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ABSTRACT

This paper analyzes the effects of flattening the tax schedule. A simple overlapping generations model, where heterogenous households optimize their work effort and, along the extensive margin, between working in the market or the home sector, is calibrated to the Slovenian economy. Given a small open economy context, free capital flows determine the capital stock by equalizing the domestic net productivity of capital to the net world interest rate. The results confirm that some flatter tax regimes do have the potential to boost the equilibrium GDP, by up to 4 percent, principally due to an increase in the work effort of the most productive workers. However, the participation rate of less productive workers in general decreases, implying an ambiguous relationship between the tax flatness and GDP. Similarly, the tax settings that produce positive effects on GDP do not necessarily increase welfare and mke a majority of the population better off. An increase of the general allowance, which is equivalent to a more progressive tax schedule at the lower end of the income distribution, can alleviate the negative effect on participation.

POVZETEK

V raziskavi so analizirani učinki zniževanja mejnih davčnih stopenj, oziroma prehoda na enotno davčno stopnjo. V ta namen je preprost model prekrivajočih se generacij, kjer heterogena gospodinjstva optimizirajo svoj delovni napor in se odločajo o aktivnosti na trgu dela, je prilagojen lastnostim slovenskega gospodarstva. Ob predpostavki majhnega odprtega gospodarstva, kjer prosti pretok kapitala na dolgi rok določa stok kapitala z izenačitvijo domače neto produktivnosti kapitala z neto svetovno realno obrestno mero. Rezultati potrjujejo, da nekateri režimi z nižjo mejno stopnjo obdavčitve dela potencialno povečajo ravnovesni BDP za do 4 %, predvsem ker spodbujajo najbolj produktivne delavce k povečanju obsega dela. Vendar pa se zmanjša delež aktivnih manj produktivnih delavcev, kar lahko BDP v nekaterih primerih zniževanja mejnih davčnih stopenj celo zmanjša. Prav tako davčne stopnje, ki sicer imajo pozitiven učinek na BDP, ne zvišujejo nujno splošne blaginje oziroma ne predstavljajo izboljšanja za večino prebivalstva. Povečanje splošne davčne olajšave, kar je enako bolj progresivnemu davčnemu sistemu na spodnjem delu dohodkovne distribucije, lahko ublaži negativen učinek na delež aktivnega prebivalstva.

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1 Introduction

The flat tax has received increasing attention ever since the Hall and Rabushka (1983, 1995) proposals to overhaul the US tax code by imposing a flat tax on personal and capital income. Such a tax would basically act as a consumption tax. Recently, the adoption of various types of flat taxes in several Central and Eastern European countries has spurred the debate on the flat tax in the economic policy arena and thus renewed the academic interest for analyzing its effects. In 2006, a flat tax also appeared as a serious candidate for the tax reform in Slovenia. This possibility was finally abandoned in favor of a less progressive tax regime than previously in place, with a lower marginal tax rate on labor.

The purpose of this paper is to analyze the effects of flattening the labor income tax schedule in Slovenia, and thus adds to the debate on the tax reform that was implemented in Slovenia in 2006.[1] To examine welfare and incentives issues, it features a simple version of an overlapping generations general equilibrium model with heterogenous agents. These decide on their work effort and whether to participate in the market sector of the economy or remain in the home sector. Introducing the home (or informal) sector enables for the endogenous extensive margin of labour adjustment, which is most often neglected in the debate on the optimality of tax regimes.[2] To focus on the case of a small open economy, free capital flows are assumed to determine the equilibrium capital stock by equalizing the domestic net productivity of capital to the net world interest rate.

Over the last few years, a number of researchers have explored the effect of flat(ter) income taxes in models with agents heterogenous in productivity, capital endowments, age, etc. Heterogeneity also allow for interesting measures of inequality to be used in the welfare analysis. Altig *et al* (1997) try out a number of flat tax variants on a heterogeneous agents model to find that many flat tax reforms can increase both GDP and welfare by boosting labor supply and savings. Castañeda, Díaz-Giménez and Ríos-Rull (1998) use a dynastic overlapping generations model to find that while switching to a proportional income tax produces efficiency gains and does not generate a larger inequality in earnings, it does increase the inequality in wealth and consumption. As high-productivity workers are more likely to be capital owners they profit from a relatively large increase in hours worked by low-productivity workers who use hours worked as an insurance device, while capital owners afford to work less due to the wealth effect. The reason for this lies with the incomplete credit market assumption, where the original progressive tax system offers a partial insurance against income risks and thus diminishes the need for precautionary savings in terms

[1] Cajner, Grobovšek and Kozamernik (2006) for is earlier and non-technical version of this reasearch.

[2] Home sector production nevertheless plays an important role for instance in business cycle models as in Benhabib, Rogerson and Wright (1991), Greenwood and Hercowitz (1991) or McGrattan, Rogerson and Wright (1995).

of more hours worked.[3] Ventura (1999) features a similar model but there the mechanism works in the other direction, with mean hours remaining about constant at the switch to a proportional income tax, while labor in efficiency units increases. Consequently, both earnings and wealth inequality rise. Gonzáles and Pijoan-Mas (2005) provide a calibration of such a model on Spain to search for different combinations of flat personal income tax rates and general allowances that would generate higher output due to an increase in labor. They find that a flat personal income tax rate could increase overall consumption but that the general allowance would need to rise substantially, both to alleviate inequality, and also to impede the supply of inefficient hours as an insurance device.

Besides stressing the trade-offs between equity and efficiency in the context of flat(ter) taxes, some contributions go further and attempt to quantify it. Conesa and Krueger (2005) seek an optimal tax regime in this type of models, by adding an explicit welfare function in order to compute the equity effect in addition to efficiency and insurance considerations. They find that taking into account the transitional dynamics the optimal tax - among a set of parameters from a given functional form of the tax - is roughly equivalent to a proportional tax with a relatively high general allowance.

We find from model economy simulations that some flatter tax-neutral tax reforms do have the potential to boost the steady state equilibrium GDP by a few percentage points, taking a regime in place in Slovenia up to 2007 (featuring high marginal tax rates on labor income) as a starting point. In accordance with the literature, this stems principally from an increase in labor supply of the most productive workers along the intensive margin. However, flatter taxes often tend to decrease the participation rate of some low-productive agents since they in general increase their effective tax burden. In some cases, this negative effect of the extensive labor supply may prevail over the intensive margin, and GDP may actually fall. In our simulations GDP changes range from an increase of about 4 percent to decreases of about 0.7 percent. Pure flat tax regimes, applied on all three tax bases considered (labor income, consumption and capital income) typically produce an increase in GDP of less than 1 percent.

Furthermore, typical flat taxes are not welfare-enhancing as they usually step up the degree of ex-ante inequality in labor income. Alternative tax schedules that flatten the labor tax to a lesser degree, and which rely more on (flat) consumption taxes, give somewhat better results on these counts. However, in order to make them welfare-enhancing they must be accompanied by large increases in the general allowance to ensure that labor participation and hours worked do not decrease. Changes in the participation rate and welfare most often change in the same direction. This implies that statutory tax rates can be flattened but the effective labor income tax

[3] This follows Aiyagari (1995) who shows that under circumstances of incomplete credit markets and idiosyncratic income shocks taxing capital can be optimal in the sense of preventing the overaccumulation of capital.

rates need to retain a large degree of progressivity - especially in the lower tail of the productivity distribution - to enhance welfare. The only tax reforms considered here that score better on welfare than the baseline scenario and are preferred by a majority of households are accompanied by a more than doubling of the general allowance. These reforms can retain (part of the) progressivity of the tax schedule, but in that case the revenue shortfall has to be financed with an approximate 2 p.p. increase in the VAT, or can involve a flat tax on labor income only, of about 38 percent. Overall, however, there appears to be little room for conventional reforms to enhance welfare by flattening the labor income tax and/or relying more heavily on consumption taxation. Besides, none of the welfare-enhancing reforms boosts GDP substantially and the flat tax on labor income might even decrease it.

Section 2 presents the model economy which is calibrated in section 3. Simulations of alternative tax regimes are evaluated and discussed in section 4. Section 5 concludes and suggests some directions for further research.

2 The Model

The model economy is an overlapping generations general equilibrium with two sectors, the market sector Y^{GDP} and the home sector Y^{HS}, also labelled as non-participation. Assuming a small open economy context, the long-run equilibrium net return on capital r corresponds to the world net interest rate and cannot be altered by domestic economic conditions. The following sections outline the households' consumption-effort objective, the production technology, the tax system, the equilibrium of the economy and the welfare criterion. Since the tax system is very detailed and plays a central role in this paper, we are as explicit as possible in showing how its elements intervene in the model.

2.1 Heterogenous Households' Objective

The model economy is populated by N individuals $i \in \{1, 2, ..., N\}$, heterogenous in their endowment with market productivity ω_i, home sector productivity ϕ_i and their share in the aggregate capital stock K, $k_i \in [0, 1]$. These individuals are randomly regrouped into pairs to form H households, $h \in \{1, 2, ..., H\}$, with $H = N/2$. It follows that each household h consists of two members, h_1 and h_2, with characteristics $\left(\omega_1^h, \omega_2^h, \phi_1^h, \phi_2^h, k_1^h, k_2^h\right)$. Each household lives for T periods, after which it is replaced by a new household characterized by the same endowments. A proportion $\frac{1}{T}$ of households within each idiosyncratic group is replaced in each period, which, in the absence of population growth, ensures a stationary population.

The two individuals h_1 and h_2 of a household h jointly maximize the household's

h lifetime utility with risk aversion σ:

$$\max_{\{s_1^h, s_2^h, l_1^h, l_2^h\}} U^h\left(c^h, l_1^h, l_2^h\right) = u\left(c^h, \varepsilon_1^h, \varepsilon_2^h\right) = \frac{1}{1-\sigma}\left(c^h - \varepsilon_1^h(l_1^h) - \varepsilon_2^h(l_2^h)\right)^{1-\sigma}, \tag{1}$$

$$\text{where} \quad \varepsilon_i'(l_i) > 0 \text{ and } \varepsilon_i''(l_i) > 0, \tag{2}$$

subject to a budget constraint for the household's lifetime consumption[4] $c^h = c^{h,\text{GDP}} + c^{h,\text{HS}} \leq$

$$\begin{aligned} & E \times \sum_{i=1,2}\left[(1-\tau_c)\, w_i^h \,\mathrm{I}\left[s_i^h = \text{GDP}\right] + \ \phi_i^h \ \bar{l} \ \mathrm{I}\left[s_i^h = \text{HS}\right]\right] \\ & +(T-E) \times \sum_{i=1,2}\left[(1-\tau_c)\left(1-\tau_{\text{health}}^{\text{pensioner}}\right) \ \theta w_i^h \ \mathrm{I}\left[s_i^h = \text{GDP}\right] + \phi_i^h \bar{l}\right] \\ & +T \times \sum_{i=1,2}(1-\tau_c) \ r \ k_i^h K \end{aligned} \tag{3}$$

and the participation condition

$$\mathrm{I}\left[s_1^h = \text{GDP}\right] + \mathrm{I}\left[s_2^h = \text{GDP}\right] \geq 1. \tag{4}$$

To maximize the household h's objective (1), h_1 and h_2 coordinate in choosing their activity s_1^h and s_2^h and optimize their labor supply l_1^h and l_2^h. They do so given the trade-off they face between lifetime consumption c^h and effort ε_1^h and ε_2^h, strictly increasing in the labor supplied. The value of consumption c^h is given by both market sector and home sector production, which are assumed perfectly substitutable in equilibrium (given the presence of a participation constraint, as discussed further below). Nevertheless, market production being the only traded good, it is also the only to which the consumption tax τ_c applies.

During the first E periods of their lifetime, the two members choose along the extensive margin between being employed in the market sector, $s =$ GDP, or remain in the home sector, $s =$ HS. Also, if they engage in GDP, they can decide along the intensive margin the amount of labor they are willing to supply, l_i. Such an individual i is rewarded a net wage $w_i = \left(1 - \tau_{\text{health}}^{\text{worker}} - \tau_{\text{pens}}^{\text{worker}}\right) W\omega_i l_i - t_i^w$ for each period of work, where t_i^w is the total tax on the labor income of i, $\tau_{\text{health}}^{\text{worker}}$ and $\tau_{\text{pens}}^{\text{worker}}$ the contribution rates for health and pension insurances and W the gross wage level per efficiency unit. A non-participating individual produces $\phi_i \bar{l}$ of the composite consumption good, with $\bar{l}$ being a fixed amount of labor supplied in the home sector. Participating individuals do not produce any home sector good, independently of how many hours they work in the market sector. Since the economic environment remains unchanged throughout the household's lifetime, there is no labor re-adjustment during the working period.

In the $T - E = R$ remaining periods an individual that has been working in the E initial periods receives a pay-as-you-go pension θw_i, with θ the ratio of the pension

[4] $\mathrm{I}[s_i = \text{X}]$ is an indicator function, taking the value 1 when $s_i = \text{X}$ and the value 0 when $s_i \neq \text{X}$.

to the lifetime net wage. Out of this cash flow the individual needs to contribute a share $\tau_{\text{health}}^{\text{pensioner}}$ for health insurance. Moreover, during retirement all individuals, independently of their preceding participation in the labour market, provide home production $\phi_i \bar{l}$ to the household's consumption.

In addition to the labor revenue, households receive in each period of time a capital revenue in proportion to their ownership of the aggregate capital stock, $r(k_1^h + k_2^h)K$. Note that households only draw on the returns from their capital stock but cannot sell or consume it. K is determined by the investment strategy relying on the free international capital flows, defined in the next section.[5]

The participation constraint (4) requires that at least one member of the household be employed in the market sector during the E initial periods. It is motivated by the assumption that households need to consume a portion of marketed goods. While market revenue can (relatively easily) be exchanged for home goods, one can easily assume that home production can be exchanged for market goods inside a household. There must therefore be at least one member of the household engaged in the market sector. A more elaborated alternative would be to separate the composite consumption good into home and market sector goods.

2.2 Technology

The economy-wide GDP production is generated by a constant returns to scale technology, represented by a Cobb-Douglas production function:

$$Y^{\text{GDP}} = F\left(K, AL^{\text{GDP}}\right) = K^{\alpha}\left(AL^{\text{GDP}}\right)^{1-\alpha}, \tag{5}$$

where $L^{\text{GDP}} = \frac{E}{T}\sum \omega_i l_i \left[s_i = \text{GDP}\right]$ is the productivity-adjusted aggregate labor supply in the market sector and A the labor-augmenting level of technology.

The next period capital stock K' evolves according to the investment-depreciation rule:

$$K' = (1-\delta)K + I \quad \text{with} \quad I_i = k_i I \quad \forall\, i, \tag{6}$$

with δ the period capital depreciation rate. Each individual i participates in the aggregate investment I by investing $k_i I$ in proportion to her share k_i in the aggregate capital stock. Out of their gross capital revenue $GMPK \times k_i \times K$ they invest δ per unit of capital and they pay a tax rate τ_K. As we consider our economy to be small and open, with perfect long-run capital mobility, the world net interest rate r is given. At the optimum, individuals are willing to invest in the domestic capital stock as long as its gross marginal productivity $GMPK$ yields at least a net revenue rk_iK, given δ and the gross capital income tax rate τ_K, so that in equilibrium $r = (GMPK)(1-\tau_K) - \delta$. Using this condition and deriving $GMPK$ in a standard way from the firm's profit-maximizing problem enables to determine the equilibrium

[5] For a more thorough discussion of the decoupling of saving and investment see section 5.

K:

$$K = \left((r+\delta) \Big/ \left[\alpha \left(AL^{\text{GDP}}\right)^{1-\alpha} (1-\tau_K)\right]\right)^{\frac{1}{\alpha-1}}. \quad (7)$$

Similarly, the firms' profit-maximizing condition determines the aggregate demand for labor in the market sector, depending on its cost, W, the gross wage level per efficiency unit:

$$L^{\text{GDP}} = \left(W \left(1+\tau^{\text{firm}}_{\text{health}}+\tau^{\text{firm}}_{\text{pens}}\right) / \left[A^{1-\alpha} (1-\alpha) K^{\alpha}\right]\right)^{\frac{1}{-\alpha}}. \quad (8)$$

The home sector production involves only a transformation of the labor input supplied to that sector, requiring no further factor input:

$$Y^{\text{HS}} = G\left(L^{\text{HS}}\right) = L^{\text{HS}} = \frac{E}{T}\sum_i \phi_i \bar{l} I\left[s_i = \text{HS}\right] + \frac{(T-E)}{T}\sum_i \phi_i \bar{l}. \quad (9)$$

Labor input in the home sector production results from the labor supply by non-participants, the first part of the equation's right hand side, and by pensioners, the second part of the equation.

2.3 The Tax and Social Security Setting

The tax system is based on a tax on consumption at the (effective) rate τ_c, an (effective) rate on capital revenue τ_K, and a tax on labor revenue comprised between M brackets, 0,...,M, with the corresponding tax rates $\tau^{w,1}$,...,$\tau^{w,M+1}$. If B^0,...,B^M represent the thresholds between successive labor income tax brackets, with $B^0 = 0$, the tax on labor t^w_i paid the individual i earning a gross wage $W\omega_i l_i$ is

$$t^w_i = \begin{array}{r} \max\left(0; (B^1 - B^0)\tau^{w,1} + ... + \left(B^m - B^{m-1}\right)\tau^{w,m}\right. \\ \left. + \left(W\omega_i l_i - B^{m_i} - \chi_i\right)\tau^{w,m_i+1}\right) \end{array} \quad (10)$$

The individual's highest marginal tax rate is given by τ^{w,m_i+1}, which applies beyond the individual's highest tax bracket threshold B^{m_i}. All tax allowances are captured in the term χ_i. These include the general allowance χ^{general}_i, an additional allowance $\chi^{\text{additional}}_i$ and allowances for children $\chi^{\text{child 1}}_i$ and $\chi^{\text{child 2}}_i$, as defined by the tax code in force. Taxes are constrained to be non-negative.

Taxes need to fund the government expenditure G, so that the equilibrated budget condition requires:

$$\frac{\tau_c}{1-\tau_c}\sum_h c^{\text{GDP},\,h} + \frac{\tau_K}{1-\tau_K}(r+\delta)K \; + \; \frac{E}{T}\sum_i t^w_i = G, \quad (11)$$

where $c^{\text{GDP},\,h}$ refers to the the value of market consumption goods consumed by household h. Since we operate only tax-neutral experiments, we can consider government expenditure in the standard way as unproductive (wasted) in the sense that it does not return to tax-payers.

Firms and workers contribute to the pay-as-you-go pensions system at rates $\tau^{\text{firm}}_{\text{pens}}$ and $\tau^{\text{worker}}_{\text{pens}}$ of the workers' gross wages:

$$\left(\tau^{\text{firm}}_{\text{pens}} + \tau^{\text{worker}}_{\text{pens}}\right) W L^{\text{GDP}} = \frac{(T-E)}{T}\left(1+\tau^{\text{pensioner}}_{\text{health}}\right)\sum_i \theta w_i \mathrm{I}\left[s_i = \text{GDP}\right] \tag{12}$$

The right hand side of (12) is the total pension expenditure in the economy. It depends on the proportion of retired individuals entitled to pensions multiplied by their former net wage w_i, the replacement rate θ and the pensioners' health insurance contribution.

Finally, health insurance contributions are paid in proportion to gross wages by firms and workers at the respective rates $\tau^{\text{firm}}_{\text{health}}$ and $\tau^{\text{worker}}_{\text{health}}$:

$$\left(\tau^{\text{firm}}_{\text{health}} + \tau^{\text{worker}}_{\text{health}}\right) W L^{\text{GDP}} + \tau^{\text{pensioner}}_{\text{health}}\frac{(T-E)}{T}\sum_i \theta w_i \mathrm{I}\left[s_i = \text{GDP}\right] = t_{\text{health}} \tag{13}$$

Just like government expenditure G, the collected amount of social contributions t_{health} is treated as waste. This is because health insurance helps to alleviate a specific idiosyncratic risk, which is absent from this model. In other word, the revenue received from health insurance cannot be consumed and thus affect the economic equilibrium only through the effect of taxes.

2.4 The Equilibrium

The long-run equilibrium of the model economy is its stationary state where:

1. Households $\left(\omega^h_1, \omega^h_2, \phi^h_1, \phi^h_2, k^h_1, k^h_2\right)$ maximize their lifetime consumption-effort objective (1) under the budget constraint (3) by supplying labor to the market sector Y^{GDP} and the home sector Y^{HS}, constrained by the participation condition (4), and given r, W, K, the tax regime $\{\tau_c, \tau_K, \tau^w, \chi, G\}$, the social security regime $\left\{\tau^{\text{worker}}_{\text{health}}, \tau^{\text{firm}}_{\text{health}}, \tau^{\text{pensioner}}_{\text{health}}, t_{\text{health}}\right\}$ and the pension system $\left\{\tau^{\text{worker}}_{\text{pens}}, \tau^{\text{firm}}_{\text{pens}}, \theta\right\}$.

2. Given r and W, the production optimality conditions (7) and (8) determine the firms' demand for capital K and labor L^{GDP}. The total production in the home sector is determined by (9).

3. The labor market in the market sector GDP balances at a productivity-adjusted efficiency unit gross wage W, so that:

$$L^{\text{GDP}} = \frac{E}{T}\sum_i \omega_i l_i \left[s_i = \text{GDP}\right] = \left[W\left(1+\tau^{\text{firm}}_{\text{health}} + \tau^{\text{firms}}_{\text{pens}}\right) / \left(A^{1-\alpha}\left(1-\alpha\right)K^{\alpha}\right)\right]^{\frac{1}{-\alpha}}$$

4. The government budget, the social security budget and the pensions system are balanced, implying (11), (13) and (12).

2.5 Welfare

Welfare measures enable to discriminate among different tax settings. The welfare measure used encompasses in a single measure the preference for trade-offs between higher income and consumption, the production effort of forgone leisure and the endowment risk newborn individuals face in a particular economy. In the above model it corresponds to the average *ex-ante* lifetime utility:

$$\text{Welfare} = \frac{1}{H} \sum_{h} U^h \tag{14}$$

It can be interpreted as the expected lifetime utility of a household at birth, before the realization of the endowments lottery determining $\omega_1^h, \omega_2^h, \phi_1^h, \phi_2^h, k_1^h$ and k_2^h. The individuals here are thus born behind what is usually termed as the Rawlsian "veil of ignorance", as for instance in Conesa and Krueger (2005).

As the convexity of the individual lifetime utility functions (1) implies that this welfare criterion exhibits aversion towards inequality, it can also be interpreted as the social planner's welfare function. This aversion by any newborn agent is captured by the parameter σ, that thus represents the lifetime utility risk aversion.

Note that given the specification of the lifetime utility, the economic equilibrium is independent of the newborn agent's lifetime utility risk aversion, as only welfare is affected. This enables to compute and compare the welfare measure for any lifetime risk aversion parameter σ without altering the economic equilibrium.

3 Calibration to the Slovenian Economy

Most of unobservable parameters are calibrated in accordance with the prevailing literature. The remaining parameters are evaluated so that the model sufficiently closely replicates important data moments of the Slovenian economy. Care is taken that these moments enable for the identification of parameters in a meaningful way. The tax system in the baseline equilibrium is the one in place in Slovenia prior the 2006 reform. At the end of the section, the calibration of the model is validated by comparing some simulated model tax aggregates to their empirical counterparts and by comparing some of the implied model elasticities to tax changes to those found elsewhere in the literature.

3.1 Technology and Preferences

The adult lifetime T is set to equal 60 years, of which the earning period equals $E = 40$ years. This leaves $20 = T - E$ years for the retirement period. In the first 20 $= \frac{1}{2}E$ years households take care of their children, which entitles them to the related tax allowances.

The market sector technology is a Cobb-Douglas production function (5), where A is normalized to 1. Such production function ensures that growing productivity levels do not affect the labor supply decision. The factor remuneration of capital and α is set to 0.35, with 1-α the factor remuneration of labor. With yearly capital depreciation rate $\delta = 0.085$ the steady state the capital stock needs to be renewed about every 12-13 years. Also in accordance with the literature is the rate of world return on capital fixed at 0.05.[6] Since the home production function (9) is equal to the effective labor supplied to home production, no additional parameters needs to be specified.

A reasonable effort function ε_i (2) is strictly increasing, and at an increasing rate, in the quantity of labor l_i provided by individual i. Given the 24 hours day, the feasible labor allocation is thus bounded between 6 and 12 hours per day on average, $l_i \in \left[l^{\min} = \frac{1}{4}; l^{\max} = \frac{1}{2}\right]$, which reflects the fact that part-time work is rare in Slovenia. Recall that the amount of work provided if engaged in home sector production is fixed without any loss of generality to $\bar{l} = l^{\min} = \frac{1}{4}$. We use the exponential effort function

$$\varepsilon_i = \gamma \ \left[\exp(\rho \ l_i) - \exp(\rho \ l_i^{\min})\right], \tag{15}$$

implying a positive effort if the quantity of labor supplied exceeds $l^{\min}$. γ is a scaling parameter, while ρ determines how steeply the effort increases with additional labor. These two parameters are unobservable and unavailable form micro data, so that we have to rely on two assumptions about the distribution for l_i to pin down their values. First, we follow the standard practice of targeting an average of eight hours worked per participating individual, or a third of their available time, so that $\frac{\sum l_i}{N^{\text{GDP}}} \approx \frac{1}{3}$ where N^{GDP} is the number of individuals engaged in the market sector. This pins down γ to 0.00133. Second, ρ is evaluated so that the distribution of hours worked exhibits a mode again equal to $\frac{1}{3}$, which yields ρ equal to 7. To avoid computational burden, but without loss of generality, we allow for $L = 10$ different levels of hours worked with increments of $\frac{1}{L-1}(l^{\max} - l^{\min})$. The resulting hump-shaped distribution of hours worked across individuals is shown in Figure 1.

FIGURE 1: Model distribution of hours worked

The parameter of lifetime risk-aversion σ in (1) is set to 3 in the benchmark, which is a standard value used for constant relative risk aversion.[7] Recall that the equilibrium of this model is invariant to σ, unlike the welfare measure (14).

[6]See for instance Caselli and Feyrer (2005) for a thorough comparison of the marginal product of capital in rich and poor countries. The (tax-exempt) gross return on capital $r + \delta$ that we choose translates into a marginal product of capital in line with their study. Gonzáles and Pijoan-Mas (2005) use 0.0851, Conesa and Krueger (2005) have 0.0658 for the yearly capital depreciation rate. See Jongen (2004) for the estimates of labor and capital share in Slovenia.

[7]See for instance Atkinson (1970). Conesa and Krueger, 2005, choose the value of 4.

3.2 The Tax and Social Security Setting

The tax and social security system are reproduced in detail to mimic very closely the code in place Slovenia prior to the reform. We start out by applying most of the rates that were in use. We then compare the government revenues generated by the model scenario with those from the data to check for the robustness of the results.

TABLE 1: Pre-reform Slovenian labor income tax code

Agents pay income taxes at a progressive rate, related to successive brackets of income level. There are five different tax rates and four different thresholds, expressed as percentages of the average gross wage, as outlined in Table 1. The general allowance is 17 percent of the average gross wage. Following the tax code, it is optimal for the individual with a higher marginal tax rate in the household to claim a general deduction for children, worth 14 percent of the gross wage for the first child. The allowance for the second child is worth 15 percent of the average gross wage, and is also claimed by the individual with the higher remaining marginal tax rate. Finally, individuals can also claim an additional allowance worth 2 percent of the gross wage, which is the upper limit for all extra deductions and which most individuals in Slovenia fulfill. The maximum allowance one individual can therefore claim is worth as much as 38 percent of the gross wage.

TABLE 2: Pre-reform Slovenian tax code: contributions and taxes

Contribution and tax rates are summarized in Table 2. We simplify the tax setting by imputing all the capital income taxes to taxes on the return on capital. This allows to implicitly include all possible investment allowances which enables a clear separation between labor and capital income taxes. Conversely, we do not consider estate or property taxes, which are of minor importance in Slovenia. Such a rate stood at about 11 percent in effective terms. Applying this rate results in a government revenue from capital income taxes worth about 4.5 percent of GDP, which corresponds well to the data.

The VAT rate in Slovenia prior to the reform was at 20 percent for a bit less than three fifths of the value sold, while for the remaining two fifths of goods' worth it amounted to 8.5 percent. Since the model embodies only one composite consumption good we have to reason again in effective terms. We use the average VAT rate, 14.825 percent of GDP. Furthermore, there is an excise tax on all goods, worth about 3.5 percent of GDP. For reasons of simplification we add up these two taxes into a general tax on market consumption goods $\tau_c = \tau_{\text{VAT}} + \tau_{\text{excise}}$.

Being at the core of interest, the social security setting is based as close as possible to the actual one. The contribution for health that workers pay is 6.56 percent of their gross wage, while firms pay 6.36 percent of gross wages for health expenditures. There is neither a general allowance nor a cap on social security and pension contributions, making these proportional to gross wages. The pension expenditure guarantees to pensioners 70 percent of their average gross wage, respecting however a statutory a cap at 2.5 times the average net wage. Firms contribute 8.85% of gross wages, while the workers' contribution is endogenous, ensuring that the pension revenue equals pension expenditure as in (12). We add to this another 6.92 percent of the paid-out pensions to account for the health contributions that pensioners must fund.

Note that we ignore a specific progressive payroll taxes paid out by employers. It accounted for about 1.6 percent of government revenue, but was gradually phased out up to 2009.

3.3 Distributions of Household's Endowments

The number of working age individuals N is set to 10.000 and the number of households $\frac{N}{2}$ equals 5.000, enough to ensure stable results. The distributions of market productivity ω_i, home sector productivity ϕ_i and capital k_i are proxied by a log-normal distribution, in line with the literature. The mean and the variance of these parameters are inferred from model simulations designed to replicate particular observable data moments.

FIGURE 2: Wage distribution

The mean μ_ω of market productivity distribution $\omega_i^{\text{distr}} \sim \ln N(\mu_\omega, \sigma_\omega^2)$ is normalized to $\ln(1)$, while its variance σ_ω^2 is identified by the observable moments of the gross wage distribution.[8] The model simulations indicate that $\sigma_\omega^2 = \ln(1.8)$ provides a good *ex-post* gross wage distribution. The median-to-mean and the standard deviation-to-mean ratios of the model gross wage distribution is matched to the observed one, as shown in Table 3. It also shows how the quintiles of the model real wage distribution, both in terms of number of individuals and the wage mass, are matching available data. Figure 2 superimposes a Kernel distribution of the model's *ex-post* gross distribution on the observed one.

TABLE 3: Actual and model wage distributions

Parameterizing the distribution of the home sector productivity $\phi_i^{\text{distr}} \sim \ln N(\mu_\phi, \sigma_\phi^2)$ is somewhat more tricky since, contrary to the market sector, no income from home production is directly observable. The natural data moment to match in estimating the parameters of ϕ_i^{distr} is the working age participation rate of 0.695, since it is largely determined by the relative average productivity π between the two sectors.[9]

[8] The avaliable database divides all taxpayers in Slovenia into bands of 100,000 Slovenian tolars according to their yearly gross wage.

[9] See IMF (2006) for the analysis of the participation rate in Slovenia.

This condition yields $\pi = 0.4985$ and therefore $\mu_\phi = \ln(0.4985)$. Changes in the variance of the home sector productivity σ_ϕ^2 do not exert significant impact on the economic equilibrium and are therefore difficult to evaluate, but at the same time do not matter much. The variance is set to $\sigma_\phi^2 = \ln(1.15)$, roughly four times lower than the variance of the market sector productivity, which reflects a smaller diversity in skills in the home sector relative to the market sector.

Finally, the parameters of the log-normal distribution of capital endowment $k_i^{\text{distr}} \sim \ln N(\mu_K, \sigma_K^2)$ are chosen according to the tax-paying population sorted by income deciles.[10] Given the normalization $k_i = \frac{k_i^{\text{distr}}}{\sum_i k_i^{\text{distr}} = K}, \forall i$, implying $\mu_K = \ln(1)$, and the variance value $\sigma_K^2 = \ln(4.5)$ generates a fair capital distribution of capital with respect to ω_i. Figure 3 presents this distribution and superimposes it on the available data. It shows that the model distribution comes very close to the targeted data. In particular, it concentrates about 60% of capital in the hands of 10% of the taxpayers, and more than 70% in the hands of 20%, a feature that comes close to what is prevalent also in other countries.

FIGURE 3: Distribution of capital income

3.4 Two Checks on the Calibration of the Model

Model features that arise directly from the calibration are not endogenously generated by the model's structure and therefore cannot be used to validate its implementation in tax experiments. This section therefore proposes two checks of the model, where model-generated features, unconstrained by the calibration, are compared to the actual data or findings elsewhere in the literature.

The first check consists in comparing the model-generated tax revenue distribution across tax brackets and tax sources to the actual one. The upper part of Table 4 shows the distribution of taxpayers according to the tax-bracket to which they belong in 2005. As it is, the simulated data fairly well proxy the share of taxpayers and the share of the labor tax revenue according to the individual brackets. Some divergences are not surprising. In particular, the size of the lower tax brackets evidently depends on the model gross wage distribution, and is consequently subject to the minimal wage distortion. It produces a somewhat higher concentration in the first bracket in the actual tax revenue distribution than the model predicts, 62.4% and 55.1%, respectively. To compensate this, the model generates a higher concentration in the third and fourth revenue bracket. A comparison in terms of the wage mass distribution also replicates the data to a large extent, with the exception of the final bracket, where the actual mass is 13.8%, as compared to the model-generated 7.1%.

[10] See Kump (2002).

In that respect, note that the personal income tax is paid on some other items than the sole wage. Also, the family situation (couples vs. single household, number of children, etc.) crucially determines the tax burden and the distribution of children may well not be independent of income as it is assumed in the model.

The model further also adequately mimics the tax setting by proxying sufficiently well the overall tax revenue from the main different tax sources. The lower part of Table 4 shows the model's performance in this respect. The actual capital income tax revenue is almost the same as in the model, 4% and 3.9% of GDP respectively. A larger number of pensioners relative to workers in the model necessitates a higher pension contribution mass, 17% instead of 14.8% of GDP. Since the model-generated private consumption in 50% of GDP, while it is roughly 55% of GDP in the data, the model uderestimates the VAT revenue, 11.6% instead of 12.4% of GDP. The model does exaggerate the tax revenue from labor income because of the non-consideration of the payroll tax that has been abolished in the aftermath of 2006. It was worth about 1.8 percent of GDP - almost the difference between the model and target data in labor income taxes.

TABLE 5: The structure of the tax revenue

The second check involves computing the model labor supply elasticity to taxes, in form of a standard sensitivity analysis, and comparing it to other findings in the literature. This is done by a one-percentage point increase in the health contribution rate. The latter is almost the equivalent to a one-percent decrease in the net wage given that all agents need to pay a flat rate when working in the market sector. In Table 6 are presented the changes to a one percentage point change of the health contribution rate $\tau_{\text{health}}^{\text{worker}}$ i.e. 0.0656 +/-0.01.

TABLE 6: Labor supply elasticity to the net wage

This experiment is used to infer the *uncompensated* labor supply elasticity in the model. Such a change in net wage triggers a decrease in the average amount of hours supplied of 0.22 percent, and a decrease of 0.29 percent in the average amount of hours supplied only by those workers who participate both before and after the tax change. The latter is the labor supply elasticity along the intensive margin only. The participation rate changes by 0,65 percent, thus representing a more than twice more important margin of adjustment.

This is consistent with the findings in the related literature. Blundell and MaCurdy (1999), Jacobsen (1998) or Devereux (2004) on the whole concur that the labor supply elasticity on the extensive margin is positive (especially for women) and that it ranges somewhere between 0 and 1. The sign and the size of the labor supply elasticity along the intensive margin is more hotly debated and may further significantly hinge on cultural and regulatory factors. As found by Filer, Hamermesh and Rees (1996) the aggregate labor supply (including both decision margins) of men is about 0 and about 0.8 for women, which, according to Blau and Kahn (2005), broadly represents the average values of studies done on the basis of the US in the seventies and eighties. Similar results are found by Evers, van Vuuren and de Mooijs (2005) for the Netherlands. Model results are also in line with Heckman (1993) who reports in detail how the labor supply elasticity is much higher on the extensive than on the intensive margin. Observe finally, that neither the labor tax nor the consumption tax involves Laffer-type features according to which a *decrease* of the tax would result in *increased* tax revenue.

These results inspire confidence that the calibration is sufficiently robust and the model economy sufficiently close to the Slovenian economy to use it as a baseline model equilibrium in conducting tax experiments. This is the matter of the next section.

4 Tax Experiments

The experiments involve comparing the calibrated model baseline to 12 tax settings at the steady state of the economy: six variants of flat tax regimes, and five variants of progressive tax regimes, and the finally adopted Slovenian tax reform. The baseline equilibrium and the simulations are presented in Table 7. All of the simulations represent coherent tax adjustments that can be used as a basis for feasible reforms. This is not seeking to find *the* optimal tax-setting, but rather to examine if there are any clear benefits associated with such reforms.

All simulations to some degree flatten the progressivity of the tax code, at least for most of the population. All simulations are tax revenue-neutral in the sense that the ratio of government revenue to GDP remains unchanged. As is standard in such experiments, if needed, decreases in the tax burden on labor are offset with taxes on consumption. Unless where otherwise stated, all parameters and tax rates remain the same as in the baseline setting. The resulting steady-states are compared to the baseline.

TABLE 7: Tax setting experiments

4.1 Flat tax on labor income, capital income and VAT, possibly with higher general allowance (simulations 1-2)

The first simulation considered is the standard flat tax experiment, i.e. a flat tax rate on labor income, capital income and value-added, with $\tau^w = \tau_K = \tau_{\mathrm{VAT}}$ such that it balances the government budget. Such a tax rate would amount to about 15.7 percent. GDP increases, but only by some 0.7 percent, which is not sufficient to offset welfare loses from inequality. This is mostly due to the substantial increase in the effective capital tax rate - by some 4.7 percentage points from a very low level in effective terms - producing a decrease of 4.7 percent in investment. Given the open economy demand for capital (7), capital taxation indeed has a large negative effect on investment and therefore on GDP. Note that the participation rate drops substantially, by 1.7 percentage points, since the tax burden on low productive workers increases, further limiting a positive net effect on GDP. GDP hence only increases because the labor income tax burden is much lower, which gives a large boost to the labor supplied by most individuals endowed with more-than-average market sector productivity (see Figure 5-i). The effective labor measured by average hours increases by roughly 3.5 percent, more than offsetting the drop in participation. The higher tax on capital also shows in a decrease of the capital-to-GDP ratio.

In terms of welfare such a tax adjustment gives particularly negative results because it boosts inequality among risk averse households. The population welfare is at the lowest level among all 13 settings compared. The increase in GDP, yielding additional revenue on average, does not compensate for negative distributional effects on welfare. Also, the redistribution effects on welfare that capital taxation brings about do not compensate for the additional dispersion in labor revenue. The share of households better off in the simulated regime is only 27 percent, others being worse off.

Consider now in addition increasing the general allowance χ^{general} from 17 percent of the average gross wage to 38 percent. This somewhat mitigates the reduced redistribution resulting from the flat tax, which must now increase to 16.8 percent. Although this proposal is preferred in terms of welfare to a pure flat tax with a lower general allowance, it still performs worse than the baseline in terms of welfare. Again, this is mainly due to the increase in the effective capital tax. The share of households that are better off vis-à-vis the baseline is still only 29.5 percent, but improves with respect to the simulation without a general allowance increase. The reason for this is that the higher general allowance must be to a large extent financed with higher value-added taxes, which is the least redistributive of all taxes here.

4.2 Flat tax rate on labor income and VAT, possibly with a higher general allowance (simulations 3-4)

So as to avoid the deadweight loss implicit in simulation 1 due to an increase in the taxation of capital it is sensible to consider a flat tax rate only on labor income and on value-added, while keeping the capital income tax rate unchanged. The resulting tax rate is $\tau^w = \tau_{\text{VAT}} = 17.5$ percent, τ_K remaining at 11 percent. GDP now increases by a substantial 3.3 percent compared to the baseline, due to a general increase in the average amount of hours worked from 8 to 8.25. As is apparent in Figure 5-iii, this is due in particular to the increase in the average hours worked of the most productive agents. This contributes to a significant increase in average productivity, reflected in a gross wage up by almost six percent. Nevertheless, although the net average wage increases by almost eleven percent, the large increase in the value-added tax negatively affects the purchasing power of net wages of low productive agents, pushing a non-trivial part of the population out of the labor market. The participation rate falls from 69.5 percent to 67.9 percent since these agents prefer to move into the home sector and produce non-taxed goods.

In terms of welfare this setting still compares badly to the baseline, but improves welfare with respect to an all-out flat tax rate on labor, value-added and capital. It occupies only the eleventh rank among the 13 settings considered. The percentage of households that are better off represent 28.6 percent of households since the new tax setting benefits only the most productive minority.

Raising the general allowance χ^{general} from 17% of the average gross wage to 38% mitigates the labour evading into the home sector, producing the higher GDP increase among the considered settings. Indeed, the participation rate of 69.2 percent is not as negatively affected as the preceding reforms, and the increase in hours worked makes GDP grow by four percent! Higher general allowance nevertheless increases the financing needs, resulting in tax rate of $\tau^w = \tau_{\text{VAT}} =$19.1 percent. Due to the large increase in the VAT, most of the households are still worse-off vis-à-vis the baseline, since ex-ante inequality increase is not compensated by a larger revenue on average. Yet, increasing the general allowance enables this setting to perform better in terms of welfare compared to the three preceding ones.

4.3 Flat tax rate only on labor income, possibly with a higher general allowance (simulations 5-6)

Acknowledging that increasing the value-added tax by a substantial amount might produce negative welfare effects, because inequality considerations might prevail over the beneficial effect of a higher average revenue, one could envisage a flat tax only on labor income. This is still intended to stimulate productive work. A flat tax rate on labor income which equilibrates the government budget amounts to $\tau^w = 24.9$ percent. GDP increases compared to the baseline by almost 1.9 percent. While average hours worked increase slightly, by less than one percent, the participation rate decreases by 0.8 percentage points. Figure 5-v illustrates how only the most productive agents are now eager to provide more hours worked, while a large proportion of the population is demotivated from working longer hours. Yet, the effect on average productivity is up by roughly three percent, generating the bulk of the positive effect on GDP.

In terms of welfare this tax setting is superior to the previously considered, occupying the eighth rank among the settings considered. The proportion of households that are better-off is about a third of the population. The losers of such a tax reform are located in the lower middle part of the productivity distribution, who now face a substantially higher tax rate. Note that, once one discards the possibility of a pure consumption tax, there is no theoretical presumption that an equal tax rate on labor income and on value-added is superior to differentiated rates.

Increasing the general allowance χ^{general} from 17 percent to 38 percent of the average gross wage produces an increase in welfare for the majority of households, but a slight fall in output. This setting more than offsets the negative welfare effects of a flat tax on labor income. τ^w now stands at 38.3%, which is relatively high, but the least productive workers now benefit from higher net wages because of the lower effective tax rate. They are also motivated to work longer hours. Since the value-added tax remains unaltered, unlike in simulation 4, and the purchasing power of net wages of this population segment increases. This is boosting the participation rate up to 72.4 percent, as the low-productive individuals productivity find it worthwhile to enter the labor market (see Figure 4-vi). The upper middle segment of the population, though, is hit hard by such reforms. These agents are also likely to reduce their work effort in face of higher marginal tax rates for all the income above the general deduction, which is why average hours worked in the economy fall substantially to 7.75, causing GDP to fall, by 0.7 percent. Despite the fall in GDP, this reform is preferred to the baseline in terms of welfare, occupying rank 3, while 50.5 percent of households are better off than in the baseline.

4.4 Less progressive labor income tax rates financed by a higher VAT (simulations 7-9)

Further simulations consider a few alternatives to the flat tax, where the value-added tax is raised to offset a reduction in the progressivity of the labor income tax. The idea is again to increase incentives for work effort, by shifting the tax burden from work to consumption.

First is examined a reduction of marginal tax rates on labor in all brackets by 16 percentage points, so that the first bracket goes to zero. To keep government expenditure constant as a percentage of GDP, the value-added tax increases to 19 percent, compared to the baseline 14.825%. The effect of such a reform is a substantial boost to GDP, by 3.9 percent. It is spurred by a very large increase of hours supplied in the face of much higher net wages, up 15.6 percent, and this by all workers (but the most productive ones since they already work a maximum amount of discretionary time). Less productive workers, however, are worse off because they do not profit much from the lower labor income tax while they need to pay much higher consumption taxes. In a similar vein, the participation rate decreases by more than 1 p.p. It follows that, in spite of the higher GDP, only 46.2 percent of households are better off and such a reform would do worse as regards welfare than the baseline setting.

Repeating the above exercise yet reducing the marginal tax rates by only 6 percentage points the tax rates in all brackets forces the value-added tax up by somewhat less, to 16.6 percent. Qualitatively this simulation performs very similarly to the preceding one, but with a lesser effect on activity. GDP increases by 2 percent mainly due to hours worked going up by a lesser amount as shown Figure 5-viii. The participation rate, meanwhile, decreases twice less. In general, this tax setting is more redistributive than the preceding one, though both are less redistributive than the baseline scenario. Because the positive efficiency effects do not outweigh the negative consequences associated with a higher VAT, welfare is again lower than in the baseline scenario, and only slightly less than a half of the population is better off.

Instead of decreasing tax rates an alternative way of lowering labor rates consists of increasing the tax brackets. To examine effect of such tax adjustment all thresholds of the tax brackets $(B^1, ..., B^M)$ are multiplied by 1.5. This simulation is preferred to the two preceding ones as regards welfare, with qualitatively similar but quantitatively less pronounced effects. The GDP increases by slightly less than 2 percent, the average hours by 1.62 p.p. and the participation rate is down by 0.68 p.p. The households most susceptible to gain from such a reform have endowments in productivity situated in between 1 and 1.75 times the average productivity. This reform suggests that adjusting tax bracket thresholds may be a more efficient way of lowering progressivity than the reduction of statutory tax rates.

4.5 The Increase in the general allowance, possibly with higher tax bracket thresholds (simulations 10-11)

The last tax adjustment interesting to examine separately is a change in the general tax allowance, compensated by a higher VAT. The general allowance χ_i^{general} is raised from 17 percent of the average gross wage to 38 percent, while all other labor income tax rates remain unchanged. To compensate the tax shortfall the VAT would need to stand at 16.8 percent, about 2 percentage points more than in the baseline. This is so far the simulation that yields the highest welfare and makes a large majority of the households, 56.2 percent, better off. Overall, GDP increases by some 1.9%. The reason for this lies in the higher participation rate of the individuals in the lower end of the productivity distribution (Figure 4 - x) and the substantially higher effort of agents at the middle productivity levels (Figure 5 - x). The participation rate increases by 0.6 p.p. Nevertheless, the most productive workers work less in the face of higher consumption taxes, but the latter effect is minor with respect to the former.

To the same reduction of the general allowance is now added tax breaks for the most productive agents, by multiplying again the thresholds of the tax brackets by 1.5. The VAT rate necessary to make this reform tax-neutral is 16.9 percent. This scenario yields very similar results to simulation 10, but, in addition the most productive workers now also have an incentive to work longer hours, producing positive repercussion. The amount of hours worked, the participation rate and GDP all increase compared to the baseline, with a positive effect of 1.23% on GDP and 0.58 p.p. on participation. Even more households are better off compared to the baseline than in the preceding reform, 57.8 percent, and welfare is highest. Because of the increased work effort at the margin, the *ex-post* labor income tax revenue is not substantially lower than in simulation 10, which is why the value-added tax is only slightly higher here than in simulation 10.

4.6 The Slovenian tax reform of 2007 (simulation 12)

With the onset of 2007 Slovenia's tax system has been undergoing substantial reform. The number of marginal tax rates on labor income was reduced from five to three while the thresholds of the brackets were squeezed together. The types of allowances remained quasi unchanged, but the additional allowances were removed. We model this reform by proxying the new labor income tax code, given in Table 8.

TABLE 8: The 2007 reform tax code

The proposal envisaged a revenue-shortfall that was not planned to be compensated with higher taxes elsewhere. Actually, a favorable business cycle environment has brought about substantial cyclical tax revenue, so that the fiscal balance even improved in 2007. To preserve the long-term equilibrium tax-to-GDP ratio with respect to the baseline, without taking into account cyclical effects, the appropriate effective VAT rate would need to increase from 14.825% to about 15.8%.

According to these simulations the design of the reform appears to have been quite a success in terms of welfare and the model generates a positive effect on GDP even when financed by a higher VAT. The overall effect on GDP is an increase of 0.33%, the participation slightly recedes and the average hours increase by 0.54 p.p. Figure 5-xii illustrates how the more-than-average productive workers increase their supply of hours while very productive workers (except the most productive) work shorter hours, decreasing their effort, as the substitution effect prevails. This reform does better in terms of welfare than all flattening tax regimes that we have considered so far, but the simulation 11. Its welfare rank is 4 out of the 12 settings considered. Nevertheless, only 44.6% of the population is better off with respect to the baseline setting (once the VAT is duly adjusted to compensate the revenue shortfall). In this reform, the lower part of the average productive workers are the ones worse-off because they virtually do not profit from the labor income tax break yet need to pay higher consumption taxes.

4.7 Discussion: Welfare and Tax Settings

When it comes to increasing welfare compared to the tax setting prior to 2007 there apparently exists only a limited set of options to render the statutory labor tax schedule less progressive by relying on consumption taxes. The only tax settings that performs better than or similarly to the current setting involve a substantial rise in the general allowance, which increases the effective progressivity of the tax system, especially in the lower part of the income distribution. An increase in the general allowance is less redistributive as a lump-sum tax-break, because the effective tax-break consists of the general allowance times the statutory tax rate of the highest tax bracket applied to the individual. Higher income individuals have more to gain in absolute terms from higher allowances, but in relative terms it is the lower income individuals that stand to gain more, and especially the ones that earn enough to profit entirely from the general allowance.

Nevertheless, equity considerations are not the only ones that stand in defence of some degree of progressivity at the lower tail of the productivity distribution. For flatter tax schedules to be welfare-enhancing they need to motivate less-than-average productive individuals, which present the bulk of the labor force, to remain active and not to decrease their labor supply effort. Higher consumption taxes decrease the purchasing power of net wages and need to be compensated with higher general allowances in the labor tax to avoid escapes into the home sector. Since there the tax-man can lay his hand neither on the production nor the consumption, the remaining active taxpayers would face higher tax rates to finance the revenue shortfall. Going beyond the presently discussed model, this phenomenon naturally extends also to the informal market. Both the home sector and the informal market sector are likely to be run mostly by individuals with lower market sector productivity levels. Their tax base is more at risk from vanishing due to higher effective tax rates than the one provided by higher productivity agents.

One should keep in mind, however, that the fact that some of the envisaged simulations that decrease the tax burden on the most productive workers are welfare-enhancing suggests that there are some efficiency gains to be achieved from cutting high marginal income tax rates. Given that they also have the potential to make a majority of the households better off furthermore implies that they are feasible from a political-economic perspective.

These findings are also corroborated when considering levels of risk-aversion different from the one used in the basic setup. The way we consider overall welfare, given in (**??**) and (14), captures each individual's aversion to the *ex-ante* endowment risk, but it can also be interpreted as the society's or the social planner's aversion in inequality, going beyond the notion of the sole aversion to negative income shocks. Consequently, our results depend on the correct value chosen for the parameter σ.

TABLE 9: Welfare rankings for different risk aversion parameters

Table 9 represents the welfare ranking of the above simulations for different values of σ, recalling that σ equal to 3 is the benchmark used in the above discussion. When σ increases, households prefer more redistributive tax systems and vice versa. We see that for realistic values of the parameter ($\sigma = 2$, $\sigma = 3$, $\sigma = 4$), there are no substantial changes in the welfare ranking. What is interesting is that a flat tax on labor income combined with a higher general allowance (simulation 6) appears to be the most redistributive tax. Nevertheless, the simulations that all rely on higher consumption taxes are much less preferred when risk-aversion increases. Note also that even when there is no *ex-ante* risk aversion at all ($\sigma = 0$), the maximum welfare is not necessarily associated with the simulations where GDP is highest. This is again because tax systems that push workers out of the formal market sector boost the home production. In addition, when there is no risk aversion, the efficiency of the equilibria can be judged by whether each welfare rank corresponds to the GDP rank. This is because the technology in the market sector allows for most agents to produce more goods than in the home sector, meaning that an efficient equilibrium would be such where most agents would be active in the market sector. Equilibria where GDP is relatively high while the welfare their ranking is relatively low are clearly inefficient from an ex-ante welfare criterion, as for instance simulations 4 and 8.

5 Conclusions

This paper implements a version of a general equilibrium model to examine the scope for a tax reform relying on a flatter tax schedule to enhance welfare and output. The model constructed to conduct this exercise is based on overlapping generations of heterogenous households that optimize their lifetime strategies by deciding upon their work effort and sectoral participation, given a detailed tax system. The international financial constraint places the analysis in a small open economy context.

The results suggest that for a standard measure of *ex-ante* risk aversion the flattening of the tax schedule may enhance welfare and make a majority of the households better off only in rare cases. These results of course rely the Slovenian endowment distribution and the tax system prior to 2007 as a starting point. We find that superior tax regimes in terms of welfare must ensure that the participation rate of agents in the lower segment of the productivity distribution and the hours worked by agents in the middle segment do not fall substantially, for which the lowering of these agents' effective tax rate is crucial. Three simulations stand out as alternative changes to the present tax regime: an overall increase in the general allowance from 17 percent to 38 percent financed with a corresponding VAT increase of about 2 percentage points; a flat tax on labor income of about 38 percent combined with a general allowance of 38 percent; and a rise of the three highest tax bracket thresholds by a multiple of 1.5 in combination with an increase of the general allowance to 38 percent, financed with a VAT increase of some 2.1 percentage points. For higher levels of risk-aversion in the social preferences function the flat tax rate on labor income involving a higher general allowance becomes the only welfare-enhancing reform of the ones considered here. The recently introduced tax reform of 2007 may increase overall welfare and GDP, although at the cost of making a slight majority of households worse off. It occupies the fourth rank among the 12 alternative settings considered. The preferred tax regimes do not necessarily boost GDP, with GDP changes ranging from -0.7 to +2.1 percent. In fact, the reforms that increase welfare and make a majority of the households better off are the only ones that increase the participation rate. Increases in the participation rate, after all, allow for the generation of more tax revenue, which enables a partial reduction of tax rates. Given these results, the future debate might consider also *more* tax progressiveness rather than less, especially in the lower tail of the productivity distribution.

Further work might address the robustness of the above results in several interesting directions. For one, appropriate modeling of the labor supply is central in conducting tax experiments. While it is admittedly realistic that the work effort can be optimized on individual level in the long run, as in the implemented model, a fixed number of hours may still characterize a certain number of jobs. If individual labor supply is assumed inelastic, there is trivially no scope for tax reductions in the view of increasing production. Quite on the contrary, because of the negative effect on the participation rate, GDP falls (significantly) after the introduction of a flat tax in such economic environment, as in Cajner et al. (2006). Also, the labor income tax base can be eroded when labor is internationally mobile. This should apply above all to the most skilled workers whose incentive to remain inside an economy's borders might diminish when facing high average and marginal tax rates. In this case an economy could suffer serious deadweight losses if these agents were to leave. Migration, though, depends on numerous parameters.

Second, VAT rate effects could also be studied in more detail. Different consumption goods are often taxed at different rates, as in Slovenia, potentially distorting production and consumption. It would also allow for a more subtle analysis of the effects of varying value-added taxes on inequality according to different income groups' demand for various products. A thorough examination of value-added tax effects in a small open economy would furthermore require consumption to be treated as an internationally mobile tax base. This is due for instance to cross border shopping, as in Joumard (2001), and is certainly relevant in the Slovenian case.

A third direction might be to consider effects of incomplete international capital mobility. While most of the literature on optimal taxes builds closed economy models, in a small open economy, especially one operating in a monetary union such as Slovenia, that home savings do not dictate the tong-run interest rate may be a better approximation. But this assumption is weakened by issues such as the home-bias effect, entrepreneurship, and incomplete credit markets. In addition, in the real world corporate taxes do not have quite the equivalent effect as various capital income taxes. Differentiated rates could be justified to some extent if (higher and possibly progressive) capital income taxes can be used to alleviate inequality while (lower) corporate tax rates attract investment.

Eventually, the tax setting might affect the accumulation of human capital, by influencing the education decision or the level of "learning by doing. For instance, Heckman et al. (1998) emphasize that progressive taxation discourages education as the tax saved while in school is smaller than future taxes due to the increased education-related earnings. This could therefore produce quantitatively larger effects of different tax settings than evaluated in this paper. A promising route would also be to consider "learning by doing", where labor productivity would increase with the time spent at work. In that context, tax systems that generate a higher level of effective labor would produce even stronger effects on production. But then again, since flat and flatter taxes are likely to decrease labor participation, these tax settings may not be the preferred ones in this context.

6 References

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TABLE 1

Labor tax bracket thresholds in multiples of average gross wage	**Tax rates**
$B^1 = 0.4$	$\tau^{w,1}=0.16$
$B^2 = 0.75$	$\tau^{w,2}=0.33$
$B^3 = 1.51$	$\tau^{w,3}=0.37$
$B^4 = 3$	$\tau^{w,4}=0.41$
$3 < base$	$\tau^{w,5}=0.50$
Types of allowances	**Allowance rates** in multiples of average gross wage
General allowance	$\chi^{general} = 0.17$
Additional allowance	$\chi^{additional} = 0.02$
Allowance first child	$\chi^{child\ 1} = 0.14$
Allowance second child	$\chi^{child\ 2} = 0.15$

Source: Republic of Slovenia's Ministry of Finance, own computations

TABLE 2

Contributions	Rates	**Taxes**	Rates
Firms:			
Pension contribution	0.0885		
Health insurance	0.0636		
Workers:		Capital tax (τ_K)	0.11
Pension contribution	0.155[1]	Value-added tax (τ_{VAT})	0.14825
Health insurance	0.0656	Excise duties (τ_{excise})	0.035
Pensioners:			
Health insurance	0.0596		

Source: Republic of Slovenia's Ministry of Finance, own computations

1. Made endogenous in the model, such that the government budget gets balanced.

TABLE 3

Wage distribution moments	Actual	Model
Gross wage median / mean	0.80	0.79
Gross wage standard deviation / mean	0.75	0.69
Intervals in multiples of average wage	Actual quintiles	Model quintiles
w < 0.514	20	18.3
0.514 - 0.695	20	18.6
0.695 - 0.938	20	24.1
0.938 - 1.338	20	20.0
1.338 < w	20	19.0
Intervals in % of average wage	Actual quintiles	Model quintiles
w < 0.712	20	18.9
0.712 - 1.032	20	22.3
1.032 - 1.407	20	21.1
1.407 - 2.091	20	17.7
2.091 < w	20	20.0

Source: AJPES, DURS

TABLE 4:

Tax payers in percent of wage distribution	Actual	Model
base < B1	62.43	55.06
B1 - B2	24.09	24.72
B2 - B3	10,31	15.32
B3 - B4	2.57	4.31
B4 < base	0.60	0.59
Tax payers in percent of wage mass	Actual	Model
base < B1	11.49	12.63
B1 - B2	24.65	22.42
B2 - B3	30.59	34.80
B3 - B4	19.44	23.07
B4 < base	13.84	7.08

Source: AJPES, DURS

TABLE 5

Tax base	Actual	Model
Consumption tax (VAT and excise duties)	12.4 (8.9 + 3.5)	11.6
Labor income tax	5.2	6.8
Capital income tax	4	3.9
Pension and health contributions	14.8	17.0

Source: Eurostat, European Commission

TABLE 6

Labor market aggregates	Elasticity[1]
Participation rate	0.63
Average hours: all ex-post participants	0.22
Average hours: initial participants anmong ex-post participants	0.29

1. Average of the one percentage point increase and decrease in the health insurance rate.

TABLE 7

Scenarios		**Flat tax on LGDP, K, CGDP**		**Flat tax on LGDP, CGDP**		**Flat tax on LGDP**		**Alternative less progressive tax schedules**					**Reform**
$\chi_{general}$		**0.17**	**0.38**	**0.17**	**0.38**	**0.17**	**0.38**	**0.17**	**0.17**	**0.17**	**0.38**	**0.38**	**0.17**
	Baseline	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Market sector													
GDP	100.00	100.67	100.61	103.35	104.02	101.86	99.29	103.88	102.01	101.23	101.87	102.05	100.33
C_{GDP}	49.97	51.37	51.57	51.66	52.01	50.92	49.63	52.00	51.05	50.66	50.99	51.08	50.21
I	19.61	18.70	18.45	20.27	20.40	19.98	19.47	20.37	20.01	19.85	19.98	20.01	19.68
Taxes and contributions													
Total taxes / GDP	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Consumption tax /GDP	0.116	0.125	0.135	0.137	0.151	0.116	0.116	0.161	0.139	0.141	0.141	0.125	0.122
Labor income tax /GDP	0.068	0.043	0.030	0.048	0.034	0.069	0.069	0.023	0.045	0.043	0.043	0.060	0.063
Capital income tax / GDP	0.039	0.055	0.059	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Pension contribution	8.93	9.44	9.80	9.55	10.02	8.84	8.65	10.35	9.55	9.09	9.61	9.63	8.93
Health contributions / GDP	0.081	0.081	0.082	0.081	0.081	0.081	0.081	0.082	0.081	0.081	0.081	0.081	0.081
Home sector consumption	21.524	21.987	21.680	21.955	21.576	21.771	20.716	21.815	21.667	21.708	21.344	21.350	21.551
Production factors													
K / GDP	2.307	2.185	2.157	2.307	2.307	2.307	2.307	2.307	2.307	2.307	2.307	2.307	2.307
L_{GDP} / GDP	0.637	0.657	0.661	0.637	0.637	0.637	0.637	0.637	0.637	0.637	0.637	0.637	0.637
Labor market													
Participation rate	0.695	0.678	0.688	0.679	0.692	0.686	0.724	0.683	0.689	0.688	0.701	0.700	0.694
Average hours (all part.)	8.010	8.286	8.310	8.251	8.265	8.087	7.748	8.360	8.192	8.139	8.149	8.156	8.052
Average hours (initial part.)	-	8.289	8.313	8.255	8.271	8.090	7.793	8.362	8.193	8.140	8.162	8.168	8.053
Average gross wage	0.457	0.471	0.464	0.483	0.477	0.471	0.435	0.482	0.470	0.467	0.461	0.462	0.459
Average net wage	0.300	0.327	0.330	0.332	0.336	0.310	0.287	0.347	0.324	0.313	0.319	0.320	0.306
Endogenous rates													
Tax rate	-	0.157	0.168	0.175	0.191	0.249	0.383	0.190	0.166	0.149	0.168	0.169	0.156
Tax type	-	$\tau^w, \tau^K, \tau^{VAT}$		τ^w, τ^{VAT}		τ^w			τ^{VAT}		τ^{VAT}		τ^{VAT}
Pension contribution rate	0.154	0.167	0.173	0.164	0.171	0.154	0.155	0.177	0.166	0.160	0.168	0.168	0.158
Welfare													
Overall welfare	-2.739	-2.818	-2.809	-2.783	-2.764	-2.760	-2.736	-2.770	-2.750	-2.743	-2.736	-2.735	-2.738
Overall welfare ranking	5	13	12	11	9	8	3	10	7	6	2	1	4
Better-off (% households)	0.00	26.96	29.50	28.64	34.48	34.46	50.50	46.20	48.28	47.62	56.18	57.78	44.60

TABLE 8

Labor tax bracket thresholds in multiples of average gross wage	Tax rates	**Types of allowances** in multiples of average gross wage	Allowance rates
$B^1 = 0.4$	$\tau^{w,1}$=0.16	General allowance	$\chi^{general} = 0.17$
$B^2 = 0.75$	$\tau^{w,2}$=0.33	Additional allowance	-
$B^3 = 1.51$	$\tau^{w,3}$=0.37	Allowance first child	$\chi^{child\ 1} = 0.14$
$B^4 = 3$	$\tau^{w,4}$=0.41	Allowance second child	$\chi^{child\ 2} = 0.15$

Source: Republic of Slovenia's Ministry of Finance, own computations

TABLE 9

		Flat tax on LGDP, K, CGDP		Flat tax on LGDP, CGDP		Flat tax on LGDP		Alternative less progressive regimes					Reform
	Baseline	Sim 1	Sim 2	Sim 3	Sim 4	Sim 5	Sim 6	Sim 7	Sim 8	Sim 9	Sim 10	Sim 11	Sim 12
$\sigma = 0$	12	8	10	3	2	4	13	1	5	6	9	7	11
$\sigma = 1$	10	13	12	7	2	8	11	1	4	6	5	3	9
$\sigma = 2$	6	13	12	11	9	10	7	8	5	3	2	1	4
$\sigma = 3$	5	13	12	11	9	8	3	10	7	6	2	1	4
$\sigma = 4$	2	13	12	11	9	8	1	10	7	6	5	4	3
$\sigma = 5$	2	13	12	10	9	7	1	11	8	6	4	5	3
$\sigma = 6$	2	13	12	10	9	7	1	11	8	4	5	6	3
$\sigma = 7$	2	12	13	10	9	4	1	11	8	5	6	7	3
$\sigma = 8$	2	12	13	10	9	4	1	11	8	5	6	7	3
$\sigma = 9$	2	11	13	9	10	4	1	12	8	5	6	7	3
$\sigma = 10$	2	11	13	9	10	3	1	12	8	5	6	7	4
GDP	12	9	10	3	1	7	13	11	2	5	6	4	8

FIGURE 1

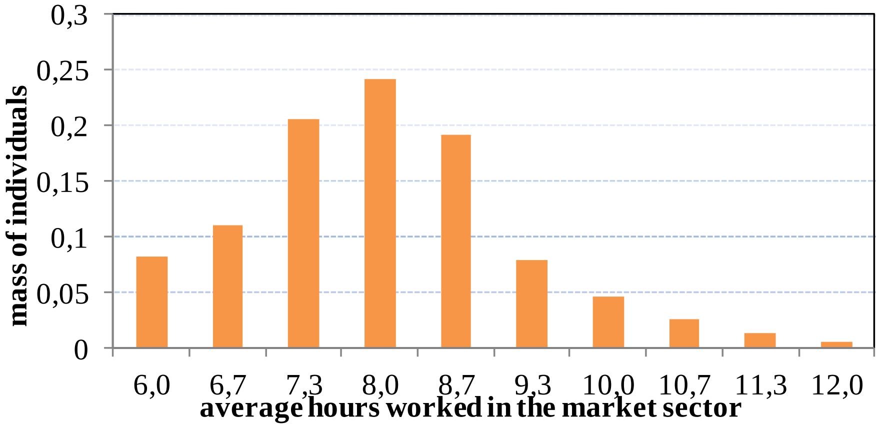


FIGURE 2

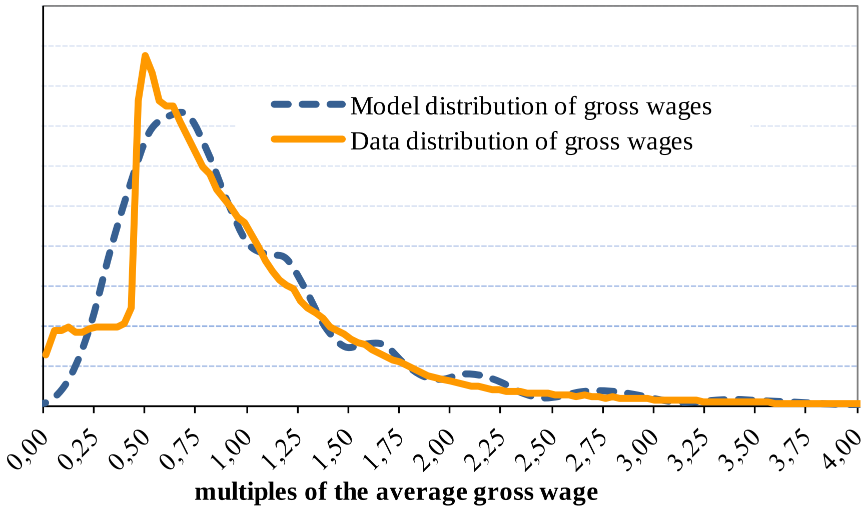
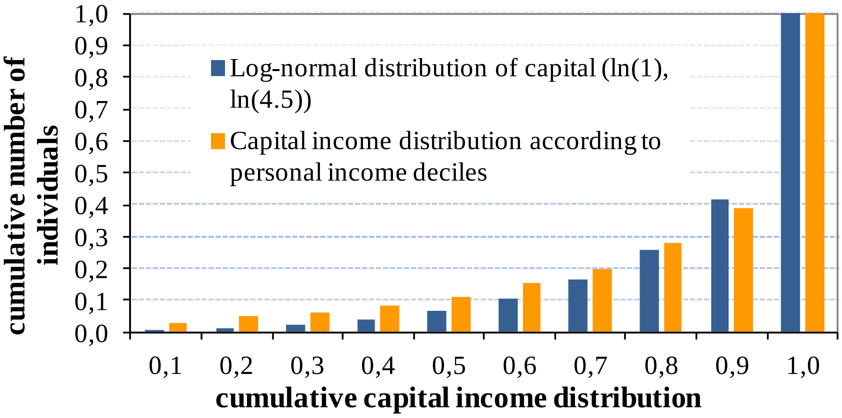
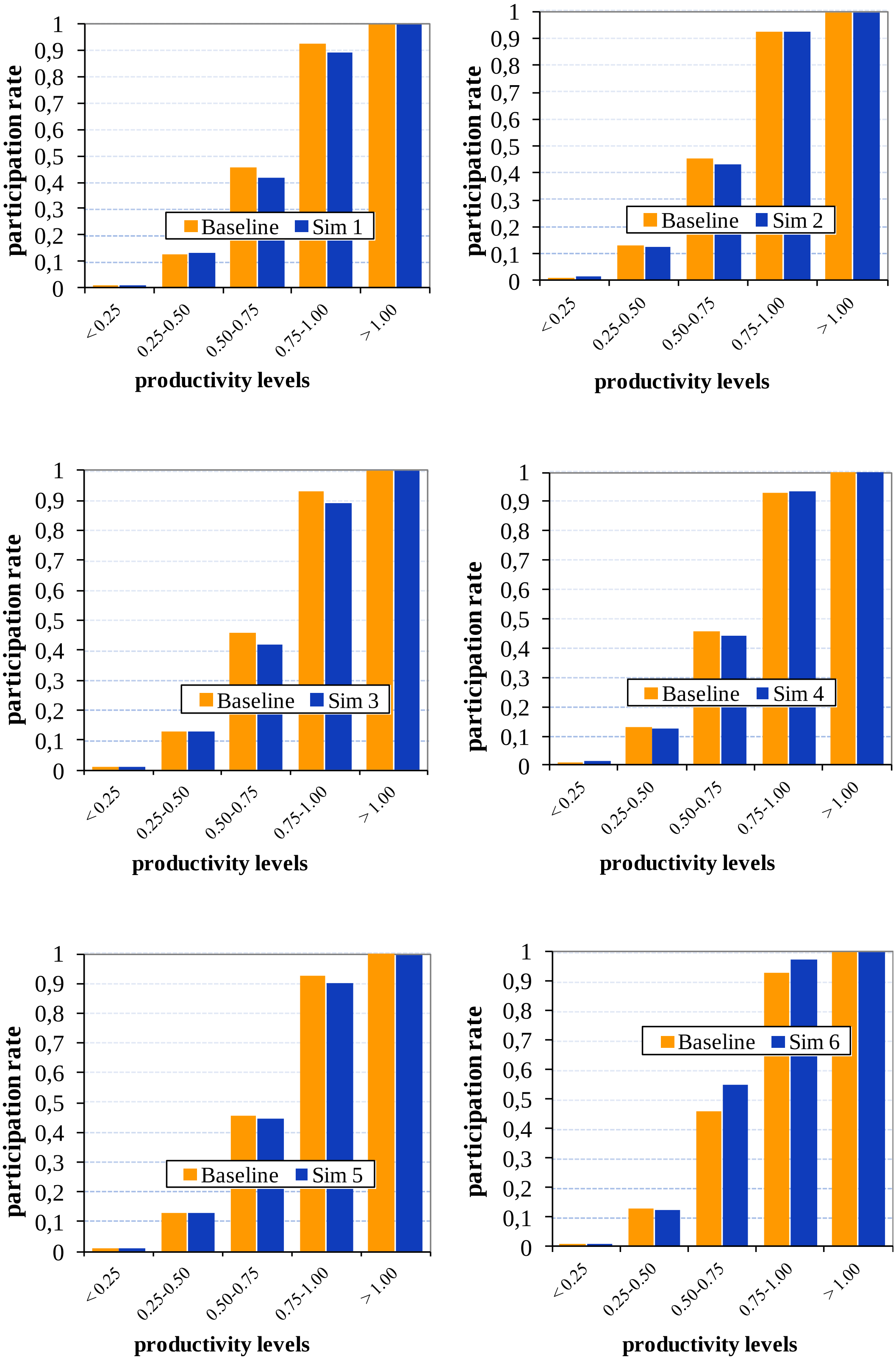


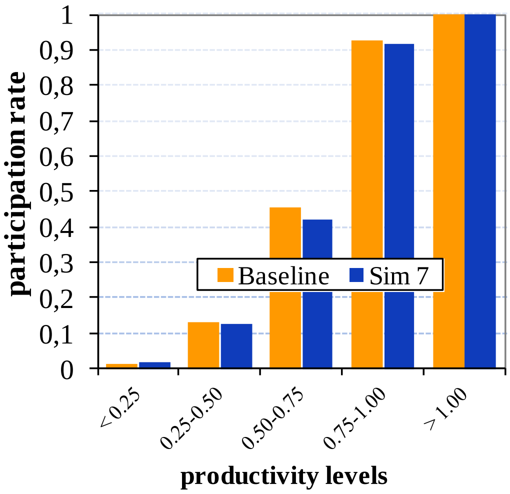
FIGURE 3

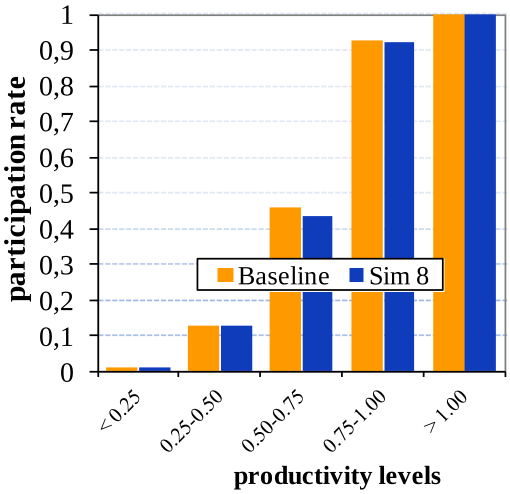


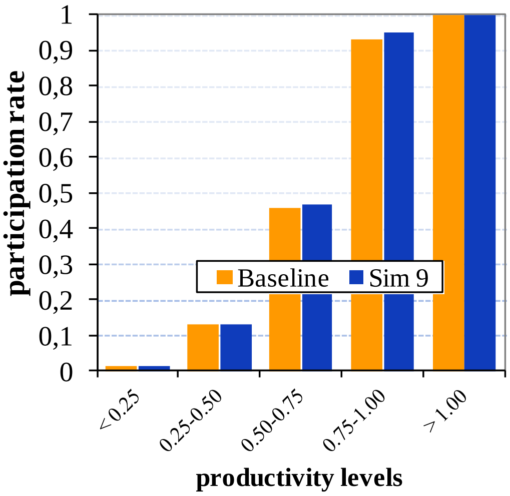
FIGURES 4 i to vi

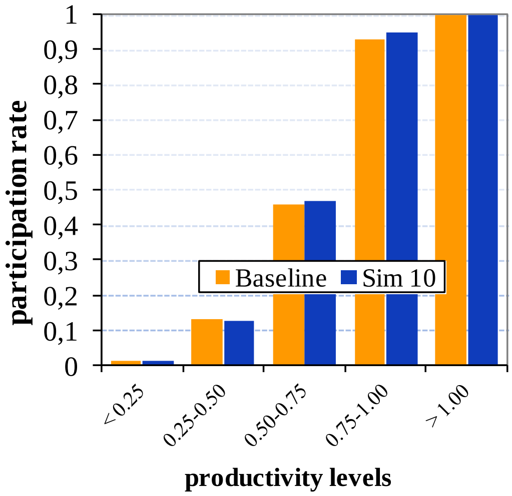


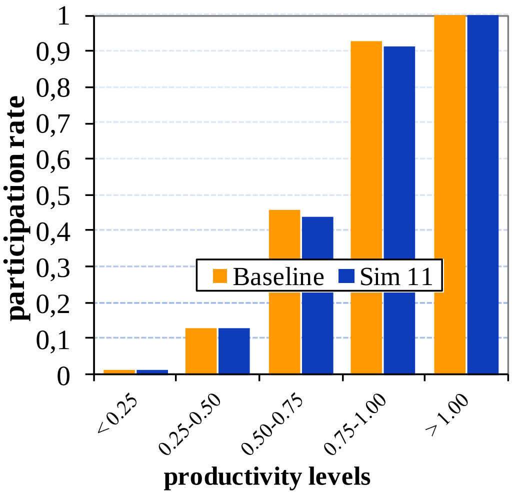
FIGURES 4 vii to xii

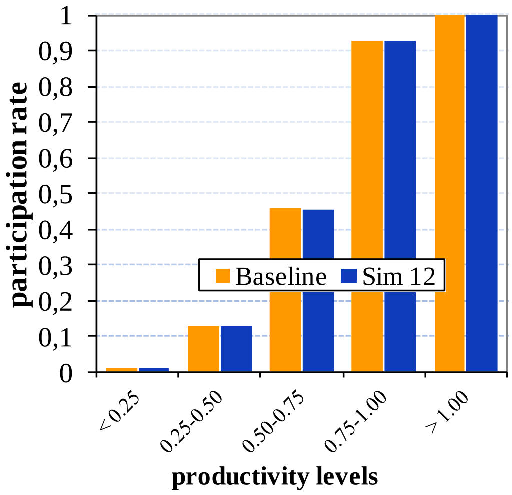




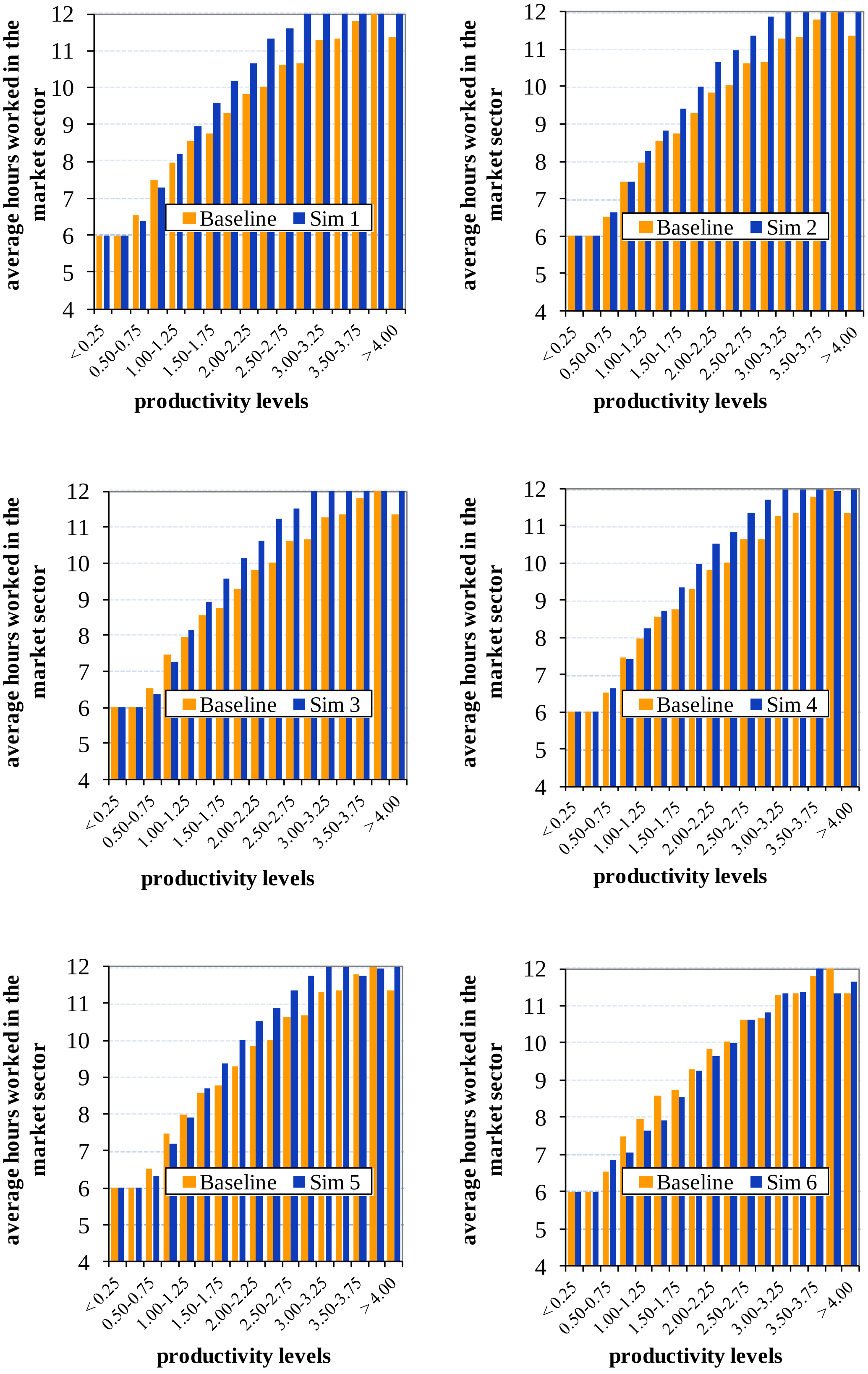








FIGURES 5 i to vi



FIGURES 5 vii to xii