0.01	-	-	-	-	0.04	0.01	-	-	-
			(0.185)	(0.542)					(0.063)	(0.747)			
Tot HH Income - excl. Home Production * t		-	-	0.03	-	-	-	-	-	0.03	-	-	-
				(0.021)						(0.066)			
Food own production; monthly		-	-	-	-0.18	-0.19	-0.18	-	-	-	-0.18	-0.20	-0.20
					(0.000)	(0.000)	(0.000)				(0.007)	(0.003)	(0.003)
Tot HH Income - with Home Production		-	-	-	-	0.01	0.00	-	-	-	-	0.03	0.01
						(0.239)	(0.905)					(0.080)	(0.629)
Tot HH Income - with Home Production * t		-	-	-	-	-	0.02	-	-	-	-	-	0.02
							(0.121)						(0.108)
R-Squared		0.38	0.39	0.39	0.39	0.40	0.40	0.41	0.42	0.43	0.42	0.43	0.43
Additional Controls:		Year and Month dummies, Employee characteristics for 2001.											
Treatment		-0.14	-0.14	-0.11	-0.12	-0.12	-0.11	-0.13	-0.14	-0.12	-0.12	-0.13	-0.12
		(0.041)	(0.037)	(0.095)	(0.059)	(0.055)	(0.097)	(0.062)	(0.052)	(0.094)	(0.080)	(0.068)	(0.104)
Tot HH Income - excl. Home Production		-	0.01	-0.01	-	-	-	-	0.04	0.01	-	-	-
			(0.218)	(0.613)					(0.052)	(0.640)			
Tot HH Income - excl. Home Production * t		-	-	0.03	-	-	-	-	-	0.03	-	-	-
				(0.040)						(0.108)			
Food own production; monthly		-	-	-	-0.17	-0.18	-0.18	-	-	-	-0.18	-0.20	-0.20
					(0.001)	(0.001)	(0.001)				(0.006)	(0.003)	(0.003)
Tot HH Income - with Home Production		-	-	-	-	0.01	0.00	-	-	-	-	0.03	0.01
						(0.276)	(0.922)					(0.068)	(0.554)
Tot HH Income - with Home Production * t		-	-	-	-	-	0.02	-	-	-	-	-	0.02
							(0.169)						(0.167)
R-Squared		0.41	0.41	0.41	0.42	0.42	0.42	0.44	0.44	0.45	0.45	0.45	0.46
Additional Controls:		Year and Month dummies, Employee characteristics for 2001, Geographical dummies.											
Number of HH		932						675					
HH treated		153						153					

Fixed Effect estimation - Robust p values in brackets

Treatment: N. private employees in 2001 with wage in 2000 between 90% of mw2000 and 110% of mw2001 and wage in 2001 between 90%-110% mw2001

Reference group: HH with at least on employee in 2001 with wage in 2001 between 90% and 200% (150%) of mw2001

NOTE: Only Households with constant family structure