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Welfare gains from the adoption of proportional taxation in a general-equilibrium model with an informal sector: the case of Bulgaria's 2008 flat tax reform

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Motivation

- This study is a first formal attempt to quantitatively evaluate the effect of the introduction of flat income taxation in Bulgaria in 2008. In 2008, a flat tax rate of 10% on personal income was introduced.
- The focus is on the effects of flat income tax rate on the size of the grey economy and unofficial employment, and the corresponding welfare improvement as a result of that.
- Other countries that have adopted flat tax rates are Abkhazia, Albania, Anguilla, Belize, Belarus, Bolivia, Bosnia and Herzegovina, East Timor, Estonia, FYROM (Former Yugoslav Republic of Macedonia), Greenland, Grenada, Guernsay, Guyana, Hungary, Jamaica, Jersey, Kyrgyzstan, Kuwait, Kazakhstan, Latvia, Lithuania, Madagaskar, Mauritus, Mongolia, Nagorno-Karabakh, Poland, Romania, Russia, Saint Helena, Saudi Arabia, Serbia, Seychelles, South Osetia, Transnistria, Trinidad and Tobago, Turkmenistan, Tuvalu, Ukraine.

Main findings

- This paper provides a quantitative evaluation of the welfare effect of the introduction of proportional taxation in Bulgaria in 2008.
- Using a micro-founded general equilibrium model, augmented with informal sector, a computational experiment is performed to evaluate the welfare gain from abolishing the progressive taxation regime and switching to a single (flat) tax rate.
- The lower effective tax burden in the new tax regime leads to the relocation of people into the official sector.
- Under proportional taxation, the size of the informal sector is smaller, and quantitatively consistent with estimates obtained in other studies.

The Facts

- Until Dec. 31, 2007, Bulgaria applied progressive income taxation on individual income:

Table: Progressive Income Taxation in Bulgaria until 2007

Monthly taxable income (in BGN)	Tax owed
0-200	Zero-bracket amount
200-250	20% on the amount earned above BGN 200
250-600	BGN 10 + 22% on the excess over BGN 250
$>$ 600	BGN 87 + 24% on the excess over BGN 600

Source: Petkova (2012)

- In 2008, a flat tax rate of 10% on personal income was introduced. This represented a considerable cut in the marginal tax rate on personal income, as compared to the earlier regime.
- At the same time, workers who were previously paying no taxes due to the size of the deductions, suddenly faced a positive tax rate.
- To compensate those low-income households, who were the main losers from this tax policy change, the minimum wage (the minimum wage being non-taxable) was increased: The minimum wage went up from BGN 180 to BGN 220 in 2008, then to BGN 240 in 2009, BGN 270 in 2012, and BGN 310 in 2014, respectively, and eventually reaching BGN 340 in 2014.

The Facts

Table: Revenue from personal income taxation

Fiscal year	2007	2008	2009	2010	2011
% of tax revenue	9.40	8.90	10.20	10.70	10.60
% of GDP	3.00	2.90	3.00	2.90	2.90

Source: Petkova (2012)

Table: Composition of Personal Income Tax Receipts

Fiscal year	2007	2008	2009	2010	2011
Labor income	77.56%	78.96%	82.30%	83.41%	81.15%
Business activities (sole proprietors, etc.)	16.80%	15.47%	12.19%	10.64%	12.57%
Lump-sum tax	2.00%	1.52%	1.02%	0.94%	0.78%
One-off tax	3.65%	4.06%	4.49%	5.02%	5.50%

Source: Petkova (2012)

Literature Review

- This paper presents a simplified version of Conesa *et al.* (2001) exogenous growth model with informal sector.
- The framework incorporates fiscal policy to study the effect of flat income taxation.
- Each household faces a two-stage decision: to participate in the official labor market, and if they decide to work in the grey economy, how many hours to supply.
- As in Hansen (1985) and Rogerson (1988), labor in indivisible in the official sector.
- Labor is divisible in the grey economy.
- The wage in the unofficial sector is the minimum wage rate, while the rate in the official sector corresponds to the average wage rate in the economy.

Representative Household's Problem

There is a continuum of ex-ante identical agents ("households") distributed uniformly on the $[0, 1]$ interval. Each household in the model economy is infinitely-lived, and there is no population growth. As in Conesa *et al.* (2001), the household maximizes the following expected utility function

$$E_t \sum_{t=0}^{\infty} \beta^t [(1 - \mu_t) \ln c_{mt} + \mu_t c_{bt} + \alpha \ln(l_t)],$$

s.t.

$$\begin{aligned} h_{mt} + h_{bt} + l_t &= 1, \\ h_{mt} &\in 0, \bar{h}, \\ (1 - \mu_t) c^h_{mt} + \mu_t c^h_{bt} + i_t &\leq (1 - \tau_t)[r_t k^h_t + w^m_t h^h_{mt}] \\ &\quad + \mu_t w^b_t h_{bt} + \pi^h_t. \end{aligned}$$

Participation Lotteries

- Following the arguments in Rogerson (1988) and Hansen (1985), it can be easily shown that a situation in which everyone works in the official, or everyone works in the unofficial sector, is not an equilibrium.
- Then it must be the case that a proportion μ_t of the agents are working in the unofficial sector, while the rest, $1 - \mu_t$ will be supplying labor services in the official sector.
- Workers in the official sector will receive consumption c_{mt}, while those working in the unofficial sector will consume c_{bt}.
- Note that μ_t can be interpreted as the probability of being chosen to work in the unofficial sector in period t.

Participation Lotteries (cont'd)

Next, following Merz (1996), we will assume that households can pool income together and doing so, they will be able to equalize consumption across states $c_{mt} = c_{bt} = c_t$. Then the problem is recast into one of choosing $\{c_t, i_t, k_{t+1}, \mu_t, h_t\}_{t=0}^{\infty}$ (and taking $\{w_t^m, w_t^b, r_t\}_{t=0}^{\infty}$ as given) to maximize total expected utility

$$E_t \sum_{t=0}^{\infty} \beta^t [\ln(c_t) + (1-\mu_t)\alpha \ln(1-\bar{h}) + \mu_t \alpha \ln(1-h_{bt})],$$

s.t.

$$c_t + k_{t+1} - (1-\delta)k_t = (1-\tau_t)[r_t k_t + w_t^m (1-\mu_t)\bar{h}] + \mu_t w_t^b h_{bt} + \pi_t.$$

Modelling the progressive tax schedule

As in Guo and Lansing (1998),

$$\tau_t = \eta \left(\frac{y_t}{y} \right)^{\phi}$$

denotes the tax rate on total (capital and labor)registered income, *i.e*, $y_t = r_t k_t^h + w_t^m h_{mt}^h$, and y is the steady-state level of household's income. In addition, $0 < \eta < 1$ and $0 \leq \phi < 1$, where ϕ measures the progressivity of the tax system, and η is the average effective tax rate in steady state.

- Notice that when $\phi = 0$, $\tau_t = \eta$, *i.e.*, the tax rate is constant ("flat tax"), while $\phi > 0$ produces a tax rate that rises with total income ("progressive tax").
- Under progressive taxation the marginal tax rate is higher than the average tax rate.

Household's Optimality Conditions

The optimality conditions from the household's problem, together with the transversality condition (TVC) for physical capital are as follows:

$$c_t : c_t^{-1} = \lambda_t$$

$$k_{t+1} : \lambda_t = \beta\lambda_{t+1}\left[(1-\delta) + \left(1-(1+\phi)\tau_t\right)r_{t+1}\right]$$

$$\mu_t : \alpha\left[\ln(1-h_{bt}) - \ln(1-\bar{h})\right] = \lambda_t\left[\left(1-(1+\phi)\tau_t\right)w_t^m\bar{h} - Bh_t^\gamma\right]$$

$$h_{bt} : \alpha(1-h_{bt})^{-1} = \lambda_t w_t^b$$

$$TVC : \lim_{t\to\infty} \beta^t c_t^{-1} k_{t+1} = 0,$$

where λ_t is the Lagrange multiplier on the household's budget constraint.

Representative Firms's Problem

The representative firm acts competitively by taking prices $\{w_t^m, r_t\}_{t=0}^{\infty}$, and income tax schedule τ_t, it chooses $k_t, H_t^m, \forall t$ to maximize firm's static profit:

$$\pi_t = A k_t^{\theta} (H_t^m)^{1-\theta} - r_t k_t - w_t^m H_t^m.$$

In equilibrium profit is zero. In addition, labor and capital receive their marginal products, *i.e.*

$$r_t = \theta \frac{y_t}{k_t},$$
$$w_t^m = (1-\theta) \frac{y_t}{H_t^m},$$
$$H_t^m = (1-\mu_t)\bar{h}.$$

Production in the unofficial sector

- Every household may decide to engage in unofficial production.
- The grey economy uses only labor.
- Each firm in the unofficial sector will hire labor h_{bt} in every period to maximize static profit

$$\max_{h_{bt}} Bh_{bt}^{\gamma} - w_t^b h_{bt}$$

With free entry, there are zero profits, hence

$$w_t^b = Bh_{bt}^{\gamma-1}.$$

Government Sector

The government collects tax revenue from registered labor and capital income to finance wasteful government consumption. The government budget constraint is then

$$\tau_t[r_t k_t + w_t^m(1-\mu_t)\bar{h}] = g_t^c.$$

Government takes prices $\{w_t^m, r_t\}_{t=0}^{\infty}$ and allocations $\{k_t, \mu_t\}_{t=0}^{\infty}$ as given. The tax rate τ_t will vary with income, and government consumption $\{g_t^c\}_{t=0}^{\infty}$ will adjust to ensure the government budget constraint is balanced in every time period.

Decentralized Competitive Equilibrium (DCE)

- Given the initial conditions for the state variable k_0, a Decentralized Competitive Equilibrium (DCE) is defined to be a sequence of prices $\{r_t, w_t^m, w_t^b\}_{t=0}^{\infty}$, allocations $\{c_t, i_t, k_t, \mu_t, h_{bt}, g_t^c\}_{t=0}^{\infty}$, income tax schedule $\{\tau_t\}$ such that (i) expected utility is maximized; (ii) the stand-in firm in the official sector maximizes profit every period; (iii) wage rate in the unofficial sector is such that profits in the grey economy are zero every period; (iv) government budget is balanced in each time period; (iv) all markets clear.

Model Parameters

Table: Model Parameters

Param.	Value	Definition
β	0.986	Discount factor
θ	0.429	Capital income share
γ	0.571	Labor intensity underground production
$1-\mu$	0.467	Participation rate official sector
δ	0.013	Depreciation rate of physical capital
α	0.513	Relative weight on leisure in utility function
η	0.110	Average effective income tax rate (flat)
η	0.140	Average effective income tax rate (progressive)
ϕ	0.430	Progressivity parameter (prog.)
ϕ	0.000	Progressivity parameter (flat)
A	1.000	Steady-state level of total factor productivity
B	0.912	Scale parameter underground production function

Steady-State Results

Table: Data Averages and Long-run solution (progressive taxation)

	Description	Data	Model
c/y	Consumption-to-output ratio	0.674	0.685
i/y	Fixed investment-to-output ratio	0.201	0.175
g^c/y	Gov't consumption-to-output ratio	0.176	0.140
k/y	Physical capital-to-output ratio	13.96	13.96
$w^m(1-\mu)\bar{h}/y$	Labor share in output	0.571	0.571
rk/y	Capital share in output	0.429	0.429
$\bar{h}$	Time spent working in the official sector	0.333	0.333
μ	Employment rate in the grey economy	0.217	0.533
$1-\mu$	Employment rate in the official sector	0.467	0.467
$\mu B\bar{h}^{\gamma}/y$	Grey economy size-to-output	0.187	0.260
$\tilde{r}$	After-tax net return to physical capital	0.010	0.013

Welfare analysis (asymptotic welfare gain)

Table: Data Averages and Long-run solution

	BG Data	Model (progressive)	Model (flat tax)
c/y	0.674	0.685	0.808
i/y	0.201	0.175	0.182
g^c/y	0.176	0.140	0.110
k/y	13.96	13.96	14.04
$w^m(1-\mu)\bar{h}/y$	0.571	0.571	0.571
rk/y	0.429	0.429	0.429
$\bar{h}$	0.333	0.333	0.333
μ	0.217	0.533	0.212
$1-\mu$	0.467	0.467	0.788
$\mu B\bar{h}^{\gamma}/y$	0.187	0.260	0.103
$\tilde{r}$	0.010	0.013	0.014
λ	-	-	0.180

Conclusions

- This paper provided a quantitative evaluation of the welfare effect of the introduction of proportional taxation in Bulgaria in 2008.
- Using a micro-founded general equilibrium model, augmented with informal sector, a computational experiment was performed to evaluate the welfare gain from abolishing the progressive taxation regime and switching to a single (flat) tax rate.
- The lower effective tax burden in the new tax regime led to the relocation of people into the official sector.
- In addition, under proportional taxation, the size of the informal sector is smaller, and quantitatively consistent with estimates obtained in empirical studies, *e.g.* Charmes (2000) and OECD (2009).