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6597
2017

July 2017

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CESifo

Impressum:

CESifo Working Papers
ISSN 2364-1428 (electronic version)
Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH
The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute
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Editors: Clemens Fuest, Oliver Falck, Jasmin Gröschl
www.cesifo-group.org/wp

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CESifo *Working Paper No. 6597*
Category 1: Public Finance

Leveraging Wage Subsidies to Facilitate Fair Wages and Increase Social Welfare

Abstract

Wage subsidies can be provided directly to the worker, as in the federal Earned Income Tax Credit (EITC) program. They can also be provided indirectly by subsidizing the employer; by reducing the cost of labor, employers are induced to offer higher wages. The standard literature stipulates that the identity of the entity that is statutorily entitled for the subsidy bears no implications for the economic incidence. We propose and test a mechanism by which indirect subsidies can lead to higher social welfare. A substantial empirical literature establishes that workers reciprocate gifts in the form of higher wages with the gift of exerting higher effort. Thus, if a wage subsidy is implemented by indirectly subsidizing employers, employers face a lower cost of labor and increase their wages, leading workers to reciprocate with higher effort and productivity than achieved by providing the equivalent direct subsidy. A controlled laboratory experiment supports our behavioral hypotheses and confirms the behavioral and welfare implications.

JEL-Codes: C920, H210, H220, H530, J330.

Keywords: wage subsidies, welfare, gift exchange, tax incidence.

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This version: May 31, 2017
We thank Raj Chetty, Omer Moav, Yona Rubinstein, and participants at seminars at Bar-Ilan University and the Interdisciplinary Center Herzliya, Economic Science Association International Meeting, Jerusalem, Cesifo Behavioral Economics Area conference, and the Incentives and Behavior change conference, Tel-Aviv for useful comments and discussion. This research was supported by the ISRAEL SCIENCE FOUNDATION (grant No. 552/14).

1 Introduction

Wage subsidy programs constitute a major component of welfare systems in most OECD countries. These programs serve the purpose of poverty alleviation and redistribution. The federal Earned Income Tax Credit (EITC) program in the US provides a salient example. This program was first introduced in 1975, reflecting wide concerns about the efficacy of the negative income tax (NIT) system as a means to reduce poverty due to its inherent disincentive effects on labor market activity. Unlike the NIT system, which guarantees a minimum standard of living to everyone, the EITC is a refundable tax credit that is targeted at the working poor. In 2010, 25 million families benefited from the tax credit at the total cost to the federal government of $61 billion (Tax Policy Center, 2013). The EITC program has gained much popularity in the public as it focuses on the 'deserving poor' class, namely individuals who participate in the labor market and exhibit efforts to make a living rather than taking the advantage of a generous welfare system (or, worse, engaging in misreporting in order to prove eligibility). Eissa and Hoynes (2011) provide a review of the voluminous empirical literature examining the labor-supply responses and the re-distributive implications of the EITC program.

The EITC program is essentially a wage subsidy given directly to the workers via the federal income tax system. Alternatively, wage subsidies to the working poor can be implemented by indirectly subsidizing their actual (or would be) employers. By doing so, the government can reduce the cost of labor faced by the employers and induce them to offer higher wage rates. The extent to which this indirect subsidy will shift to workers (the subsidy economic incidence) depends on the market structure, and in particular on the labor demand and labor supply elasticities. The standard literature stipulates the irrelevance of statutory incidence: the identity of the entity that is statutorily entitled for the subsidy bears no implications for the economic incidence, that is, who will actually gain from the subsidy. In contrast, we develop a theoretical argument introducing a novel channel by which indirect subsidies (IDS) may lead to an efficiency gain compared to direct subsidies (DS). We report on a laboratory experiment validating our behavioral assumption and confirming our conclusions in simple labor relationship.

Our theoretical analysis is rooted in the notions of fair wages and gift exchange. Akerlof (1982) analyzed employer-worker relations as a gift-exchange in which the employer gives a gift in the form of a fair wage (wages above the competitive equilibrium

level) and the workers reciprocate with the gift of exerting higher effort than the minimum contractible levels (see also Akerlof and Yellen, 1988; Akerlof and Yellen, 1990). The insight driving our results is the following. Indirect subsidies are shifted to the worker as part of the wages paid by the employer. Thus, by reducing the cost of labor, indirect subsidies allow the employer to offer a fair wage, incentivizing the worker to increase voluntary effort and thereby overall productivity. Direct subsidies, on the other hand, are paid directly to the worker and do not enter the gift exchange relationship between the worker and the employer.

The welfare dominance of the indirect-subsidy regime over direct subsidization is premised on the labor market incompleteness. The inability to remunerate based on the observable (or ex-post verifiable) effort levels introduces a positive externality, not accounted for by the profit-maximizing employer, which implies that the wage rate and effort level set in the laissez-faire equilibrium are inefficiently low. Assuming, in line with our experimental evidence, that workers respond to the direct compensation received from the employer (excluding any direct subsidies provided by the government), rather than to the total compensation, implies that a direct subsidy scheme operates like a lump-sum transfer, inducing a pure income effect, thereby affecting neither the choice of the worker, nor that of the employer. In contrast, the indirect subsidy regime induces a substitution effect, as the employer shifts part of the subsidy to the worker, offering a higher wage rate that in turn, yields a higher effort level. This serves to mitigate the distortion in the labor market and enhance welfare.

We ran a controlled laboratory experiment to test the assumptions underlying the theoretical analysis, and the predicted efficiency enhancing properties of indirect subsidies. We build on the bilateral gift exchange game first studied by Fehr et al. (1998), and introduce direct- and indirect-subsidy regimes. The results support the assumption that workers respond to the gross wages set by the employer. Consistent with our theoretical prediction, indirect subsidies lead to higher overall efficiency than direct subsidies for the same level of subsidies.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 presents the theoretical analysis, followed by the normative analysis in Section 4. Sections 5 and 6 describe the experimental design and results, respectively, and Section 7 concludes.

2 Related literature

This paper brings together two strands of the literature. On one hand, we contribute to the literature testing statutory tax incidence equivalence. Our approach differs from the existing literature in that we do not test violations of theoretically predicted tax incidence irrelevance, but propose and test a new theory that predicts that behavioral and economic outcomes are sensitive to the tax liability side. On the other hand, we build on the experimental study of labor relations as gift exchange. To the best of our knowledge, the only other paper that tested tax side equivalence in a gift exchange environment is Riedl and Tyran (2005), discussed below.

Empirical studies have shown that statutory tax incidence equivalence predicted by theory does not necessarily hold in the laboratory or in the field. Examples include inclusive vs. exclusive taxes (Chetty, Looney, and Kroft, 2009; Feldman and Ruffle, 2012) and income vs. sales taxes (Blumkin, Ruffle, and Ganun, 2012; Riedl and Van Winden, 2012). Closer to the current research, several studies looked at the effect of the tax liability side on economic outcomes. Kerschbamer and Kirchsteiger (2000) looked at simple ultimatum bargaining, where a lump sum tax is levied either on the proposer or on the responder after reaching an agreement. The results show that the tax liability side influenced the economic outcome, with the tax tending to 'stick where it lands'. Nonetheless, other studies have found that the the tax liability side had no effect in competitive markets (Borck et al., 2002; Ruffle, 2005; Sausgruber and Tyran, 2005).

The experimental interest in labor relations as a gift exchange started with Fehr, Kirchsteiger, and Riedl (1993), who studied a market with excess labor supply and gift exchange. Their results established that employers offer wages that are significantly above the equilibrium prediction under the assumption of pure money maximizers; that workers exert effort beyond the minimum effort dictated by selfish preferences; and that higher wages lead to higher effort. In a follow up study, Fehr et al. (1998) tested whether the high wage offers observed in the market are driven by an attempt to attract workers or by the gift exchange effect. They found that behavior in a bilateral gift exchange game, in which an employer and a worker are exogenously matched, is similar to that observed in the gift exchange market of Fehr, Kirchsteiger, and Riedl (1993). A complete contracts market, in which workers who accept a wage offer are committed to exerting full effort, however, resulted in low wage offers and unemployment, showing that firm competition

in itself can not explain the high wages observed in the gift exchange market. Sundry studies followed up on these pioneering efforts, establishing the existence and robustness of reciprocal labor relations (e.g., Bellemare and Shearer, 2009; Brandts and Charness, 2004; Charness, 2004; Gneezy and List, 2006; Kube, Marechal, and Puppe, 2012; Kube, Maréchal, and Puppe, 2013; Maximiano, Sloof, and Sonnemans, 2007).

Closely related to our paper is the experiment by Riedl and Tyran (2005), who studied a gift exchange market with excess supply and a linear production function. Following Kerschbamer and Kirchsteiger (2000), Riedl and Tyran (2005) conjectured that the tax liability side effects the perceptions of social norms. Since social norms play an important role in gift exchange markets—as in the ultimatum game studied by Kerschbamer and Kirchsteiger (2000)—Riedl and Tyran (2005) hypothesized that liability side equivalence may break down in such markets. In their experiment, each employer-worker pair had to pay a specific (lump-sum) tax of 20 units. In different phases of the experiment the tax was levied on either the employer or the worker. Although effort and wages were strongly correlated, the effort levels were not significantly affected by the tax incidence.

This study differs from our experiment in several respects. First, our interest is in the normative welfare analysis, which is absent in Riedl and Tyran (2005), who did not provide a formal theoretical framework for their experiment, and were interested in testing tax equivalence empirically. More importantly, as we show in the theoretical analysis below, the statutory incidence is relevant for equilibrium effort decisions in a model that incorporates gift-exchange preferences with *proportional*, rather than lump-sum tax. Thus, our theoretical analyses predicts both the tax equivalence found in Riedl and Tyran (2005) and the violation of tax equivalence in our experiment, which implements proportional subsidies in a gift exchange game framework.

3 Theoretical model

Consider a labor market with an equal number of firms and workers (each normalized to a unit measure with no loss in generality).[1] Each firm can employ at most one worker

[1]The partial equilibrium framework with a fixed number of firms and workers will be the relevant setting for our experimental part. In the theoretical analysis we also consider the extension to the general equilibrium case with free entry of firms in section 4 below.

and its output, denoted by x, is given by the following production function:

$$x = f(e), \tag{1}$$

where $f' > 0$, $f'' \leq 0$ and e denotes the level of (non-contractible) effort exerted by the hired worker.

The preferences of a typical worker are represented by the following utility function:

$$u(w, e) = w - h(e) + \alpha v(w, e), \tag{2}$$

where w denotes the total compensation paid by the firm to the worker, $h(e)$ denotes the cost of effort and $v(w, e)$ represents the worker's psychological utility obtained from gift exchange.

We assume that the cost of effort is strictly increasing and strictly convex; namely, $h'(e) > 0$ and $h''(e) > 0$, and further satisfy $h'(0) = 0$. We further assume that there exists some threshold level of compensation, $\hat{w} \geq 0$, such that $v(w, e) = 0$ for all $w \leq \hat{w}$; and $\frac{\partial v}{\partial w} > 0$, $\frac{\partial v}{\partial e} > 0$, $\frac{\partial^2 v}{\partial w \partial e} > 0$, $\frac{\partial^2 v}{\partial e^2} \leq 0$ for all $w > \hat{w}$. Finally, we assume that $\alpha \geq 0$.

Several remarks are in order. For tractability we invoke a quasi-linear functional form (which rules out income effects). The latter is common in the optimal tax literature (see, e.g., Diamond, 1998; Salanie, 2003). The first two terms in (2) are standard and represent the payoff to the worker from receiving the wage w, and exerting an effort e. The third term captures the double reciprocity pattern stressed by the literature on gift-exchange. Provided that the level of compensation crosses a certain threshold setting a benchmark level of 'fair-remuneration', $\hat{w}$, workers derive a strictly positive utility from exerting a positive effort level, which increases with respect to both the level of compensation and the effort level exerted.[2] Wage and effort are complementary, so that the psychological utility that the worker derives from exerting an incremental effort is increasing in the level of remuneration received from the employer. The parameter $\alpha \geq 0$ measures the intensity of the gift exchange component, so that the standard model without social (other-regarding) preferences becomes a special case of our model with $\alpha = 0$ (cf. Rabin, 2013). The assumption that the total compensation does not depend on the level of effort

[2]This approach is roughly equivalent to the models of reciprocal labor relations included in Dufwenberg and Kirchsteiger (2004), Falk and Fischbacher (2006), and Rabin (1993). Our model is context-specific, but allows for a general functional form.

chosen by the worker (as in Akerlof, 1982) reflects a realistic pattern of labor market incompleteness: efforts are often non-verifiable by third parties, even when observed by the employer; hence, remuneration can not be based on the observed level of efforts as this form of contract can not be legally enforced.[3] In the absence of social preference (setting $\alpha = 0$), the effort level chosen by the worker would be zero, so as to minimize the cost of effort, for any level of compensation. Assuming that $\alpha > 0$ implies that the worker would optimally choose a strictly positive level of effort despite the incomplete contract. Furthermore, as will be shown below, by virtue of the complementarity property, the optimal effort level would be increasing in the level of remuneration.

The benchmark level of 'fair remuneration' is likely to vary across societies and industries and to be endogenously determined in the market equilibrium (for instance, it may be affected by minimum wage legislation). For tractability we invoke a simplifying assumption by letting $\hat{w}$ be exogenously given. We further normalize it to zero, with no loss in generality.

The typical firm's payoff function is given by:

$$\pi(w, e) = f(e) - w. \tag{3}$$

We turn next to characterize the benchmark equilibrium in the labor market in the absence of government intervention.

3.1 Benchmark equilibrium

Unless noted otherwise, we analyze in the following the case of $\alpha > 0$, hence setting focus on the case where workers exhibit gift-exchange reciprocal preferences. The protocol of the labor-market game is as follows. First, the employer posts a wage offer w. Next, the worker observes the wage offer and chooses an effort level e. The firm then receives the gains from production $f(e)$ and remunerates the worker.

We solve the two-stage game by backward induction. Starting from the second stage, given a wage w, the worker maximizes the utility in (2) by determining the effort level e. In the first stage, given the optimal response function of the worker, $e(w)$, the firm is

[3] Our qualitative predictions hold if we relax the assumption and allow for labor contracts to depend on verifiable effort levels.

maximizing the profit in (3) by determining the wage w. Formulation of the worker's first-order condition yields:

$$-h'(e) + \alpha \frac{\partial v(w,e)}{\partial e} = 0. \tag{4}$$

Let $e(w)$ denote the optimal effort level chosen by the worker as a function of the wage w, given by the implicit solution to (4). Notice that by virtue of the properties of the utility function in (2) it follows that the second-order condition is satisfied. It further follows that $e(0) = 0$ and $e(w) > 0$ for w>0. Moreover, full differentiation of the first-order condition in (4) with respect to w yields upon re-arrangement (arguments are omitted to abbreviate notation):

$$\frac{\partial e}{\partial w} = \frac{\alpha \frac{\partial^2 v}{\partial e \partial w}}{\left(h'' - \alpha \frac{\partial^2 v}{\partial e^2}\right)} > 0, \tag{5}$$

where the inequality sign follows as $\alpha > 0$ (strict inequality is assumed, otherwise e is zero for any w), $h'' > 0$, $\frac{\partial^2 v}{\partial w \partial e} > 0$ and $\frac{\partial^2 v}{\partial e^2} \leq 0$.

We thus conclude that despite the incomplete contract and due to the gift exchange psychological effect, the optimal effort level chosen by the worker is bounded away from zero for any positive wage offered by the firm and is increasing with respect to the wage offer.

Substituting the optimal effort level $e(w)$ into the production function $f(e)$, letting $g(w) \equiv f[e(w)]$, the firm's payoff function can be re-written as:

$$\pi(w) = g(w) - w. \tag{6}$$

As $f' > 0$ and $\frac{\partial e}{\partial w} > 0$, it follows that $g' > 0$. We further assume that $g'' < 0$ and $\lim_{w \to 0} g'(w) = \infty$.[4]

Formulating the firm's first order condition with respect to w yields:

$$g'(w) = 1 \tag{7}$$

[4]Clearly, the concavity and INADA properties of g impose restrictions on the forms of the production function given in (2) and the utility function given in (3). It is straightforward to verify that these properties of g are satisfied by a large class of commonly used functional forms. For instance, letting $f(e) = e$, $h(e) = \frac{e^2}{2}$ and $v(w,e) = w \ln(e)$, for $w > 0$, implies that $g(w) = e(w) = \sqrt{\alpha w}$. It is straightforward to verify that the function g is strictly concave and satisfies the INADA condition.

The optimal wage offer set by the firm is given by the implicit solution to (7). By virtue of the strict concavity of g, the second-order condition is satisfied. Furthermore, by virtue of the INADA property of g, the optimal wage offer set by the firm is strictly positive.

We thus conclude that, despite the incomplete contract and due to the gift exchange psychological effect, the optimal wage set by the firm is bounded away from zero. The firm does so as it anticipates that the worker will reciprocate to a strictly positive wage offer by exerting a strictly positive effort level

Finally, it is straightforward to verify that in the absence of the gift exchange effect, namely when $\alpha = 0$, $e(w) = 0$ for any wage w and hence the optimal wage rate set by the firm would be zero. Thus, due to the incomplete contract, both the remuneration offered by the firm and the effort level chosen by the worker will be set to zero.

3.2 Policy regimes

The government is seeking to raise the wellbeing of a typical worker by offering a wage subsidy. We examine two alternative regimes. The first regime is a wage subsidy that is directly paid to the worker (DS) and resembles the earned income tax credit (EITC) program in the US. The second regime is an indirect wage subsidy, which is paid to the firm/employer (IDS). In the absence of the psychological component of the utility function ($\alpha = 0$), the two regimes are equivalent (namely, the statutory incidence of the subsidy plays no role). When $\alpha > 0$, however, equivalence between the DS and the IDS regimes no longer necessarily holds. The exact effect of the policy requires an additional assumption to be posed on the psychological component of the utility; namely , defining properly what the worker is responding to. As we show below, if the worker responds to the direct compensation received from the employer, IDS leads to higher effort levels and a higher level of aggregate welfare (to be properly defined in the following). Alternatively, the workers may respond to their total compensation—which include direct subsidies—or to the employer's sacrifice—which excludes indirect subsidies. As will be shown below, invoking either one of these alternative assumptions would render the two policy regimes (DS and IDS) equivalent in terms of elicited effort levels and aggregate welfare.

We start with the assumption that the psychological utility depends on the direct compensation. We turn first to the DS regime. Reformulating (2) yields that the worker's

utility under DS is given by:

$$u(w,e)^{DS} = bw - h(e) + \alpha v(w,e). \tag{8}$$

where $b > 1$ denotes the rate of direct subsidy provided by the government to the worker and w denotes the wage rate set by the employer.

Note that the psychological component in the utility, $v(w,e)$, depends on the direct compensation received from the employer w rather than on the total compensation bw, which includes the direct subsidy granted by the government. The employer's payoff remains as in (3). As the subsidy b does not enter the worker's first-order condition (determining the optimal effort level e given the wage rate w)—which remains as in (4)—it is straightforward to verify that the equilibrium analysis remains as in the benchmark case with no subsidy in place, yielding the same wage rate and effort level. Thus, the direct subsidy regime induces a pure income effect and changes neither the optimal choice of the worker nor that of the firm.

We turn next to the IDS regime. The employer's payoff becomes:

$$\pi(w,e)^{IDS} = f(e) - \frac{w}{b}, \tag{9}$$

where $b > 1$ denotes the rate of indirect subsidy provided by the government to the employer and w denotes the wage rate set by the firm. As in the absence of direct subsidies, w reflects both the direct and the total compensation from the point of view of the worker, the worker's utility remains as in (2). Thus, the worker's optimal response function $e(w)$ remains as in the benchmark case with no subsidy in place. Substituting the optimal effort level $e(w)$ into the production function $f(e)$, letting $g \equiv f[e(w)]$, the firm's payoff function can be re-written as:

$$\pi(w)^{IDS} = g(w) - \frac{w}{b}. \tag{10}$$

Formulating the employer's first order condition with respect to w yields:

$$g'(w) = \frac{1}{b}. \tag{11}$$

The strict concavity of g implies that the optimal wage offer set by the firm, given by

the implicit solution to (11), is strictly higher than the optimal wage offer under the benchmark regime given by the implicit solution to (7). As the optimal response function of the worker is increasing in w, it follows that the effort level exerted by the worker under the IDS regime strictly exceeds the effort level exerted under the benchmark (and the DS) regime.

To sum up, compared with the DS regime, the IDS regime induces an incentivizing effect, yielding a higher level of remuneration and in response a higher level of effort exerted by the worker, so that the equivalence between the two policy regimes fails to hold.

A commonly stipulated goal of providing wage subsidies is to raise the utility level of the worker. Two related remarks are in order. First, note that this policy goal is indeed realized by implementing the IDS regime. This follows, as the worker's utility under both the benchmark and the IDS regimes is identical [given by (2)], whereas the IDS regime yields a higher level of remuneration than under the benchmark regime. Further notice that the extent to which the indirect subsidy would be shifted to the worker generally depends on the properties of g. The direct compensation offered to the worker under the IDS regime w is strictly increasing in the rate of subsidy b [this follows from (11) by virtue of the strict concavity of g]; namely, the firm shifts (at least part of) the subsidy to its employee to elicit a higher effort level. Notwithstanding, the cost of labor w/b may either increase or decrease with respect to the rate of subsidy b, implying, respectively, over- or under-shifting of the subsidy to the worker.[5]

3.2.1 Alternative assumptions

In the previous subsection we have demonstrated that statutory incidence equivalence fails to hold if the worker responds to the compensation directly received from the employer. In the current subsection we turn to re-examine the equivalence between the direct and the indirect subsidy schemes, posing two alternative assumptions regarding what the worker is responding to.

Consider first the case in which the worker responds to the total compensation received, including any government subsidy directly transferred to the worker, which is the

[5]When the function g is sufficiently concave (formally, when the coefficient of CRRA exceeds unity, $-\frac{g''(w)w}{g'(w)} > 1$), it is straightforward to show that the cost of labor w/b decreases with respect to b, implying under-shifting of the subsidy to the worker.

standard presumption in neo-classical frameworks. In this case, under the DS regime, the worker's utility is formulated as:

$$u(w,e)^{DS} = bw - h(e) + \alpha v(bw, e). \tag{12}$$

and the firm's payoff function remains as in (3). The worker's utility and the firm's payoff under the IDS regime remain as in (2) and (9), respectively. In this case, the subsidy (b) enters the psychological component in the worker's utility under both the direct- and the indirect subsidy regimes, leading to a higher (identical) effort level than under the benchmark (*laissez-faire*) regime. The complete derivation is included in the appendix.

The experiments conducted by Kube, Marechal, and Puppe (2012) show that the efficacy of increased wages in inducing higher effort levels depends on the extent to which the employer invests effort into the compensation presentation. These results suggest that workers might be concerned with actual costs incurred by their employer in providing the wages rather than with the direct compensation (or total compensation as we just postulated). We consider next, therefore, the case in which the worker responds to the cost of labor (the employer's sacrifice), excluding any government subsidy indirectly transferred to the firm.

The worker's utility and the firm's payoff under the DS regime remain as in (8) and (3), respectively. Under the IDS regime, the worker's utility becomes:

$$u(w,e)^{IDS} = w - h(e) + \alpha v(\frac{w}{b}, e), \tag{13}$$

while the firm's payoff remains as in (9). In equilibrium, under both the DS and the IDS regimes, the cost of labor borne by the employer, and consequently the elicited effort level, would be identical. The complete derivation is included in the appendix. In contrast to the case where workers respond to the total compensation received from the employer, the subsidy (b) does not enter the psychological component in the worker's utility in both the direct- and the indirect subsidy regimes. Therefore, the equilibrium effort levels are the same as under the benchmark (*laissez-faire*) regime.

Before turning to the normative analysis, some final remarks are in order. First, the three alternative assumptions are not mutually exclusive. That is, it is possible, e.g., that workers respond to some combination of the gross wages and the employers' costs. We

can accommodate such a situation by replacing w in (2), not with $\frac{w}{b}$, as in (13), but with some function $f(w,b)$; $\frac{w}{b} < f(w,b) < w$, $\frac{\partial f}{\partial w} > 0$, $\frac{\partial f}{\partial b} < 0$. It is easy to confirm that, as long as workers respond positively to gross wages received over and above the employer's sacrifice, our main analysis holds qualitatively, and equilibrium effort levels are higher under IDS than under DS.

Second, note that in the latter case examined, in which the worker responds to the cost of labor, the equivalence between the DS and the IDS regimes crucially hinges on the worker being aware of the employer's payoff structure. Under realistic situations, workers do not receive direct information about the employer's subsidy, and may not be able to deduce this information due to ignorance of the law or cognitive limitations (see, e.g., Duflo et al., 2006). On the other hand, it is not clear that employers will increase the wages offered in this situation.

Finally, it is interesting to compare our theoretical model's prediction with an earlier experimental study by Riedl and Tyran (2005). In this study, Riedl and Tyran tested the tax liability side equivalence (the irrelevance of statutory incidence) in a labor market context exhibiting gift exchange type relations. Assuming that taxes were specific (exogenously set at a fixed amount), they showed that the equivalence between a regime in which a tax is levied on workers and one in which an identical tax is imposed on employers remains to hold in the presence of gift-exchange considerations. Our formal analysis reveals that the statutory incidence does matter when the tax is proportional to the wage set by the firm. In contrast, with a specific tax in place, in line with the predictions of Riedl and Tyran (2005), both tax regimes induce a pure income effect which does not affect the first-order conditions and, hence, the optimal choices of the agents.

4 Normative analysis

In the current section we turn to compare the DS and IDS regimes from a welfare perspective. We invoke the standard welfare measure used in partial equilibrium settings by letting the welfare be measured by the aggregate social surplus given by the sum of: (i) firms' profits, and (ii) workers' utility. Assuming that the gift exchange component depends only on the compensation the worker receives directly from the employer, we will compare the DS and the IDS regimes under the calibrating assumption that the total government expenditure is identical across the two policy regimes. Our first proposition

states the welfare dominance of the IDS regime.

Proposition 1. *The IDS regime attains a higher level of aggregate social surplus than the DS regime, for the same level of government expenditure.*

See the appendix for the proof.

To understand the rationale for the welfare dominance of the IDS regime it would be instructive to compare the *laissez-faire* equilibrium with the Pareto efficient allocation. Let e^* and w^* denote, respectively, the effort level chosen by the worker and the wage offer set by the firm in the *laissez-faire* equilibrium, given by the implicit solution to the first-order conditions in (4) and (7). Further denote by π^* the profits earned by the firm in the *laissez-faire* equilibrium, given by:

$$\pi^* = f(e^*) - w^*. \tag{14}$$

An allocation is *Pareto* efficient if it maximizes the utility of the worker subject to a constraint that the firm's payoff is weakly exceeding a certain threshold. To render the comparison with the *laissez-faire* allocation more transparent, suppose that this threshold is set at π^*, the level of profits earned by the firm in the *laissez-faire* equilibrium. A *Pareto* efficient allocation is, hence, given by the solution to the following maximization program:

$$\begin{aligned} &\max_{e,w}[w - h(e) + \alpha v(w,e)] \\ &s.t. \\ &f(e) - w \geq \pi^*. \end{aligned} \tag{15}$$

It is straightforward to verify that in the optimal solution for the maximization program the constraint is binding. Substituting for w from the (binding) constraint into the objective yields the following reformulated (unconstrained) maximization program:

$$\max_{e}([f(e) - \pi^*] - h(e) + \alpha v[f(e) - \pi^*, e]). \tag{16}$$

Formulating the first-order-condition with respect to e (assuming that the second-order

condition is satisfied) yields:

$$f'(e) - h'(e) + \alpha \frac{\partial v}{\partial e} + \alpha \frac{\partial v}{\partial w} f'(e) = 0. \tag{17}$$

Let e^{**} denote the worker's effort level in a *Pareto* efficient allocation, given by the implicit solution to (17). Further let w^{**} denote the firm's wage offer in a *Pareto* efficient allocation, given by:

$$w^{**} = f(e^{**}) - \pi^*. \tag{18}$$

Comparing the first-order conditions in (4) and (17) reveals that $e^{**} > e^*$ and $w^{**} > w^*$. Namely, the wage and effort levels in the *laissez-faire* equilibrium are lower than the corresponding levels associated with the *Pareto* efficient allocation.

To see this, differentiate the objective in (16) with respect to e and evaluate the derivative at the *laissez-faire* effort level, e^*, to obtain:

$$f'(e^*) - h'(e^*) + \alpha \frac{\partial v[f(e^*) - \pi^*, e^*]}{\partial e} + \alpha \frac{\partial v[f(e^*) - \pi^*, e^*]}{\partial w} f'(e^*) > 0, \tag{19}$$

where the inequality sign follows by virtue of the first-order condition in (4) [recalling that $w^* = f(e^*) - \pi^*$], and as $\alpha > 0$, $\frac{\partial v}{\partial w} > 0$ and $f' > 0$, by assumption. By virtue of the second-order condition for the maximization program in (16), which is assumed to hold, it follows that $e^{**} > e^*$. Conditions (14) and (18) and the fact that $f' > 0$ hence imply that $w^{**} > w^*$.

The inefficiency of the *laissez-faire* allocation derives from an externality. The firm is setting the wage rate to maximize its profits [the first order condition is given in (7)] but fails to account for the positive externality an increase in the wage offer would exert on the worker. The latter comes from two sources: (i) the remuneration to the worker; and, (ii) the contribution to the psychological gift-exchange component.

The market failure associated with the *laissez-faire* equilibrium is the driving force underlying the welfare dominance of the IDS regime. As, by presumption, the worker responds to the direct compensation received from the employer (rather than to the total compensation), the DS regime operates in an equivalent manner to a lump-sum transfer by inducing a pure income effect, thereby, changing neither the optimal choice of the worker nor that of the firm. In contrast, the IDS regime induces an incentivizing (substitution) effect, yielding a higher level of remuneration and in response a higher level of

effort exerted by the worker. This serves to mitigate the distortion in the labor market and enhance welfare.

Before concluding this section, a final comment is in place. It is important to notice that the welfare-enhancing role of the indirect wage subsidy scheme is sensitive to the welfare measure being invoked. If, for instance, we launder-out the gift-exchange component from the welfare calculus, the government would seek to maximize the 'real' surplus given by the output minus the cost of effort. In such a case, if the intensity of the gift-exchange component, measured by the parameter $\alpha > 0$, is sufficiently large, the effort associated with the *laissez-faire* allocation will exceed the *Pareto* efficient level, implying, therefore, that any level of subsidization will be welfare detrimental.[6]

4.1 General equilibrium

Thus far, we have considered a partial equilibrium setting, assuming a fixed number of firms. Allowing for free entry of firms will induce an (upward) adjustment in the wage rate that will be set at a level that renders firms' profits to zero.

Formally, in equilibrium the following condition would hold:

$$g(w) - w = 0, \tag{20}$$

where the definition of g remains as in the partial equilibrium analysis. We let $\tilde{w}$ denote equilibrium wage rate in the presence of free entry given by the implicit solution to (20).

By virtue of the properties of g, $g(w^*) - w^* > g(0) - 0 = 0$; where w^* denotes the optimal wage offer set by the firm in the partial equilibrium case, given by the implicit solution to (7). Hence, by the strict concavity of g, it follows that $\tilde{w} > w^*$. Note that $\tilde{w}$ is indeed the optimal wage offer set by a firm in the presence of free entry; namely, no firm has an incentive to deviate from offering $\tilde{w}$. A deviation to a lower wage rate will allow the firm to earn positive profits but induce the worker to reject the offer and seek an alternative employer who offers him a higher wage rate (and earning non-negative profits, nonetheless). A deviation to a higher wage rate will result in negative profits.

[6]For instance, letting $f(e) = e, h(e) = \frac{e^2}{2}$ and $v(w, e) = w \ln(e)$, the government is seeking to maximize the 'real' surplus given by the term $e - \frac{e^2}{2}$. The surplus-maximizing effort level is hence given by $e = 1$. In the benchmark regime (with no government intervention in place) the effort level would be given by $e = \frac{\alpha}{2}$. For $\alpha > 2$, any level of subsidization is clearly welfare detrimental!

Table 1: cost of effort.

Effort level e	1	2	3	4	5	6	7	8	9	10
Cost of effort $c(e)$	0	1	2	4	6	8	10	13	16	20

To see this notice that as $\tilde{w} > w^*$, by virtue of (7), (20) and the strict concavity of g, it follows that $g(w) - w < 0$ for all $w > \tilde{w}$.

Our second proposition states that the welfare dominance of the IDS regime, established for the partial equilibrium setting (see proposition 1), extends to the general equilibrium case.

Proposition 2. *Allowing for free entry of firms, the IDS regime remains welfare-dominant to the DS regime, by attaining a higher level of aggregate social surplus for the same level of government expenditure.*

See the appendix for the proof.

5 Experimental design and procedure

The basic experimental game is adapted from the bilateral gift exchange game introduced by Fehr et al. (1998). The game involves an employer and a worker. The employer first chooses a wage $w \geq 30$. The worker observes the wage and chooses an effort level $e \in (0, 10)$. The payoff of the employer in the No subsidy (NS) treatment is given by

$$\pi_{\text{employer}} = 120 - w + 10e.$$

The payoff of the worker is given by

$$\pi_{\text{worker}} = w - c(e),$$

where the cost of effort $c(e)$ is presented in Table 1.

In the Direct subsidy (DS) treatment, the worker's payoff is revised in line with the theoretical analysis to be

$$\pi_{\text{worker}} = bw - c(e).$$

Table 2: Sessions and treatments.

Periods 1–10	Periods 11–20	N groups
Switch subsidy		
DS	IDS	10
IDS	DS	9
Introduce subsidy		
NS	DS	6
NS	IDS	6

In the Indirect subsidy (IDS) treatment, the employer's payoff is revised to be

$$\pi_{\text{employer}} = 120 - \frac{w}{b} + 10e,$$

with the subsidy factor set at $b = 1.5$ and all other aspects of the experiment remaining fixed.

The roles of employer and worker were fixed throughout the session, with employers and workers randomly matched in pairs at the beginning of each period within matching groups of eight. Participants knew that there will be two parts to the experiment, each consisting of ten periods, and that they will be randomly rematched with a new partner for each period. We conducted two types of sessions, summarized in Table 2. In the *Switch subsidy* treatments, participants first played in either DS or IDS for ten periods, and then switched to the other regime for an additional ten periods. In the *Introduce subsidy* sessions, participants first played for ten periods without subsidies, after which one of the regimes—DS or IDS—was introduced for the next ten periods.

The experiment was programmed in z-Tree (Fischbacher, 2007) and conducted in the Negev Experimental Economics Laboratory at Ben-Gurion University of the Negev. Two hundred and forty eight participants, recruited through ORSEE (Greiner, 2015), participated in 14 sessions. The average total payoff was 73.29 NIS (approximately 19 USD).

Table 3: Summary of results.

Treatment	Gross wages	Net wages	Employer's costs	Worker's effort	Subsidy costs	Employer's payoff	Worker's payoff	Efficiency
NS	52	52	52	3.5	0	103	48	151
	(24.4)	(24.4)	(24.4)	(2.9)	(–)	(22.0)	(20.9)	(23.1)
DS	56	84	56	3.7	28	101	79	152
	(39.5)	(59.2)	(39.5)	(3.0)	(19.7)	(35.4)	(56.2)	(24.4)
IDS	70	70	47	4.1	23	114	64	155
	(38.0)	(38.0)	(25.3)	(3.3)	(12.7)	(23.4)	(33.6)	(26.2)

Note: uncorrected standard errors in parentheses.

5.1 Hypotheses

Our first two hypotheses relate to the behavioral assumptions of the theoretical analysis. First, we test the hypothesis that workers reciprocate gross wages.

Hypothesis 1. *Workers' effort across treatments is higher for higher gross wages, controlling for net wages and employers' costs.*

Next, we test the hypothesis that employers shift indirect subsidies to workers.

Hypothesis 2. *Gross wages in IDS are higher than in NS.*

Our last hypotheses tests the implication of Proposition 1.

Hypothesis 3. *Workers' effort—and consequently aggregate payoffs—is higher in IDS than in NS and DS for the same subsidy level.*

6 Experimental results

Table 3 presents summary statistics. Efficiency is defined as the sum of the employer and worker's 'real' surplus, minus the government expenditures. The mean gross wages are in line with Hypothesis 2, with higher gross wages in IDS compared to NS and DS. Subsidy shift is only partial, however, as the increase in net wages when indirect subsidies are introduced is only 56% of the increase resulting from direct subsidies. Although

net wages are lower in IDS than in DS, workers' mean effort is higher, lending support to Hypothesis 3 and suggesting that workers respond to gross wages, as stipulated in Hypothesis 1.[7] The latter is also supported by the effort response graphs depicted in Figure 1. Panel (b) reveals that, in DS, workers choose lower effort levels for the same net wages—as gross wages are actually lower—whereas Panel (c) shows that, in IDS, effort levels are higher for the same employer's costs—as gross wages are actually higher. The response to gross wages in Panel (a) is similar across treatments, indicating that workers indeed respond to gross wages, although there is a small downward shift in IDS, suggesting that there may be some sensitivity to employer's actual costs.

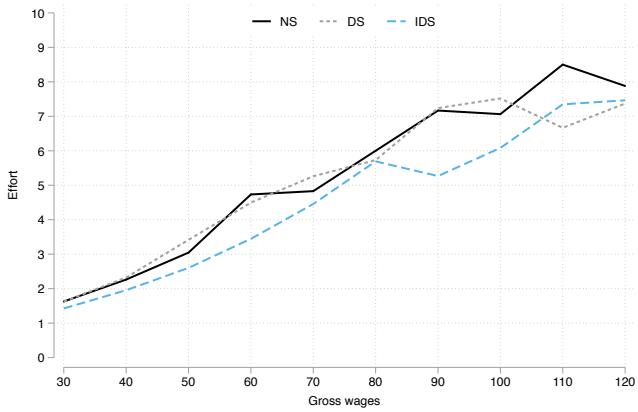
Table 4 presents OLS regressions of worker's effort on gross and net wages and employers' costs, with robust standard errors clustered on matching groups. The results confirm the conclusions drawn based on Figure 1. Gross wages emerge as the best predictor for the worker's effort. Although the employer's costs have some marginal predictive validity, it is eliminated when pitted directely against the gross wages by removing the net wages from the model in Columns (3) and (4).[8] Thus, the regression analysis provides empirical validity to Hypothesis 1.

Result 1. *Workers respond to the gross wages chosen by the employer.*

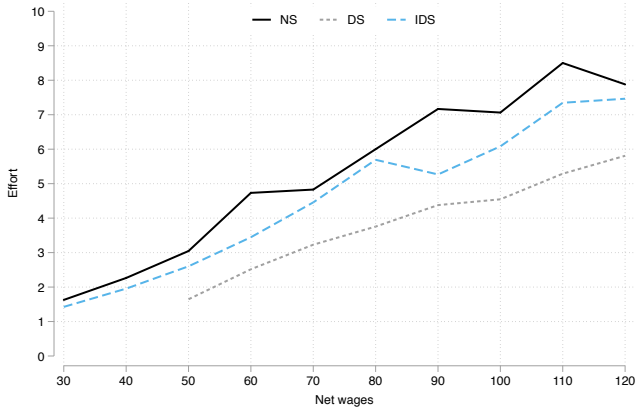
Table 5 reports OLS regressions on treatment with robust standard errors clustered on matching groups. Consistent with the theoretical predictions, direct subsidies increase the worker's payoff without affecting the employers' or workers' decisions. Indirect subsidies, in contrast, lead to significantly higher gross wages, indicating that employers shift the subsidy to workers. The net wages are, however, significantly lower in IDS compared to DS ($\delta = 13.94, p < 0.001$), indicating a partial shift. The results support Hypothesis 2.

[7]The *Introduce subsidy* sessions may be the most interesting. Over the first ten periods, the workers can be assumed to develop a certain pattern of response to their wages. On average, workers receive wages of 52.27, and choose a mean effort level of 3.51. From period 11 onwards, they experience a regime change. When the switch is to the DS regime, the mean gross wages (and employer's costs) decrease from 52.27 to 46.00, while the mean net wages increase to 69.00. The mean effort is 2.98, lower than in the benchmark regime. When workers experience a switch to the IDS regime, in comparison, the mean wages increase to 66.08 while the employer's costs decrease to 44.05. Should workers increase their effort—as their remuneration goes up—or decrease their effort—as the employer is investing less in their remuneration? The mean effort, in fact, increases to 3.75.

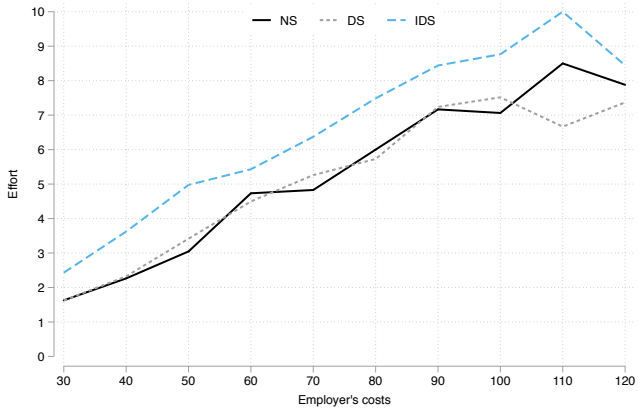
[8]Recall that to obtain the dominance of the IDS regime, it is enough to assume that the workers resopnd to some combination of the gross wages and employer's costs.



(A) By gross wages.



(B) By net wages.



(C) By employer's costs.

Figure 1: Worker effort.

Table 4: Regressions on workers' response function.

	(1)	(2)	(3)	(4)
Gross wages	0.058***	0.050***	0.052***	0.045***
	(0.010)	(0.009)	(0.007)	(0.007)
Employer's costs	0.021	0.035***	-0.001	0.005
	(0.016)	(0.012)	(0.022)	(0.020)
Net wages	-0.019	-0.025		
	(0.016)	(0.015)		
Constant	0.627	0.792	0.692	0.851
	(0.671)	(0.685)	(0.730)	(0.759)
Individual fixed effects	No	Yes	No	Yes
N	2480	2480	2480	2480

Notes: Robust standard errors clustered on matching groups in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Regressions on treatment effects.

	(1) Gross wages	(2) Net wages	(3) Employer's costs	(4) Subsidy costs[a]	(5) Worker's effort	(6) Employer's payoff	(7) Worker's payoff	(8) Efficiency
DS	3.74	31.75***	3.74		0.19	-1.83	31.27***	1.43
	(4.11)	(5.41)	(4.11)		(0.44)	(2.96)	(4.79)	(3.56)
IDS	17.81***	17.81***	-5.55	-4.65***	0.61*	11.64***	16.37***	4.65*
	(4.40)	(4.40)	(3.47)	(1.51)	(0.34)	(2.27)	(3.85)	(2.73)
Constant	52.27***	52.27***	52.27***	28.01***	3.51***	102.79***	48.02***	150.81***
	(3.01)	(3.01)	(3.01)	(1.68)	(0.33)	(2.07)	(2.50)	(2.68)
N	2480	2480	2480	2000	2480	2480	2480	2480

Notes: Robust standard errors clustered on matching groups in parentheses. [a] DS taken as baseline treatment. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Result 2. *Employers (partially) shift indirect subsidies to workers.*

The comparisons between DS and IDS are all significant at the $p < 0.01$ level, except for the comparisons for effort and efficiency. Although the subsidy costs (i.e., government expenditures) in IDS are lower, and the employer's payoff higher, the increase in overall efficiency does not reach significance. This is because the workers lose, both from the partial subsidy shifting and from the higher costs associated with the higher effort. When considering the welfare implications, however, it is important to acknowledge that the workers choose to exert higher effort in IDS, hence revealed preference implies that the utility loss is smaller than reflected in the lower payoff.

Although the increased effort when switching from DS to IDS is not significant, there is a significant increase in productivity and efficiency when considering the reduced subsidy costs. Recall that Proposition 1 states that the social surplus (which efficiency in the experiment is a lower bound of) is higher in IDS for the same level of government expenditures. We therefore calculate for each observation the effort and efficiency divided by the subsidy costs, and regress the resulting variables on the treatment (with robust standard errors clustered on matching groups). Once the subsidy costs are accounted for, the effect of the subsidy regime is highly significant. Switching from DS to IDS increases the effort per subsidy unit by 0.039 ($p < 0.001$) and the overall efficiency per subsidy unit by 1.826 ($p < 0.001$). The results support Hypothesis 3.

Result 3. *Indirect subsidies lead to higher effort and efficiency than direct subsidies for the same level of government expenditures.*

7 Conclusion

Wage subsidies (in the form of EITC program in the US) constitute a prevalent policy tool to promote redistributive goals and alleviate poverty amongst the working poor. In a standard neoclassical framework the statutory incidence of such wage subsidies is typically policy irrelevant and bears no normative implications. In this paper we provide a theoretical analysis of the potential perceptional advantage of providing indirect subsidies to the employers relative to subsidizing workers directly. Employing a behavioral theoretical setting, we demonstrate that by shifting from direct to indirect subsidies the government can enhance the well being of workers, while maintaining the level of

expenditure unchanged. Our experimental results support the behavioral assumptions underlying the theoretical analysis, and provide direct evidence for the welfare enhancing potential of indirect subsidies.

Our theoretical analysis suggests that when remuneration cannot be based on observed (or ex-post verified) effort levels; and hence, the incentivizing structure relies on a gift-exchange (double reciprocity) mechanism, workers respond to the amount of compensation received directly from the employer, rather than to the total compensation (including government direct subsidies). Thus, a standard assumption in neo-classical frameworks of perfect substitutability between a dollar of remuneration received from the employer and a dollar of compensation obtained (in the form of a direct subsidy) from the government, fails to hold. Workers seem to care not only about the 'bottom line' (total amount received) but also about the 'channel' (whether the direct source of remuneration is the employer or the government). This novel feature supported by our experimental evidence may bear important implications for the design of labor contracts and welfare policy.

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Appendix A: Proofs and derivations

A.1 Alternative assumptions

In the following, we characterize the equilibrium under the alternative assumptions of section 3.2.1. Consider first the case in which the worker responds to the total compensation received, including any government subsidy directly transferred to the worker, which is the standard presumption in neo-classical frameworks. In this case, under the DS regime, the worker's utility is formulated as:

$$u(w,e)^{DS} = bw - h(e) + \alpha v(bw,e). \tag{A1}$$

and the firm's payoff function remains as in (3) and given by:

$$\pi(w,e)^{DS} = f(e) - w, \tag{A2}$$

where w denotes the wage rate set by the firm and total compensation hence given by bw.

Turning next to the IDS regime, the worker's utility and the firm's payoff are, correspondingly, given by:

$$u(w,e)^{IDS} = w - h(e) + \alpha v(w,e), \tag{A3}$$

and

$$\pi(w,e)^{IDS} = f(e) - \frac{w}{b}, \tag{A4}$$

where w denotes the wage rate set by the firm and $\frac{w}{b}$ denotes, therefore, the cost of labor. Reformulating the equations given in (A3) and (A4) by setting $z \equiv \frac{w}{b}$ yields:

$$u(z,e)^{IDS} = zb - h(e) + \alpha v(zb,e), \tag{A5}$$

and

$$\pi(z,e)^{IDS} = f(e) - z, \tag{A6}$$

where z denotes the cost of labor borne by the firm (the employer's direct sacrifice). Comparing the equations given in (A1) and (A2) associated with the DS regime with the corresponding reformulated equations given in (A5) and (A6) associated with the

IDS regime, it is straightforward to verify that the two alternative policy regimes are equivalent. [formally, substituting z for w in equations (A1) and (A2) yields equations (A5) and (A6)]. Thus, in equilibrium (the derivations are similar to those in the main analysis and are hence omitted), under both the DS and the IDS regimes, the total compensation received by the worker and, consequently, the elicited effort level, would be identical.

Next, consider the case in which the worker responds to the cost of labor (the employer's sacrifice), excluding any government subsidy indirectly transferred to the firm. Reformulating the worker's utility and the firm's payoff under the DS regime yields, respectively:

$$u(w,e)^{DS} = bw - h(e) + \alpha v(w,e), \tag{A7}$$

and

$$\pi(w,e)^{DS} = f(e) - w, \tag{A8}$$

where w denotes the wage rate set by the firm, which reflects the cost of labor in the absence of indirect subsidies.

Turning next to the IDS regime yields the following corresponding equations:

$$u(w,e)^{IDS} = w - h(e) + \alpha v(\frac{w}{b}, e), \tag{A9}$$

and

$$\pi(w,e)^{IDS} = f(e) - \frac{w}{b}, \tag{A10}$$

where w denotes the wage rate set by the firm and $\frac{w}{b}$ denotes the cost of labor.

Reformulating the equations given in (A9) and (A10) by setting $z \equiv \frac{w}{b}$ yields:

$$u(z,e)^{IDS} = zb - h(e) + \alpha v(z,e), \tag{A11}$$

and

$$\pi(z,e)^{IDS} = f(e) - z, \tag{A12}$$

where z denotes the cost of labor borne by the firm. Comparing the equations given in (A7) and (A8) associated with the DS regime with the corresponding reformulated equations given in (A11) and (A12) associated with the IDS regime, it is straightforward to verify that the two alternative policy regimes are equivalent [formally, substituting z

for w in equations (A7) and (A8) yields equations (A11) and (A12)]. Thus, in equilibrium (the derivations are similar to those in the main analysis and are hence omitted), under both the DS and the IDS regimes, the cost of labor borne by the employer and, consequently, the elicited effort level would be identical.

A.2 Proofs

Proposition 1. *The IDS regime attains a higher level of aggregate social surplus than the DS regime, for the same level of government expenditure.*

Proof. Denote by $b^{DS} > 1$ and $b^{IDS} > 1$ the subsidy rates associated with the DS and IDS regimes, respectively. Further denote by w^{DS} and w^{IDS} the corresponding wage rates optimally set by the firm in equilibrium under the DS and IDS regimes, which are formally given by the implicit solution to:

$$g'(w^{DS}) = 1, \tag{A13}$$

$$g'(w^{IDS}) = \frac{1}{b^{IDS}}, \tag{A14}$$

where $g(w) \equiv f[e(w)]$ and $e(w)$ denotes the worker's optimal response function (specifying the effort level as a function of the compensation directly received from the firm). Finally, let E^{DS} and E^{IDS} denote the total government expenditure levels associated with the DS and the IDS regimes, respectively, formally given by:

$$E^{DS} = (b^{DS} - 1)w^{DS}, \tag{A15}$$

and

$$E^{IDS} = \frac{(b^{IDS} - 1)}{b^{IDS}} w^{IDS}. \tag{A16}$$

By virtue of our definition of the welfare measure, given by the sum of firms' profits and workers' utility, the welfare measures associated with the DS and IDS regimes are correspondingly given by:

$$W^{DS} = [g(w^{DS}) - w^{DS}] + \left[b^{DS}w^{DS} - h[e(w^{DS})] + \alpha v[w^{DS}, e(w^{DS})]\right], \tag{A17}$$

and

$$W^{IDS} = [g(w^{IDS}) - \frac{w^{IDS}}{b^{IDS}}] + \left[w^{IDS} - h[e(w^{IDS})] + \alpha v[w^{IDS}, e(w^{IDS})]\right]. \quad \text{(A18)}$$

Subtracting (A17) from (A18) and employing the fact that, by virtue of our calibrating assumption, total government expenditure is identical across regimes; namely, $E^{DS} = E^{IDS}$, it follows that:

$$W^{IDS} - W^{DS} = K(w^{IDS}) - K(w^{DS}), \quad \text{(A19)}$$

where $K(w) \equiv g(w) - h[e(w)] + \alpha v[w, e(w)]$.

Conditions (A13) and (A14) imply, by virtue of the strict concavity of g and the fact that $b^{IDS} > 1$, that $w^{IDS} > w^{DS}$. Thus, to complete our proof it suffices to show that K is strictly increasing in w. Differentiating K with respect to w, employing the worker's envelope condition, yields:

$$K'(w) = g'(w) + \alpha \frac{\partial v}{\partial w} > 0, \quad \text{(A20)}$$

where the positive sign follows as $\alpha > 0$ and $\frac{\partial v}{\partial w} > 0$, by assumption, and $g' > 0$, by our earlier derivations. This concludes the proof. □

Proposition 2. *Allowing for free entry of firms, the IDS regime remains welfare-dominant to the DS regime, by attaining a higher level of aggregate social surplus for the same level of government expenditure.*

Proof. Denote by $b^{DS} > 1$ and $b^{IDS} > 1$ the subsidy rates associated with the DS and IDS regimes, respectively. Further denote by w^{DS} and w^{IDS} the corresponding wage rates optimally set by the firm in equilibrium, under the DS and IDS regimes, which are formally given by the implicit solution to the zero-profit conditions:

$$g(w^{DS}) - w^{DS} = 0, \quad \text{(A21)}$$

$$g(w^{IDS}) - \frac{w^{IDS}}{b^{IDS}} = 0, \quad \text{(A22)}$$

where $g(w) \equiv f[e(w)]$ and $e(w)$ denotes the worker's optimal response function (specifying the effort level as a function of the compensation directly received from the firm).

Finally, let E^{DS} and E^{IDS} denote the total government expenditure levels associated with the DS and the IDS regimes, respectively, formally given by:

$$E^{DS} = (b^{DS} - 1)w^{DS}, \tag{A23}$$

and

$$E^{IDS} = \frac{(b^{IDS} - 1)}{b^{IDS}} w^{IDS}. \tag{A24}$$

By virtue of our definition of the welfare measure, given by the sum of firms' profits and workers' utility, the welfare measures associated with the DS and IDS regimes are correspondingly given by:

$$W^{DS} = [g(w^{DS}) - w^{DS}] + \left[b^{DS}w^{DS} - h[e(w^{DS})] + \alpha v[w^{DS}, e(w^{DS})]\right], \tag{A25}$$

and

$$W^{IDS} = [g(w^{IDS}) - \frac{w^{IDS}}{b^{IDS}}] + \left[w^{IDS} - h[e(w^{IDS})] + \alpha v[w^{IDS}, e(w^{IDS})]\right]. \tag{A26}$$

Subtracting (A25) from (A26) and employing the fact that, by virtue of our calibrating assumption, total government expenditure is identical across regimes; namely, $E^{DS} = E^{IDS}$, it follows that:

$$W^{IDS} - W^{DS} = K(w^{IDS}) - K(w^{DS}), \tag{A27}$$

where $K(w) \equiv g(w) - h[e(w)] + \alpha v[w, e(w)]$.

Recall that we have shown (see the proof of proposition 1) that K is strictly increasing in w. Thus, to complete our proof it suffices to show that $w^{IDS} > w^{DS}$. Letting $M(w, b) \equiv g(w) - \frac{w}{b} = 0$, where $b \geq 1$ denotes the indirect subsidy rate provided to the firm, conditions (A21) and (A22) can be reformulated as:

$$M(w^{DS}, 1) = 0, \tag{A28}$$

$$M(w^{IDS}, b^{IDS}) = 0. \tag{A29}$$

Fully differentiating $M(w, b)$ with respect to b yields upon re-arrangement:

$$\frac{\partial w}{\partial b} = \frac{-\frac{w}{b^2}}{[g'(w) - \frac{1}{b}]} > 0, \tag{A30}$$

where the inequality sign follows as $g'(w) < \frac{1}{b}$, by virtue of the fact that the equilibrium wage rate in the presence of free entry strictly exceeds the partial equilibrium wage rate [given by the implicit solution to $g'(w) - \frac{1}{b} = 0$] and the strict concavity of g.

By virtue of condition (A30) and the fact that $b^{IDS} > 1$, conditions (A28) and (A29) imply that $w^{IDS} > w^{DS}$. This concludes the proof. □

Appendix B: Experimental Instructions

General instructions

<Placed on table>

Hello, and thank you for agreeing to participate in the experiment.
Please turn off all mobile phones.
Important: Do not talk to the other participants.

The experiment consists of several rounds, during which you will be able to accumulate points according to the decisions you will take.
These points will be converted to money at a rate of **15 points = 1 NIS**.
The final payment in the experiment will be determined according to the **average** of the points in the round that you will accumulate, in addition to a base of **25 NIS**.
At the end of the experiment please wait for the experimenter to call you for payment.
We will distribute the instructions for the experiment and read them out loud. If you have any questions, please wait until we have finished reading the instructions and then raise your hand. The experimenter will approach you to answer your question privately. Please do not ask questions aloud.

Instructions for the experiment

<Presented as a pdf document and available throughout the experiment>

The experiment

The experiment is divided into two phases. Each phase consists of ten rounds.
At the beginning of the experiment you will be allocated into two groups – employers and workers. This allocation is random, and will remain fixed throughout the experiment.
In each round, you will be randomly **rematched in pairs**, where each pair consists of **one worker and one employer**.
The employer will chooses a wage (the minimum is 30), to pay to the worker.
Next, the worker will choose the number of units that he will produce for the employer.
The worker incurs the cost of producing the units, as will be explained below.
The payoff of each employer in the round is:

Payoff	=	120	-	Wage paid to the worker	+	10×The number of units produced.

The payoff of each worker is:

Payoff	=	Wage received from the employer	-	Cost of production

The worker can produce between 1 and 10 units, where the cost of production is given in the following table:

Number of units	1	2	3	4	5	6	7	8	9	10
Cost of production	0	1	2	4	6	8	10	13	16	20

Instructions for the first/second phase <ONLY IN DS>

Additionally, in the first/second phase of the experiment, the following addition applies *<in second phase of switch subsidy sessions:* (instead of the first phase addition)>

For the wage that the employer will choose to pay the worker, we will give the worker a supplement of 50%.

For example: if the employer will choose to pay a wage of 30 points, we will give the worker a supplement of 15 points, so that the worker will receive 45 points in total.
If the employer will chose to pay a wage of 80 points, we will give the worker a supplement of 40 points, so that the worker will receive 120 points in total.

Instructions for the first/second phase <ONLY IN IDS>

Additionally, in the first/second phase of the experiment, the following addition applies *<in second phase of switch subsidy sessions:* (instead of the first phase addition)>

For the wage that the employer will choose to pay the worker, we will give him a rebate of 33.3%.

For example: if the employer will choose to pay a wage of 30 points, we will give him a rebate of 10 points, so that the employer will pay 20 points in total.
If the employer will chose to pay a wage of 120 points, we will give him a rebate of 40 points, so that the employer will pay 80 points in total.