Bank of Israel Research Department

On the Dark Side of Welfare: Estimation of Welfare Recipients Labor Supply and Fraud

by

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Discussion Paper Series 2001.12

December 2001

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Abstract

The paper suggests a novel analytical and empirical framework for exploring labor market behavior and fraud among welfare recipients. First, cheating is introduced in the form of concealing information from social security authorities. Second, the relevance of working hours constraints is tested. Third, we study labor supply as well as participation decisions. Fourth, the model includes estimation of the labor supply decision under uncertainty, subject to a non-linear budget set. We find that when individual decisions involve illegitimate actions such as fraudulent collection of welfare benefits, immoral aspects are perceived as separable from the economic consequences of these actions. In addition, working hours constraints do provide obstacles to welfare recipients' labor market participation.

On the Dark Side of Welfare:
Estimation of Welfare Recipients Labor Supply and Fraud*

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1. Introduction

Income maintenance is the principal benefits program for very needy families, operated by the Israel's National Insurance Institute. Since its establishment in 1982, when less than 1% of working-age households were beneficairies, the program has experienced ceaseless growth in its budget and number enrolled, such that it now supports about 9% of all working-age households.

Like many similar welfare programs around the world (TANF in the US, WFTC in the UK, etc.) benefits are granted to recipients provided they do their utmost to participate in the labor market. Claimants incapable of working and mothers with young children are exempt from this requirment.

The program includes a means test. The test can be summarized as follows. A family is eligible for full benefits (ranging from 20% of average wage for single individuals, up to 66.5% of average wage for a couple with at least two children which has been enrolled in the program more than two years), unless its income from work exceeds the disregard income (13% of average wage for single persons, otherwise 17%). Beyond this level of earnings, benefits are offset against income from work at a rate of 100% (60% for a single-parent family) till it is phased out completely at the break-even point. Non-labor income diminishes support at the same rate without disregard. Because welfare

* We would like to thank Jacob Braude and participants of the Bank of Israel seminar for many helpful suggestions.

recipients are entitled to other state-provided benefits (subsidized rent, medical insurance, etc.) which cease with loss of eligibility for income maintenance, the program's offset rate and related benefits together impose an effective marginal tax rate well above 100%. This phenomen, dubbed the "poverty trap", induces two well-known negative effects. First, sky-high offset rates discourage recipients capable of working from participating in the labor market and also reduce labor supply by those who do participate (in Israel, two-thirds of those receiving income maintenance do not work at all). Second, the means test encourages under-reporting of earnings and hours worked, while it promotes large scale employment in the informal sector.

Comprehensive negative income tax experiments, conducted in the US during the early 1970s, triggered extensive research of welfare programs optimal structure and impact on labor supply. In a seminal paper, Burtless and Hausman (1978) suggested an econometric method to estimate labor supply under nonlinear budget set. This technique has been applied by researchers in a wide variety of contexts.[1]

Mainstream empirical studies of welfare recipients labor supply nonetheless neglected two salient phenomena: a) fraudulent collection of welfare benefits by under-reporting of earnings or informal sector employment; b) constraints imposed on hours worked.

In a rare analysis of under-reporting habits, Greenberg, Moffit and Friedman (1981) found that amongst married and single-parent female participants in the income-maintenance experiment, under-reporting of labor income was 10 percentage

[1] See also Moffitt and Kehrer (1981), Burtless (1986), and Moffitt (1986) for excellent discussions about the technique and its applications, and for a survey of results.

points higher than in the control group; concealed income amounted to almost half of their actual earnings. About 40% of the female working participants evaded all income, as compared to 30% in the control group. Surprisingly, under-reporting by male participants was found to be negligible. Greenberg and Halsey (1983) reported similar results.

Few researchers have incorporated working hours constraints in labor supply estimation. Moffitt (1982) augmented the Tobit model with a minimum hours restriction, but admitted that this model poorly fits the conventional bi-modal distribution of working hours, with one peak found in part-time jobs (most frequent amongst women), and another peak in full-time jobs (prevalent amongst men). Tummers and Woittiez (1991), using survey data on Dutch females in two-adult households, estimated a labor market equilibrium model with job offer flows generating a given distribution of employment scope. Their findings suggest not only the existence of hours restrictions, but also a nonlinear budget constraint. Dickens and Lundberg (1993) estimated a similar model for the Denver Income Maintenance Experiment and found substantial amounts of rationing in the work hours amongst low-income men, most of whom worked less than they would like. Dickens and Lundberg also surveyed studies of demand constraints on the desired amount of hours worked.

Our study presents a novel examination of unexplored aspects of welfare programs having a means test. We develop a behaviorial model of labor supply with integrated income under-reporting and exogenous working hours constraints. Estimation of this model allows us to identify the economic and (im)moral aspects of fraud, to quantify the impact of these factors on participation and labor-supply decisions made under uncertainty, and to test the relevance of working hours constraints in the formal and informal labor markets. The estimation makes use of information contained in the Household Expenditure Survey (HES) conducted by Israel's Central Bureau of Statistics. Since similar data sources can be found in many countries, we believe the suggested econometric framework may be useful for applied research of means test-based social security transfers wherever opportunities to abuse modern welfare state programs - a seemingly inherent feature of these programs - exist.

The paper is organized as follows. Section 2 describes the data and explains how this information can be used to estimate the scope of welfare recipient earnings concealment. Section 3 contains a behavioral model of participation and labor supply for welfare recipients who are able to conceal information regarding their earnings from social security authorities, given exogenous working hours constraints. In Section 4 we specify the econometric framework for estimation of this model. Section 5 concludes with results of the estimation and a discussion of the findings.

2. The data

The study is based on pooled 1997 and 1998 Household Expenditure Survey (HES) samples. This survey, conducted annually by Israel's Central Bureau of Statistics contains, inter alia, detailed information on current household income from all sources, including labor market earnings and the range of social security transfers, a selection of traits regarding labor force participation (weekly hours worked, economic branch, occupation, and so forth), and a wide array of socio-demographic characteristics.

Since the HES provides information about income from work and welfare benefits, we are able to estimate the extent of earnings not reported to social security authorities as follows.

The formula used by social security authorities to compute income maintenance benefits is:

$$\min[(G - \max(w_1 h_1 - D, 0)) \cdot 0.6, \overline{G} - w_1 h_1] \qquad (1)$$

where G is person's maximum income maintenance benefits; D is disregard income level; $\overline{G}$ is break-even income level; h_1 is monthly working hours reported to social security authorities (in the formal sector); w_1 is hourly wage.

Thus, knowing a person's welfare benefits (G) and income maintenance program parameters (D and $\overline{G}$) enables derivation of recipient's declared income from work ($w_1 h_1$).[2] What the welfare recipient reports to the HES is his/her total earnings, namely, $w_0 h_0 + w_1 h_1$, where h_0 is monthly working hours *not reported* to social security authorities (in the informal sector), and w_0 is hourly wage in the informal sector. The gap between the values of $w_1 h_1$ and $w_0 h_0 + w_1 h_1$ is an estimate of the earnings concealed from social security authorities, referred to later as 'informal labor market earnings'. If declared, these earnings would diminish welfare benefits at a rate 100% (60% for single mothers). This indicates why the estimate of informal labor market earnings is tantamount to the value of fraudulently collected welfare funds. Worth noting is that this estimate constitutes a lower bound of the extent of cheating because some surveyed welfare recipients probably did not share all information about their employment with the HES interviewer.

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[2] Welfare recipients have negligible non-labor income liable to offset. For simplicity, we ignore this income in formula (1).

Our analysis is conducted on a sample of 446 households of working-age welfare recipients, representing a population of 95,000 Israeli families supported by the income maintenance program, two-thirds of them non-working.

The data clearly show a bi-modal pattern in the distribution of working hours. Among employed male welfare recipients, 25% hold a part-time job (15-25 hours per week), and 65% hold a full-time job (more than 35 hours weekly). The percentages of part-time and full-time employment amongst female welfare recipients are 25% and 43%, respectively. Given that every welfare recipient (excluding single mothers) working more than 10 hours per week (at minimum wage) faces a 100% offset rate, we may be surprised to find that the majority of employed welfare recipients “choose” to work sufficiently to be taxed so heavily. Holding recipients’ unawareness of offset incidence and rate as a possible explanation, this “irrational” behavior may be attributed to two factors: The number of jobs offering flexible or short hours (employment scope that yield earnings below disregard) falls below demand. Thus, observations of welfare recipients holding full-time or part-time jobs probably indicate rationing of desireable posts rather than irrational decisions. Alternatively, welfare recipients may avoid offset of benefits by concealing their earnings from social security authorities. If so, they choose the scope of hours worked not subject to the statutory budget set assigned to welfare recipients, yet subject to the budget set faced by ordinary labor market participants.

Using this backward computational approach, we find that 57% of working welfare recipients concealed their income from work to some extent. The scope of fraud reaches almost half their total (formal and informal labor market) income, or up to 13% of all welfare benefits paid. On average, cheating welfare recipients underreported 25 working hours per week.[3] These estimates are significantly higher than those reported by Greenberg et al. (1981) and Greenberg and Halsey (1983) in the studies of non-compliance in negative income tax experiments.

As expected, the share of concealed out of total income from work increases with income, rising from a few percents at income level below disregard, up to 70% at income close to break-even income. Concealed earnings are relatively more frequent amongst couples with children. Not surprisingly, cheating welfare recipients are employed et masse in trade and services, well-known domains known for the job opportunities they provide within the informal economy.

3. Behavioral model

Analysis of welfare recipients' labor market participation reveals that part-time and full-time jobs are the prevailing form of employment, a striking pattern considering very high marginal tax rates welfare recipients are subject to, given offset of income maintenance benefits against their income from work. It may be that job offers having fixed scope of working hours explain the observation of individual placed in the clearly inferior positions on his budget set frontier.

Estimates of the scope of informal labor market earnings demonstrate that fraudulent collection of social security benefits based on concealing information regarding actual employment and earnings seems to be widespread, especially amongst welfare recipients working long hours.

[3] We assume that w_0=w_1 (see footnote 8) and that all income from work below disregard was reported.

We attempt to combine these two features in a novel behavioral model that explores welfare recipients' market participation and labor supply decisions subject to the exogenous constraints imposed on the set of feasible market equilibriums. In contrast to highly structured models of choice[4] that match individual labor supply to the flow of job offers (replicating an observed distribution of part- and full-time jobs), we do not specify (formal and informal) labor market demand because of the absence of specific information about any actual offers received by a job seeker. That is why we define the following model as a behavioral model, one that focuses on the individual's decisions, and leaves detailed exploration of demand to future studies.

Let each income maintenance recipient i have preferences represented by an additive utility function $U_i = u_i(Y_i(e_i, h_i), L_i) + v_i(e_i)$, where Y_i is disposal income defined by Eq. (2) and (3), L_i is leisure (in terms of posts) which adds up to a monthly time budget ($\bar{L}$) with total work time h_i (in terms of posts) divided between two markets: $h_i = h_{i0} + h_{i1}$. Because of exogenous working hours constraints, h_i may assume three values: 0 for the unemloyed, 1/2 for the persons holding a part-time job, and 1 for the persons holding a full-time job; we denote it as $h_i \in \{0, \frac{1}{2}, 1\}$. Lastly, e_i is the scope of income concealed from social security authorities ($e_i = w_{i0}h_{i0}$).

Disposable income of a welfare recipient caught cheating is:

$$Y^{+} = w_1 h_1 + G - (w_1 h_1 - D)\theta + w_0 h_0 (1 - \theta(1+\pi)) \qquad (2)$$

Disposable income of a welfare recipient not caught is:

$$Y^{-} = w_1 h_1 + G - (w_1 h_1 - D)\theta + w_0 h_0 \qquad (3)$$

[4] See for example Tummers and Woittiez (1991) and Dickens and Lundberg (1993).

Disposable income in Eq. (2) and (3) is derived under assumption that the benefits are offset at a rate θ ($0 \le \theta \le 1$) only against formal labor market earnings above disregard income level *D*. Employment in the informal market is uncovered by social security authorities with a probability *p* ($0 \le p \le 1$). If detected, all "black market" income is fined at a proportional rate π ($0 \le \pi \le 1$); benefits are offset against all informal market earnings at rate θ.[5] For simplicity, the existence of direct taxes is ignored.[6]

A key role in our model is played by $v_i(\cdot)$, defined as disutility from cheating (by concealing information about informal market earnings or employment). Little can be said about this function's specification, or even its sign, other than 'it depends'. Hessing, Elffers, Robben and Webley (1992) conclude that "[t]here are probably three groups of taxpayers: (1) taxpayers who never evade taxes...; (2) taxpayers who will try to evade now and then; and (3) taxpayers who will often try to evade (habitual evaders)" (p. 304). We speculate that for the first group, inherently honest welfare recipient, $v_i(\cdot)$ may be a negative and increasing (in absolute value) function of illegally collected welfare benefits, meant to express shame and guilt related with cheating and its possible detection [see Erard and Feinstein (1994) for a model that incorporates these attitudes into the standard model of rational tax evasion]. For the second group, the occasional cheaters, $v_i(\cdot)$ is probably a positive and quasi-concave function. For the third group, habitual evaders who are

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[5] Because of very low disregard income *D*, we assume $D < w_1 h_1$, therefore benefits are offset against all "black market" income.

[6] This assumption seems plausible, at least for the Israeli case, where a vast majority of welfare recipients are well below the income tax threshhold. As to social security contributions, non-working individuals and employees earning less than one fourth of the average wage are obliged in a fixed sum payment.

presumably led by the desire 'to beat the system', this function is positive and convex. In any case, $\nu_i(.)$ includes any excess burden of evasion[7], while $v_i(0)=0$.

Without limiting generality, let an individual's wage be the same in both markets,[8] $w_{i0}=w_{i1}=w_i$, with p and π exogenous and constant.

Each individual faces the same set of employment possibilities: a) not working at all; b) taking a part-time job; and c) taking a full-time job. Denoting each as $(0),(\tfrac{1}{2}),(1)$, respectively, expected utility is:

$$U_i(0)=u_i(G_i,\overline{L}) \tag{4.1}$$

$$U_i(\tfrac{1}{2})=\mathrm{E}u_i(Y_i|h_i=\tfrac{1}{2},\overline{L}-\tfrac{1}{2})+v_i(e_i|h_i=\tfrac{1}{2}) \tag{4.2}$$

$$U_i(1)=\mathrm{E}u_i(Y_i|h_i=1,\overline{L}-1)+v_i(e_i|h_i=1) \tag{4.3}$$

where $\mathrm{E}(\cdot)$ is the expected value operator. Notation $(e_i|h_i=\tfrac{1}{2})$, for example, indicates informal sector earnings, if the individual takes a part-time job. If *the only* part-time job taken is in the informal sector, we denote it as $(e_i(\tfrac{1}{2}))$.

Since employment outcomes constitute a complete set, the observed employment mode is presumably preferred over two other feasible outcomes for any individual:

unemployed	if	$U_i(0)>U_i(\tfrac{1}{2})$ and $U_i(0)>U_i(1)$	(5.1)
part-time job	if	$U_i(\tfrac{1}{2})>U_i(0)$ and $U_i(\tfrac{1}{2})>U_i(1)$	(5.2)
full-time job	if	$U_i(1)>U_i(0)$ and $U_i(1)>U_i(\tfrac{1}{2})$	(5.3)

[7] Yitzhaki (1987) defines the excess burden of tax evasion as "[t]he difference between the utility obtained under a tax system with tax evasion and that obtained under a system in which the taxpayers agree not to cheat while the government gets the same average tax" (p.129).

[8] Indeed, wage rates in two markets should not differ too much because of low effective marginal direct tax burden (see footnote 6) on the one hand, and a risk premium of less than one-third of the wage rate in the formal sector (income tax and employer's share in social security contributions "saved" by informal employment of a welfare recepient that he/she may bargain over this rate with his/her employer) on the other.

We explore condition (5.1) at length.[9] Rewrite (5.1) as

$$\begin{cases} u_i(G_i, \bar{L}) > \mathrm{E}u_i(Y_i|h_i = \tfrac{1}{2}, \bar{L} - \tfrac{1}{2}) + v_i(e_i|h_i = \tfrac{1}{2}) & (5.1.a) \\ u_i(G_i, \bar{L}) > \mathrm{E}u_i(Y_i|h_i = 1, \bar{L} - 1) + v_i(e_i|h_i = 1) & (5.1.b) \end{cases}$$

Total differentiation of these conditions and algebraic rearrangment of terms including substitution of $dY_i = (\mathrm{E}Y_i|h_i = \tfrac{1}{2}) - G_i$ and $dL_i = L_i(0) - L_i(\tfrac{1}{2}) = -\tfrac{1}{2}$ into inequality (5.1.a), and $dY_i = (\mathrm{E}Y_i|h_i = 1) - G_i$ and $dL_i = L_i(0) - L_i(1) = -1$ into inequality (5.1.b), where $\mathrm{E}Y_i = w_i[h_{i1}(1-\theta_i) + h_{i0}(1 - p\theta_i(1+\pi))] + G_i + D_i\theta_i$ [from (2) and (3)], gives:

$$\begin{cases} ((\mathrm{E}Y_i|h_i = \tfrac{1}{2}) - G_i)\left(\dfrac{\partial u_i(0)}{\partial Y_i} - \dfrac{\partial u_i(\tfrac{1}{2})}{\partial Y_i}\right) > \dfrac{1}{2}\left(\dfrac{\partial u_i(0)}{\partial L_i} - \dfrac{\partial u_i(\tfrac{1}{2})}{\partial L_i}\right) + v'_i(e_i|h_i = \tfrac{1}{2}) & (6.1.a) \\ ((\mathrm{E}Y_i|h_i = 1) - G_i)\left(\dfrac{\partial u_i(0)}{\partial Y_i} - \dfrac{\partial u_i(1)}{\partial Y_i}\right) > \left(\dfrac{\partial u_i(0)}{\partial L_i} - \dfrac{\partial u_i(1)}{\partial L_i}\right) + v'_i(e_i|h_i = 1) & (6.1.b) \end{cases}$$

That is, income maintenance recipients who chose not to work do so as a result of the prohibitive offset rates, which seems to be inescapable without deliberate false reporting to social security authorities. This decision is at least partially motivated by strong disutility from cheating.

Assuming that this group has $v_i(e_i) < 0; v'_i(\cdot) > 0;$ for any positive e_i, and provided that $u_i(\cdot,\cdot)$ exhibits decreasing marginal utility in both arguments, we note that conditions (6.1.a) and (6.1.b) hold because all RHS terms are negative while LHS is positive for each. In fact, condition (6.1.b) is redundant because its LHS is larger than the LHS in (6.1.a), and its RHS is smaller than the RHS in (6.1.a).

We depict condition (5.1) in Figure 1.a, and conditions (5.2) and (5.3) in Figures 1.b and 1.c, respectively. Each figure shows total utility for individual *i* as the sum of two

[9] Conditions (5.2) and (5.3) are elaborated in a similar fashion. Details can be obtained upon request.

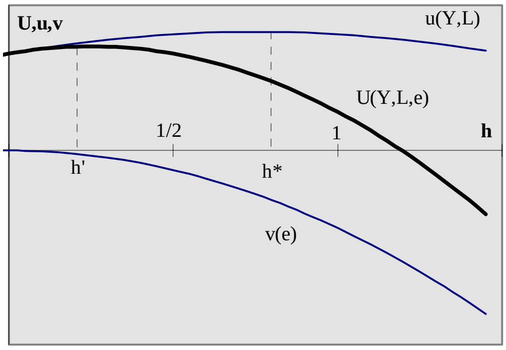
elements. *u(Y,L)* is the utility function in the standard labor supply decision, its optimum being at h^* hours of work.[10] Adding $v_i(\cdot)$, whose value depends on individual attitudes toward cheating, determines optimal hours of work as a solution to the maximization problem of *U(Y,L,e)*, denoted as *h'*, *h''* and *h'''*. With this as the optimum, the closest feasible position is chosen given the existing labor market structural restrictions $\left\{0, \tfrac{1}{2}, 1\right\}$.

Verbally, this decision process can be summarized as follows:

- Individual *i* remains outside the labor market when distaste for work and cheating is stronger than utility from additional earnings, partially offset against income maintanance if earned in the formal sector, or substantially diminished by probable enforcement if earned in the informal sector;
- Individual *i* takes a part-time job when his utility from additional disposal income net of disutility from part-time work is stronger than aversion to possible cheating, but short of distaste for the large-scale cheating indispensible for taking a full-time job;
- Individual *i* works full time when utility from disposal income prevails against disutility from work, while cheating - necessary to keep most of his earnings out of offset - is either enjoyable or not very disturbing.

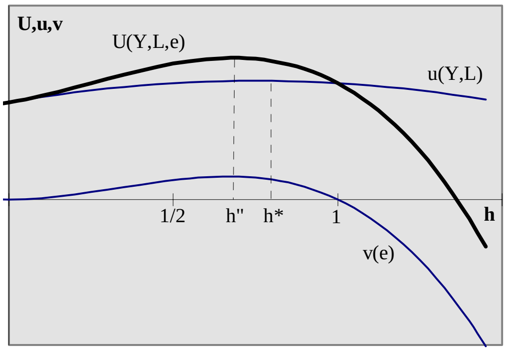
[10] Note that in Figure 1, without limiting generality, concealed income is not an argument of *u(.)*, but affects *v(.)*. Alternatively, h^* may be seen as a solution of $u(., e_i)$.

Figure 1. Income maintenance recipients’ choices and utility components



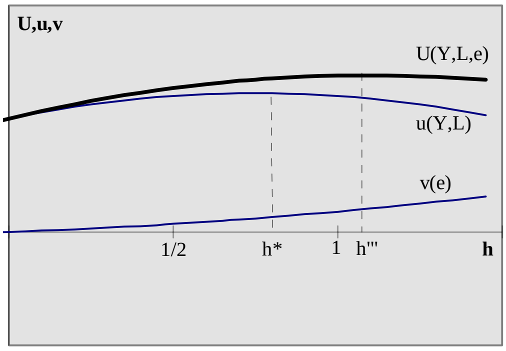
a. The closest feasible position to *h’* is:

Unemployment



b. The closest feasible position to *h’’* is:

Part-time employment



c. The closest feasible position to *h’’’* is:

Full-time employment

4. Econometric model

This decision framework gives rise to the following econometric model.

Let $U_i = U(u_i[Y_i(e_i, h_i), L_i]; v_i[e_i])$ be $U_i \equiv \alpha' Z_i = \alpha_1 u_i[Y_i(e_i, h_i), L_i; X_{1i})] + \alpha_2 v_i[e_i(X_{2i})]$, where X_{1i} and X_{2i} are vectors of individual *i* characteristics, controlling for heterogeneity of tastes in the econometric model; α_1 and α_2 are weights of the two utility components. Provided the regressors u_i and v_i are in hand (obtained with the procedures detailed below), and assuming a stochastic error term $\varepsilon_i \sim N(0,1)$, the standard ordered probit model (7) is required for estimation of the weights α and the threshhold μ determining choice between part- and full-time jobs: [11]

$$U_i^* = \alpha' Z_i + \varepsilon_i \tag{7}$$

with individual employment mode as the observed indicator of the latent variable U_i^*:

$h_i = 0$	if	$U_i^* \leq 0$	then	$\Pr(h_i = 0 \mid Z_i) = 1 - \Phi(\alpha' Z_i)$
$h_i = \frac{1}{2}$	if	$0 < U_i^* \leq \mu$	then	$\Pr(h_i = \frac{1}{2} \mid Z_i) = \Phi(\mu - \alpha' Z_i) - \Phi(-\alpha' Z_i)$
$h_i = 1$	if	$U_i^* > \mu$	then	$\Pr(h_i = 1 \mid Z_i) = 1 - \Phi(\mu - \alpha' Z_i)$

A principal challenge posed by this model is the explicit construction of two utility components to serve as regressors in (7), the main model. Starting with the second component, $v_i[e_i(X_{2i})]$, notice that it is censored because the scope of concealed earnings $e_i = w_i h_{i0}$ (derived from the HES by the backward computation detailed in Section 2) is observed only for employed income maintenance recipients. For that reason, we specify v_i as a function of propensity to cheat, e_i^*, defined as $e_i^* = \gamma' X_{2i} + \eta_i$, where $\eta_i \sim N(0, \sigma_\eta^2)$.

[11] The first threshhold, which separates unemployment from a part-time job, is normalized to 0.

Parameters γ and σ_η are estimated by maximum likelihood in the Tobit model[12] with e_i being the observed counterpart of e_i^*:

$$Log\ L = \sum_{e_i > 0} \log\left[\frac{1}{\sigma_\eta}\phi\left(\frac{e_i - \gamma' X_{2i}}{\sigma_\eta}\right)\right] + \sum_{e_i = 0} \log\left[1 - \Phi\left(\frac{\gamma' X_{2i}}{\sigma_\eta}\right)\right] \tag{8}$$

The conditional mean function of the latent variable $\hat{\gamma}' X_{2i}$ is thereafter substituted into (7).

Derivation of the first regressor in (7), $u_i[Y_i(e_i, h_i), L_i; X_{1i}]$ is more involved, because it requires combined estimation of participation decision, labor supply with nonlinear budget set, and choice under uncertainty. In this part, our econometric model closely resembles Hausman's (1985) model; we thus keep the exposition as brief as possible.

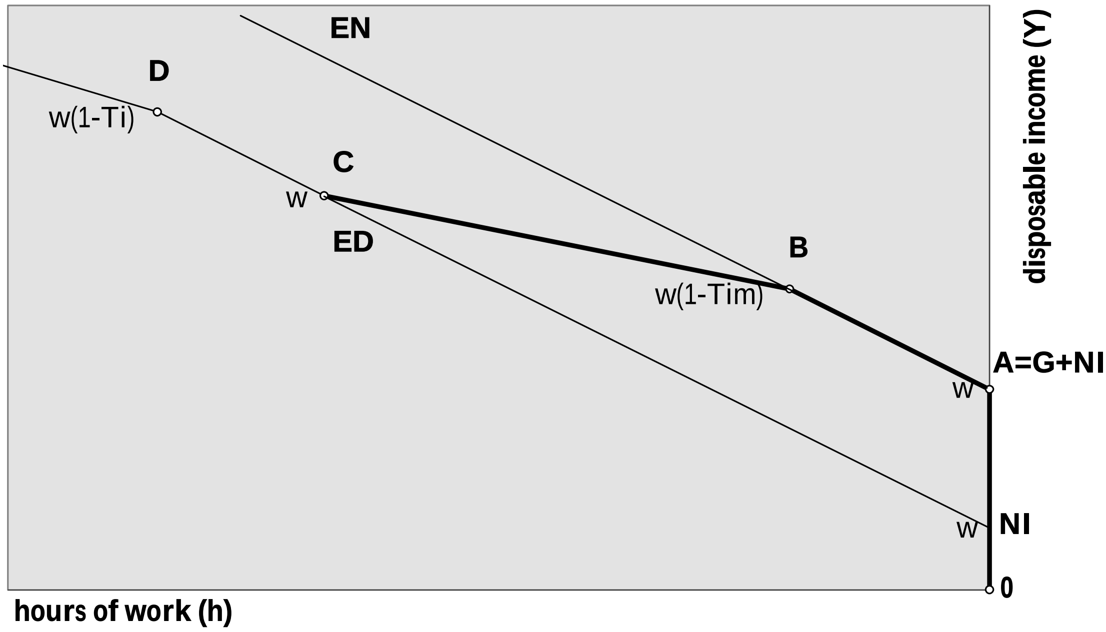
Figure 2 presents the typical budget set faced by a welfare recipient when deciding about his labor supply in the two (formal and informal) markets given uncertainty as to whether his participation in the informal market will be detected. If detected, the cheater's eligibility for income maintenance will be suspended, together with numerous other public sector benefits.

A welfare recipient has non-labor non-welfare income NI and welfare benefits G. For an honest recipient, welfare is offset at rate T_{im} against the income from work (with hourly wage rate *w*) above disregard (point B) till the break-even point (point C), where welfare benefits phase out. Income from work above the tax threshhold (point D) is taxed at rate T_i. Thus, the budget set for an honest welfare recipient is A-B-C-D. If a recipient

[12] The Tobit model, commonly used for estimation of the extent of tax noncompliance, perfectly fits our context: Those who do not work would or would not cheat if working, depending on their attitudes toward cheating. See Andreoni, Erard, and Feinstein (1998) for a discussion of Tobit model shortcomings, and for a survey of alternative estimation tehniques.

who conceals his earnings (above disregard) remains undetected, his/her budget constraint is A-B-EN. If the fraud is detected, the individual loses welfare benefits and faces the budget set O-NI-ED (the budget constraint for non-income maintenance recipients).

Figure 2. Budget sets of compliant and cheating welfare recipient



We proceed by assuming linear specification of the labor supply function

$$h_i^* = \delta_w w_i + \delta_y Y_i + s_i \tag{9}$$

where h_i^* is the individual's preferred hours of work, and $s_i = \delta_X ' X_{1i}$ denotes difference in tastes. For working welfare recipients, the indirect utility function that corresponds to the labor supply function (9) is:

$$V(w,Y) = \exp(\delta_y w)\left(Y + \frac{\delta_w}{\delta_y} w - \frac{\delta_w}{\delta_y^2} + \frac{s}{\delta_y} \right) \tag{10}$$

The corresponding direct utility function at zero hours of work is:

$$u(0,\overline{G}) = \exp\left(-\left(\frac{\delta_y^2\tilde{G} + \delta_y s}{\delta_w}\right)\right)\left(\frac{-\delta_w}{\delta_y^2}\right) \qquad (11)$$

where $\tilde{G}$ is non-work income at zero hours worked, including welfare payments.

Applying the von Neumann-Morgenstern expected utility concept indicates that a decision not to cheat is made if the individual is better off if participating only in the formal labor market (U_{WN}) rather than gambling between being caught cheating (U_{ED}) and being undetected (U_{EN}):

$$U_{WN} \geq pU_{ED} + (1-p)U_{EN} \qquad (12)$$

This condition can be restated[13] as an indirect utility function (10):

$$g(s_i) = V(w, Y_{WN}) - [pV(w, Y_{ED}) + (1-p)V(w, Y_{EN})] \geq 0 \quad for \quad h_i^* > 0 \qquad (13)$$

where Y_{WN}, Y_{ED} (=A) and Y_{EN} (=NI) denote virtual non-work income corresponding to the three budget sets depicted on Figure 2. For consistency with the theory of choice under uncertainty, which rests on the cardinality of the utility function, we parametrize $V(\cdot)$, as $-V^{-\lambda}/\lambda$ with $\lambda \leq -1$, following Hausman's (1985) specification. The implicit function $g(s_i \mid \lambda) = 0$ can be solved for each individual conditional on his participation, given the specific value of the probability of detection.[14] Condition (13) has the implicit solution $s_i^* \mid \lambda$ such that for any $s_i \geq s_i^*$, welfare recipient is found not to conceal earnings (and

[13] What makes this transformation possible is the separability of the 'monetary' effect of cheating (which determines a level of state-dependent income or consumption), represented by $u_i(.)$, and the 'conscience' effect, manifested through $v_i(.)$. The transition from (12) to (13) holds when $v_i(.)$ is either positive, or negative and sufficiently close to zero.

[14] Since the probability of detection is assumed to be exogenous, we impute it at the average level of frequency of inspections, according to the broad classes defined by the National Insurance Institute (NII). The frequences are taken from an NII internal report on the monitoring of recipient eligibility to income maintenance.

employment) from social security authorities.

Individual i stays unemployed if $U_{UE} > \max(U_{WN}, [pU_{ED} + (1-p)U_{EN}])$. Note that there is no uncertainty in the participation decision; therefore, it is independent of s_i^*. The only difficulty with its estimation is that the market wage rate is unknown for non-working individuals. We impute it after estimating a standard wage equation on a subsample of working welfare recipients. In our data, there is no evidence of the self-selectivity bias usually ascribed to the participation decision, possibly due to the homogeneity of the reservation wage and the effective human capital characterizing our sample of welfare recipients.[15]

Stochastic specification of the model allows for two sources of stochastic variation, as discussed at length in Hausman (1985). The first one, stemming from unaccounted heterogeneity of tastes for work s_i and from inexact matching of the linear specification of the labor supply function,[16] is a zero-mean additive disturbance, τ_i; so, $S_i = \delta_X' X_{1i} + \tau_i = s_i + \tau_i$. The second source is related to measurement errors in the hours of work: $h_i = h_i^* + \varsigma_i$. First, substituting S_i into h_i^* (Equation (9)), then h_i^* into h_i, yields $h_i = \delta_w w_i + \delta_y Y_i + s_i + \varphi_i$, where $\varphi_i = \tau_i + \varsigma_i$. Provided joint in dependent normality of τ_i and ς_i,

$$(S_i, \varsigma_i) \sim N(\delta_X' X_{1i}, 0; \sigma_\tau^2, \sigma_\varsigma^2; 0)$$

$$(\varphi_i, \tau_i) \sim BN(0,0; \sigma_\varphi^2, \sigma_\tau^2; \rho) \quad where \quad \sigma_\varphi^2 = \sigma_\tau^2 + \sigma_\varsigma^2; \rho = \sigma_\tau / \sigma_\varphi .$$

[15] The estimate of the selectivity term in the wage equation (estimated with Heckman's (1979) technique) is 0.11 and statistically insignificant. Estimation details are available upon request.

[16] It may include also non-pecuniary aspects of labor market participation like self-esteem, social norms toward work, welfare recipient's stigma, and depreciation of human capital during stay on welfare.

Hausman (1985) also allows for a third source of variation: by varying the value of λ across the population according to a normal distribution. Considering that estimation of the model with three stochastic errors is computationally burdensome, and that estimates in the model with varying λ are reported to be similar to estimates in the constant parameter model, we embrace the two-errors specification with constant λ. The optimal value of λ is found via a grid search.[17]

We are now ready to construct the likelihood function. For an unemployed welfare recipient $\varsigma_i \leq 0$; hence, the likelihood of observation is simply

$$l_{1i} = \Pr(\varsigma_i \leq 0) = 1 - \Phi\left(\frac{\delta_w w_i + \delta_y \tilde{G}_i + s_i}{\sigma_\varsigma}\right). \tag{14}$$

A welfare recipient with positive hours of work is either cheating, or not. In the latter case, the likelihood of observation is

$$l_{2i} = \Pr(\varphi_i | S_i \geq s_i^*) = \left[1 - \Phi\left(\frac{(s_i^* - s_i)/\sigma_\tau - \rho\varphi_i/\sigma_\varphi}{\sqrt{1-\rho^2}}\right)\right]\frac{1}{\sigma_\varphi}\phi\left(\frac{h_i - (\delta_w w_i + \delta_y Y_{WN} + s_i)}{\sigma_\varphi}\right). \tag{15}$$

This expression represents the individual's labor supply choice subject to a piecewise-linear budget constraint. Using the Burtless and Hausman (1978) estimation technique, we arrive at l_{2i} for our specific budget set A-B-C-D in Figure 2 as given in Appendix A.

If the individual is working and cheating (his/her labor supply is then defined subject to the budget set A-EN in Figure 2), the likelihood of observation is

$$l_{3i} = \Pr(\varphi_i | S_i < s_i^*) = \Phi\left(\frac{(s_i^* - s_i)/\sigma_\tau - \rho\varphi_i/\sigma_\varphi}{\sqrt{1-\rho^2}}\right)\frac{1}{\sigma_\varphi}\phi\left(\frac{h_i - (\delta_w w_i + \delta_y \tilde{G} + s_i)}{\sigma_\varphi}\right). \tag{16}$$

Thus, the log-likelihood of the sample is

[17] Hausman's (1985) estimate of λ was -4.5.

$$L = \sum_{h_i=0} \log l_{1i} + \sum_{h_i>0;\, e_i=0} \log l_{2i} + \sum_{h_i>0;\, e_i>0} \log l_{3i} \quad (17)$$

We summarize the estimation procedure, step-by-step, as follows:

a. Using Household Expenditure Survey data on received income maintenance benefits, backwards compute [from Eq. (1)] the earnings declared to the social security authorities. The (negative) difference between this value and labor income reported in the Survey represents an estimate of concealed earnings.

b. With this (censored) variable in hand, estimate propensity to cheat by the Tobit model (8). Results are given in Table 1. Compute and retain the predicted values.

c. Having estimated the standard wage equation on the sample of working welfare recipients, impute the market wage to the non-participating individuals.

d. Solve the implicit function (13) for s_i^* and estimate parameters of the log-likelihood function (17). Results are given in Table 2.

e. By substituting estimates of a set of the preference parameters - net wage elasticity, virtual nonlabor income elasticity and slopes of the variables controlling for heterogeneity in tastes - into the indirect utility function (10) or direct utility function (11), construct the conditional mean function of utility ($\hat{u}_i$) for each welfare recipient.

f. To estimate the main model’s parameters, substitute the expected values of utility and propensity to cheat as regressors in (7). The results are given in Table 3.

5. Estimation results

After having estimated the extent of informal labor market earnings, we proceed with estimation of propensity to cheat by means of the Tobit model (see Table 1). Definitions of the variables are given in Appendix B. With the exemption of two variables - immigrant status and eligibility for full welfare benefits - the explanatory variables used in the estimation are standard socio-demographic characteristics. Their impact on propensity to cheat matches, in general, findings from empirical studies of factors influencing tax evasion.[18] Elderly welfare recipients tend to cheat less, as do more educated persons and earners with many dependents. Other factors being equal, single mothers in Israel are more inclined to conceal their earnings from social security authorities, probably because they are not obligated to prove their inability to work to retain eligibility for income maintenance.

Table 1. Estimates of propensity to cheat.

Explanatory variable	Estimate	Standard error
Age	-0.218	0.129
Number of children	-0.129	0.110
Education	-0.769	0.339
Immigrant	0.561	0.321
Single mother	0.724	0.301
Full welfare benefits	1.576	0.400
Constant	-3.308	1.055
σ_η	1.973	0.181
Log-likelihood / Number of observations	-884.0 / 446	

[18] See Andreoni et al. (1998) for a survey.

Adding a dummy variable for immigrant status to the list of socio-demographic characteristics is required for Israel where almost one million new immigrants (about a fifth of the country's population on the eve of the wave of mass immigration that began in 1989) have been absorbed in the 1990s; most immigrants came from the former U.S.S.R. Every second welfare recipient is an immigrant (see Apendix B). The positive estimate of the slope for this variable suggests that immigrants have a higher propensity to cheat than do veteran immigrants or native Israelis. As has been found in numerous sociological studies, former Soviet citizens generally have lower regard for government than do naitive Israelis. Coming from a country where 'beating the system' was the name of the game, many new immigrants often do not accept obedience to government laws as taken-for-granted, normative behavior.

After controlling for other factors, scope of welfare benefits was found to encourage cheating. While being quite counterintuitive, this positive correlation may result from a technical factor - the sample's high relative frequency of couples with children amongst cheaters - because this category of recipients has the highest benefits.

Table 2 presents maximum likelihood estimates of the labor supply function parameters. As expected, the effect of virtual non-labor income on labor supply (δ_y) is negative, while the effect of net wage rate (δ_w) is positive. Elasticity of monthly hours worked with respect to virtual non-labor income is -0.8. This estimate is somewhat higher than the elasticities reported in most studies of income maintenance experiments (Moffitt and Kehrer, 1981). In contrast to other studies, our estimation procedure explicitly accounts for labor supply in both formal and informal markets. It follows that income elasticity in the informal sector is probably much higher than income elasticity in the regular labor market, given the range of formal market elasticities reported in the experimental studies. Elasticity of monthly hours of work, with respect to net wage rate, is 1.4, an estimate very close to the substitution elasticities found by previous research.

As to the policy implications of the findings regarding the income and price effects, what follows is that decreasing welfare benefits for non-working recipients and lowering the offset rate (or even subsidizing wage) for the working ones may be two ways to encourage their participation in the labor market. We explore this issue at length in Romanov and Zussman (2001).

Table 2. Estimates of cheating and labor supply model.

Explanatory variable	Estimate	Standard error
Virtual non-labor income	-0.463	0.065
Net wage rate	1.486	0.122
Age	-0.479	0.048
Number of children	-0.346	0.072
Education	-0.490	0.187
Immigrant status	0.339	0.210
Single mother	0.690	0.177
Men	0.130	0.284
Constant	0.297	0.281
σ_{τ}	1.216	0.112
σ_{ς}	0.065	0.018
Log-likelihood / Number of observations	-134.7 / 446	

The remaining explanatory variables in Table 2 control for heterogeneity of tastes, parameter *s* in the labor supply function (9). With the exemption of education, the signs of the estimates are as anticipated. Hours of work decline with age and number of children. Immigrants and single mothers work more, other factors held constant. We do not find any significant differences in the labor supply of men as compared to that of women. As for the impact of education on labor supply, which was found to be negative, we propose that this might be due to the very low return on schooling amongst new immigrants. The human capital of this group is effectively depreciated because the imported skills do not fit local labor market needs. However, an interaction between immigration and education was not found to be significantly different from zero.

Worth noting is the relative significance of the two sources of stochastic variation specified in the model. Our estimates show that the variation of unaccounted heterogeneity of taste for work (σ_τ) is about twenty-fold wider than the measurement error in hours worked (σ_ς). Both factors are found to be significant, confirming the appropriateness of specification with two disturbance terms. Convexity parameter of the utility function (λ) which maximizes the log-likelihood is -4, similar to what was found by Hausman (1985).

In the final step of our estimation procedure, we substitute the following, as regressors, into the main model (7): the predicted values of the indirect utility function (V_i) for working welfare recipients or the direct utility function (u_i) for unemployed recipients, and the conditional mean function of latent propensity to cheat, e_i^*, representing a cardinal measure of disutility of fraud (v_i).

The purpose of the main model is to test the validity of working hours constraints manifested through the choice among three states of employment: unemployment, part-time job, and full-time job. This is done with an ordered probit model, which estimates the coefficients of two utility function components. The relative magnitude of the estimates has no economic meaning since utility from work and disutility from fraud may have different scales. What does matter is the weights' significance and signs. Significance would indicate that individuals indeed separate the monetary perks of cheating from moral sentiments like guilt and shame, presumably attached to cheating per se. The third estimated parameter is the threshhold μ, which differenciates between the choice of a part-time and full-time job. Estimates are shown in Table 3.

Table 3. Estimates of the ordered probit model.

Explanatory variable	Estimate	Standard error
Utility from leisure and income	0.088	0.012
Disutility from cheating	0.419	0.034
Threshhold μ	0.355	0.047
χ^2 / Number of observations	118.5 / 446	

The model's good fit supports the assumption regarding relevance of working hours constraints for welfare recipients. The estimates' significance indicates that both factors - utility from disposable income and leisure, and disutility from cheating the government - are important for the participation and labor supply decisions of income maintenance claimants. Therefore, neglecting moral sentiments as a factor of rational decision making may lead to biased conclusions.

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To summarize, the paper suggests a novel analytical and empirical framework for exploring labor market behavior and fraud among welfare recipients. First, cheating is introduced in the form of concealing information from social security authorities concerning the full extent of earnings. Second, the relevance of working hours constraints, when part-time and full-time jobs are the only available employment options, is tested. Third, this framework allows to study labor supply as well as participation decisions. Finally, the model includes estimation of the labor supply decision under uncertainty, subject to a non-linear budget set.

Estimation of the behavioral model reveals a number of interesting results. We find that immoral aspects are seriously taken into consideration when individual decisions involve illegitimate actions such as fraudulent collection of welfare benefits, and are perceived as separable from the economic consequences of these actions. In addition, working hours constraints do provide obstacles to welfare recipients' labor market participation. However, having established the relevance of both factors for labor supply, we believe that by imposing rocketing effective marginal tax rates, the inadequate structure of the means test used by Israel's income maintenance program, discourages supported families from integrating in the labor market, thereby trapping them in poverty.

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Appendix A

The likelihood of observing a welfare recipient with non-zero working hours, who reports all his earnings to social security authorities, and whose budget constraint is ABCD (Figure 2), is

$$l_{2i}=\left[\Phi\left(\frac{\rho\varphi_{1i}/\sigma_{\varphi}-(s_i^*-s_i)/\sigma_{\tau}}{\sqrt{1-\rho^2}}\right)\right]\frac{1}{\sigma_{\varphi}}\phi\left(\frac{\varphi_{1i}}{\sigma_{\varphi}}\right)$$

$$+\left[\Phi\left(\frac{\bar{h}_{Bi}-(\delta_w w_{2i}+\delta_y Y_{2i}+s_i)}{\sigma_{\tau}}\right)-\Phi\left(\frac{\bar{h}_{Bi}-(\delta_w w_{1i}+\delta_y Y_{1i}+s_i)}{\sigma_{\tau}}\right)\right]\frac{1}{\sigma_{\tau}}\phi\left(\frac{h_i-\bar{h}_{Bi}}{\sigma_{\tau}}\right)$$

$$+\left[\Phi\left(\frac{\rho\varphi_{2i}/\sigma_{\varphi}-(s_i^*-\tilde{s}_i)/\sigma_{\tau}}{\sqrt{1-\rho^2}}\right)-\Phi\left(\frac{\rho\varphi_{2i}/\sigma_{\varphi}-(s_i^*-s_i)/\sigma_{\tau}}{\sqrt{1-\rho^2}}\right)\right]\frac{1}{\sigma_{\varphi}}\phi\left(\frac{\varphi_{2i}}{\sigma_{\varphi}}\right)$$

$$+\left[\Phi\left(\frac{\rho\varphi_{3i}/\sigma_{\varphi}-(s_i^*-s_i)/\sigma_{\tau}}{\sqrt{1-\rho^2}}\right)-\Phi\left(\frac{\rho\varphi_{3i}/\sigma_{\varphi}-(s_i^*-\tilde{s}_i)/\sigma_{\tau}}{\sqrt{1-\rho^2}}\right)\right]\frac{1}{\sigma_{\varphi}}\phi\left(\frac{\varphi_{3i}}{\sigma_{\varphi}}\right)$$

$$+\left[\Phi\left(\frac{\bar{h}_{Di}-(\delta_w w_{4i}+\delta_y Y_{4i}+s_i)}{\sigma_{\tau}}\right)-\Phi\left(\frac{\bar{h}_{Di}-(\delta_w w_{3i}+\delta_y Y_{3i}+s_i)}{\sigma_{\tau}}\right)\right]\frac{1}{\sigma_{\tau}}\phi\left(\frac{h_i-\bar{h}_{Di}}{\sigma_{\tau}}\right)$$

$$+\left[\Phi\left(\frac{(s_i^*-s_i)/\sigma_{\tau}-\rho\varphi_{4i}/\sigma_{\varphi}}{\sqrt{1-\rho^2}}\right)\right]\frac{1}{\sigma_{\varphi}}\phi\left(\frac{\varphi_{4i}}{\sigma_{\varphi}}\right)$$

where

- subscript 1 referrs to section AB of the budget constraint, subscript 2 referrs to section BC of the budget constraint, etc.;
- $\bar{h}_{Bi}, \bar{h}_{Di}$ are working hours of individual *i* at the kink points B and D, respectively;
- w_{ji} is net (after offset and income tax) wage rate;
- Y_{ji} is virtual income of individual *i* at section *j* of the budget constraint (j=1,2,3,4).

As defined in Section 4, $\varphi_{ji}=h_i-(\delta_w w_{ji}+\delta_y Y_{ji}+s_i)$. $\tilde{s}_i$ is a value of s_i at which an individual's indifference curve is tangent to sections BC and CD of the budget set ABCD. For the indirect utility function (10), $\tilde{s}_i=1/q[\delta_y(Y_{3i}-qY_{2i})+\delta_w(w_{3i}-qw_{2i})-\delta_w/\delta_y(1-q)]$, where $q=\exp(\delta_y(w_{2i}-w_{3i}))$.

Appendix B

The following table presents the explanatory variables (in alphabetical order) used in estimation of the behavioral model. Certain variables were normalized to ease the computational burden. Details are available upon request.

Variable	Definition	Units[a]	Mean[b]
Age	Welfare recipient's age	years	41.6
Education	Years of schooling completed in all types of educational institutions	years	12.1
Full welfare benefits[c]	Statutory income maintenance payments (before offset)	NIS	1,975
Immigrant status	Dummy variable, 1 if recipient immigrated after 1989		43.5
Men	Dummy variable, 1 for male welfare recipient		39.7
Net wage rate[c]	Hourly wage net of marginal offset rate	NIS	12.8
Number of children	Number of children under 18 in welfare recipient's nuclear family		1.7
Single mother	Dummy variable, 1 for single mother		30.7
Virtual non-labor income[c]	Intercept that equals non-labor income of the budget set that the individual faces at the margin	NIS	2,033

[a] The average exchange rate in 1997, the year the data was collected, was US$1=NIS3.45.
[b] For dummy variables, the percentage of 1-group is presented. Percentages of the 0-group sum up to 100%.
[c] For comparison, in 1997 the average gross monthly wage for employee post was NIS5,446, whereas the average minimum hourly wage was NIS12.4.