The long-term economic impact of the flat tax in Poland. CGE simulation under alternative assumptions

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Abstract

The purpose of this paper is to assess the long-term macroeconomic effects of introducing the flat personal income tax at the level of 18% in Poland. We perform the simulation on a static CGE (computable general equilibrium) model which helps track the reaction of the economy on the impulse arising from the change in the tax regime. We assume that the gap in government revenues arising from the flat tax introduction will be fully matched by cuts in government consumption. The literature suggests that the flat tax reform is likely to stimulate labor supply and capital expansion. The actual macroeconomic outcome largely depends on adjustment mechanisms at work – especially the driving force of investment. If the increased household savings were to be fully transformed into investment, GDP gain of 0.7–0.9% is observed, otherwise this effect is dampened to 0–0.2%. The tax regime change in the analyzed form will deepen inequality and is likely to reduce welfare of some (particularly low-income) households.

Keywords: CGE modeling, flat tax

JEL: C68, H24

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1. Introductory remarks

The global financial crisis and concomitant economic slowdown has had a strong and negative impact on public finances in Poland. This effect was magnified by numerous tax cuts introduced in Poland in the years 2007−2009, which were not matched by the equivalent reduction in expenditures. As a result, both general government deficit and debt widened substantially. According to the estimates presented by the Central Statistical Office (GUS 2012), in 2011 the general government deficit, measured in ESA-95 standards, reached a level of 5.1% of GDP (as compared with 7.8% in 2010) and the debt-to-GDP ratio stood at 56.3% of GDP (54.8% in 2010). In order to mitigate the risk related to fast debt increase the government introduced a mixture of expenditure cuts and tax increases. These measures embraced *inter alia* introduction of an expenditure rule, changes in the funded defined contribution scheme (limiting transfers to open pension funds – OFE) and adjustment of indirect taxes (value added tax was raised from 2011 by 1 p.p.).

The current environment is therefore not conducive to reduction in personal income tax (PIT) and it is unlikely that this issue will top policy agenda in the coming years. Nevertheless, the impact of the possible PIT cuts on the Polish economy remains an interesting research area. Within this scope of research the special case of PIT reduction, combined with the introduction of flat tax, deserves particular attention. Introduction of the flat PIT in Poland remains still a viable policy option as the only group of individuals which may opt for single (flat) tax rate of 19% (equal to corporate income tax (CIT)) are those who conduct business activity. However, 24.7 mn out of 25.4 mn taxpayers – retirees, pensioners, wage earners or self-employed persons – still fall under a progressive tax schedule with two marginal tax rates of 18% and 32% accompanied by personal allowance and numerous deductions (Ministerstwo Finansów 2010).

Since the beginning of economic transformation the case for flat tax in Poland has been frequently made in the public debate. Surprisingly little, however, has been said so far on the long-run macroeconomic effects of changing the tax regimes towards single PIT rate on the Polish economy. The empirical research on this topic barely exists and papers published so far addressed only the revenue effects of the tax reform (Neneman, Pivowarski 2004). The purpose of this paper is to fill this gap by providing a quantitative assessment of macroeconomic effects of the flat PIT on the Polish economy in the long-term horizon. We perform the simulation on a static CGE (computable general equilibrium) model which helps track the reaction of the economy on the impulse arising from the change in the tax regime.

The remainder of the paper is organized as follows. In the second section the major channels through which the flat tax affects economic activity are presented and empirical studies on the economic effects of the flat tax in other countries are analyzed. The third section presents the underlying simulation assumptions and a short characteristics of the CGE model. In section four the results of the CGE modeling are discussed. Section five concludes.

2. What the flat tax literature tells us

Following Keen, Kim, Varsano (2006) we define the flat tax as a single marginal tax rate on labor income that results in the tax liability of the following form:
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\[ T_F(Y) = \max\{t \cdot (Y - A_F), 0\} \] (1)

where:
- \( T_F(Y) \) – the liability on labor income \( Y \),
- \( t \) – the single positive marginal tax rate,
- \( A_F \) – the sum of personal allowance and special tax reliefs.

The tax regime defined in this way is not entirely consistent with original flat tax concept of Hall and Rabushka (1985), which did not envisage the special tax reliefs with accompanying distortionary effects. Further, it should be noted that the change in tax regime towards the form in (1) may imply that the single marginal tax rate will be higher than the lowest marginal rate before the flat tax introduction or due to reduction in allowances the tax liability may rise for some taxpayers even though the marginal rates are reduced.

Since the mid-1990s the number of countries that implemented the flat tax reforms has grown rapidly (Mitchell 2008). Before 1990 there were only four countries with the flat tax schedule in place: Jersey (the schedule was enacted in 1940), Hong Kong (1947), Guernsey (1960) and Jamaica (1986). In 1994 Estonia joined the flat tax club and it was followed by 19 countries, including inter alia Latvia (1995), Lithuania (1996), Russia (2001), Slovakia (2004), Czech Republic (2008) and Bulgaria (2008). The rising interest in moving to single marginal tax system in these countries has been motivated by both revenue and growth effects, postulated in the flat tax literature (Saavedra, Marcincin, Valachy 2007):
- increase in compliance; lower and simpler tax rates are conducive to accurate reporting of income and thus compliance by taxpayers,
- decrease in administrative costs; the flat tax regime makes the process of tax collection less complex,
- increase in savings and investment; lower marginal tax burden increases the after-tax rate of return and thus stimulates investment; lower marginal tax rate may spur savings as the propensity to save for wage earners in high income brackets is usually high,
- increase in efficiency; if tax rates across different types of income are equal or converge, distortionary effects on resource allocation stemming from differentiated tax rates is limited,
- increase in labor supply; lower marginal tax rate boosts labor supply (substitution effect) but this effect can be reversed once the average tax rate falls and individuals trade work for leisure (income effect).

Several empirical studies addressed the impact of the flat tax reforms in the aforementioned countries on the fiscal revenues and compliance (Paulus et al. 2009; Saavedra, Marcincin, Valachy 2007; Stepanyan 2003) or inequality (Voinea, Mihăescu 2009). However, the long-run effects of the shift to new flat tax regimes have been little studied. It is understandable as in nearly half of the aforementioned countries the flat tax system has not been in place long enough to show positive impact on potential output. Nevertheless, some authors attempt to estimate the long-run growth effects of flat tax as an available policy option. Majcen, Verbic, Cok (2007) use a dynamic general equilibrium model to analyze the impact of several tax and structural reform scenarios on the Slovenian economy. Two flat tax scenarios, with a single marginal PIT rate of 22% and 25% (versus the progressive PIT with 16%, 33%, 37%, 41% and 50% brackets in the baseline scenario)
have marginally positive influence on output in the long-run. As both flat tax scenarios imply
greater inequality than alternative (progressive) tax schedules, they conclude that the progressive
PIT is better suited to the country's long-term economic development. Pires and Jensen (2011) apply
a meta-regression analysis on 18 calibration studies on flat tax reforms to estimate the long-run
growth effects of eliminating PIT progressivity in OECD countries in 2007. The growth potential
from revenue-neutral flat tax reform is large and ranges from 3.9% in New Zealand and Iceland to
17.8% in Hungary. Interestingly, the growth potential for Poland is estimated at ca. 8% and comes
from a large reduction in tax progressivity (the top marginal PIT rate is reduced from 42.7% to 19%).

Other authors assess the long-run effects of flat tax by means of partial analysis, focusing on
work incentives as a major supply-side effect arising from flat tax reforms. Moore (2005) shows that
flat tax reform and accompanying withdrawal of social benefits, implemented in Slovakia in 2004,
reduced the marginal effective tax rate and work disincentives especially for parents with large
families. Ivanova, Keen, Klemm (2005) use micro-level panel data to assess the impact of the flat
tax reform in Russia on the hours worked by individuals and households. They found that the labor
supply changes were essentially the same for both affected and unaffected by the flat tax reform.
Hence, there is so far no evidence of strong effects of the flat tax introduction on labor supply in
Russia. Stepanyan (2003) provides qualitative assessment of the flat tax reform in Baltics, Russia
and other countries of the former Soviet Union and expects no significant impact of the new regime
on the labor supply in these countries. He points to high unemployment and family structure as the
main factors inhibiting a choice between leisure and work and thus reducing the positive supply
side effects of a new tax regime.

The empirical research on supply side effects of flat tax is scarce. The studies we referred to
suggest that the available evidence for large and positive macroeconomic effects of the flat tax
reform is ambiguous. This ambiguity refers both to studies focused on long-run growth potential and
research papers measuring the impact of flat tax on labor supply. Therefore, these two issues will be
explicitly addressed in the CGE simulation described below. Further, the analysis will embrace the
possible changes to domestic savings arising from lowering the tax burden for households who are
in the upper part of the income ladder and have a high marginal propensity to save.

3. Simulation assumptions

In the simulation we make the following assumptions. First, we assume that the higher PIT rate
(32%) is eliminated and the flat tax rate is set at the level of lower PIT rate (18%). The flat tax rate
of 19% that applies to individuals conducting business activity remains unchanged.

Second, we focus on the impact that the flat tax might have on the economy via greater labor
supply and higher domestic savings. We consider the measurement of the remaining long-run
effects arising from greater compliance, lower administration costs and more efficiency as an
interesting issue for further research.

1 The highest marginal PIT rate in Poland in 2007 was 40%. Authors apparently included health insurance (1.25%) and
other compulsory contributions in their estimate of the highest marginal tax rate. Further, in 2009 the PIT progressivity in Poland was substantially reduced and two marginal PIT rates of 18% and 32% (instead of 19%, 30% and 40%) were introduced.
Third, we assume that the flat tax regime change will not directly affect the taxpayers in the lower income bracket. The tax liability faced by households will either fall or stay unchanged (as long as their gross income is unchanged) and the transformation of the tax system will be implemented only by lowering the marginal tax rate while leaving the personal allowance and existing tax reliefs unchanged. The new system will thus be characterized by less progressivity (Figure 1). This type of change in the tax schedule suggests that there will be both positive impact of lower marginal tax rate (substitution effect) on the labor supply and negative effects on this supply arising from higher disposable income (income effect).

Fourth, we assume that the negative impact of the flat tax reform on general government revenues will be compensated by the equal reduction in government spending. In particular, the gap in revenues will be fully matched by cuts in government consumption. This assumption is not in line with the theory of second best policy myopia (Aidt, Dutta 2007), according to which governments prefer transfers to long-term public investments. However, we prefer the reduction in government consumption to cuts in public investment as the latter would exacerbate the potential output to a greater extent. Besides, tax cuts accompanied by equivalent reduction in government expenditures will more likely boost domestic savings. Empirical findings suggest that Ricardian equivalence proposition is more likely to hold in very high debt countries (Nickel, Vansteenkiste 2008). As a corollary, we may expect that deficit-financed introduction of the flat tax in Poland would lead to fall in domestic savings thus lowering growth potential. Further, tax cuts that are not matched by reduction in public expenditures may mislead households into overestimating their true wealth, thus leading to overconsumption and under-working (Phelps 2002). Finally, a 0.8% real drop in government consumption recorded in 2011 in Poland suggests that under debt...
constraint provided by legally binding debt rules\(^2\) and strong long-term public investment bias (motivated inter alia by maximizing the utilization of EU structural funds) our assumption on matching the gap in PIT revenues and reduction in government consumption is plausible.

To measure the direct impact of flat tax on labor supply we employ uncompensated labor supply elasticities (percentage change in hours worked due to a percent increase in net real wage), the values of which are taken from existing literature results. Using the uncompensated rather than compensated elasticities guarantees that both substitution and income effects of changes in real wages are taken into account. The literature provides a substantial number of empirical estimates of labor supply elasticities. Those results differ across studies, partly due to differences in theoretical frameworks and estimation methods used (Blundell, MaCurdy 1999). Evers, de Mooij and van Vuuren (2008) provide a synthesis of 209 estimates of uncompensated labor supply elasticities found in literature, and report their median value equal to 0.08 for men, and 0.26 for women.\(^3\) In our model we use estimates for Poland, found in a recent work by Bargain, Orsini and Peichl (2011). According to their results, wage elasticities of labor supply for Poland are among the lowest in the whole set of 18 countries (17 European countries and the U.S.). The estimates of uncompensated elasticities are only 0.10 and 0.04 for women and men in couples, respectively, and 0.09 for singles – either women or men.\(^4\) At the same time, labor supply in Poland does not seem to be responsive to changes in non-labor income (zero income elasticities). In our model we employ weighted average of the results by Bargain, Orsini, Peichl (2011), which equals 0.075.

In the model we distinguish three types of labor force, according to education level: high-, medium-, and low-skilled. It might be expected that the high income earners (individuals paying 32% marginal tax rate; those facing 18% marginal tax rate will be referred to as low income earners) are usually skilled workers. Based on the analysis of wage structure in Poland (GUS 2007) it was possible to derive approximate shares of skill groups among individuals in different income brackets. According to the results, 75% of high income earners are high-skilled workers, while 25% of them are medium-skilled workers. Thus, we may assume that no low-skilled workers fall into the high income bracket. This brings us to a conclusion that the flat tax reform would directly impact the high skilled workers mainly.

Worth emphasizing is the fact that, according to personal income tax statistics for the year 2009 (Ministerstwo Finansów 2010), only 1.6% of persons falling under the progressive tax schedule, are subject to the higher (32%) marginal tax rate. From this perspective introducing flat tax in the analyzed form is actually a relatively minor change to the current tax system. At the same time, contribution of that group to effective (wage-bill weighted) labor is significantly larger (13%), as is their share in total household income, savings, and taxes paid. This is why the impact of flat tax is expected to be greater than suggested just by the 1.6% share.

Labor supply responses to changes in real wage consists of two effects – a change in the participation rate (the so called extensive margin of labor supply), and a change of work hours of

\(^{2}\) According to the Polish Constitution (article 216), it shall be neither permissible to contract loans nor provide guarantees and financial sureties which would endanger a national public debt exceeding 60% of GDP. The debt rule set at constitutional level is enhanced by two debt-to-GDP thresholds (50% and 55%) enshrined in the Public Finance Act. A detailed discussion of the debt rules in Poland can be found in Jędrzejowicz, Kitala, Wronka (2009).

\(^{3}\) The difference between the two elasticities may be attributed to the relatively low participation rates of women in the labor market. However, the study by Evers, de Mooij and van Vuuren (2008) does not support this claim.

\(^{4}\) These elasticities should be interpreted as showing labor supply response at the extensive and the intensive margin jointly.
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those already employed (intensive margin of labor supply). A typical empirical finding is that the role of participation effect is greater than that of work hours (Immervoll et al. 2007). According to the results by Bargain, Orsini and Peichl (2011), in Poland labor supply responses to changes in real wage are – on average – almost fully composed of changes in participation (extensive margin). The question arises, whether average elasticities can be appropriately applied to such small and specific subgroup of the total labor force as individuals paying the higher marginal tax rate. Literally relating the results by Bargain, Orsini, Peichl (2011) to high income earners would imply that their labor supply elasticity is very close to zero, since it is reasonable to assume that the extensive labor supply response does not apply to that group. This, however, seems unlikely in the light of the few available empirical studies concerning sensitivity of top income groups to changes in taxation. For example Gruber and Saez (2000) suggest, based on U.S. data that work incentives act stronger for very high income earners than for lower income earners (implying high intensive labor supply elasticities). Accordingly, Kopczuk (2011) estimates considerable effects on taxable income (being a wider concept than the effects on labor supply) of the Polish business flat tax reform, although it is probably in a big part attributable to increase in compliance. Nonetheless, evidence is scant, which directs attention to microdata-based estimation of labor supply elasticities for Poland as a prospective research topic.

The lack of appropriate estimates makes the choice of labor supply elasticity for high income earners arbitrary. Therefore in our simulations we use three alternative values: 0, 0.075 (equal to the estimate of the overall elasticity for Poland), and 0.15, as a simple sensitivity analysis. With these values we keep within plausible bounds, taking into account the values estimated or used in similar simulation studies for other countries (e.g. Immervoll et al. 2007), take 0.1 as the elasticity at the intensive margin across the whole income distribution; Bach, Corneo and Steiner (2011) estimate labor supply elasticity for high income bracket in Germany to be between 0.14 and 0.18).

The next crucial set of parameters are the marginal propensities to consume. We need them to assess the impact of the new tax regime on domestic savings. Marginal propensities to consume were subject to a simple assessment procedure. First, average propensity to consume was regressed on disposable income, using household budget survey data by decile groups. Second, the resulting function was transformed to represent marginal propensities to consume, as well as income elasticities of consumption, as a function of income. In this way we obtained marginal propensities to consume equal to 0.81 and 0.61, for low and high earners respectively. The related elasticities equal 0.84 and 0.81, respectively.

In the simulation experiment we reduce marginal tax rate for the high income group from 32% to 18%. The immediate impact of this shock involves increase in the net wage for the high earners, which stimulates (mainly the high-skilled) labor supply and increases household savings and consumption. It also reduces tax revenues of the general government and, by assumption, leads to a cut in government consumption. The computable general equilibrium framework makes it possible to analyze economy-wide consequences of this shock, both at aggregate and industry level.

In this study we use an 18-industry/commodity static computable general equilibrium model of the Polish economy. Its formulation largely follows the ORANI-G model structure (Horridge 2003; see also Dixon, Parmenter 1996). Compared to ORANI-G, our model does not differentiate between structures of investment outlays across industries. On the other hand it employs a more elaborate representation of income distribution, mirroring national accounts by institutional
sectors. The model has also been extended to represent certain detail in the determination of personal income tax liabilities and net income of different taxpayers. The model is calibrated using two distinct data sets. The tax module parameters are based on 2009 data (as explained below); otherwise 2005 input-output data (latest available table in the required form) were used to account for structural characteristics of the economy. The choice of elasticity parameter values was either based on own estimation (income and price elasticities of consumption, by commodities), or set to plausible, although fairly arbitrary values suggested in the CGE literature. Following the approach recommended by Adams (2005), rather than presenting the full-detailed model, we explain its mechanisms, along with simulation results, by means of stylized, aggregate representation of model’s equations (a “model of the model”).

In our model taxpayers are disaggregated into 8 groups, based on breakdown presented in the information on personal income tax receipts, published by the Polish Ministry of Finance (Ministerstwo Finansów 2010). We distinguish 4 groups of individuals according to their income sources:

- employees,
- pensioners,
- self-employed,
- other (taxpayers receiving income from multiple sources).

Each of the abovementioned groups is divided into two groups:

- low income,
- high income.

The low income taxpayers are persons, to which the lower (18%) PIT rate applies. The high income taxpayers are individuals whose income exceeds the threshold, above which the other (32%) rate applies.

Calculation of tax payments for each taxpayer group involves three steps. First, the “nominal” tax liability is calculated using the official (nominal) rates, coupled with values of income threshold and personal allowance. Second, the nominal liability is transformed to effective liability, taking into account deductions characterizing each group of taxpayers. Third, health insurance contribution is calculated – the amount that is (almost fully) deducted from the tax liability.

The resulting tax liability allows for calculation of after-tax income. The changes in after tax income, combined with marginal propensities to consume, lead to estimates of changes in consumption within income groups, which in turn allows to modify aggregate household consumption and savings in the economy.

CGE models allow the user for some flexibility in the simulation set-up. Namely, the user formulates the so called closure, i.e. determines which variables in the system are held fixed (exogenous), and which of them will be adjusting to make the modeled economy reach a new equilibrium after introducing the shock. In other words, the choice of closure reflects assumptions on economic adjustment mechanisms at work. In all simulations we are taking the long-run perspective (i.e. using long-run closures), which means, among other things, that capital stock is allowed to adjust to accommodate the shock. The GDP deflator acts as a numeraire, so all price changes in the model are treated as relative to the GDP price index. In all simulations we allow for some degree of substitutability between skill categories of labor (with the elasticity of substitution equal to 0.5).
Within this long-run perspective we vary model’s closure with respect to the following three aspects of adjustment processes: the driving force of investment, persistence of marginal propensities to consume, and adjustment of the current account balance. This eventually leads to nine model runs: three simulation (closure) variants, each of them being repeated for three different high-earners labor supply elasticity. The closures are analyzed along with simulation results in section 4.

All results are interpreted in a comparative static manner. Thus, we do not explicitly refer to the time necessary for the effects to materialize.

4. Results analysis under alternative model closures

4.1. Simulation 1

For simulation 1 we adopt a closure, according to which fixed capital formation (investment) is fully determined by changes in the domestic savings level. It is assumed that there will be no permanent (long-run) shift in the current account balance, so the change in domestic savings equals change in total savings in the economy. Households’ propensities to consume\(^5\) remain fixed within the two distinguished income groups. Such assumptions bring us close to the interpretations stemming from the Solow’s growth model (Solow 1956) – a rise in the (exogenous) savings rate lifts the economy to a higher growth path. Finally in the adopted closure government consumption will adjust to compensate for changes in tax (as well as non-tax) revenues of the public sector. A summary of this closure and the other two closure options is presented in Table 1. Under each closure we consider three simulation variants, varying the elasticity of labor supply for the high-income group. The adopted values are: 0 in variant “a”, 0.075 in variant “b”, and 0.15 in variant “c”.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Simulation 1</th>
<th>Simulation 2</th>
<th>Simulation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal propensities to consume/save by households</td>
<td>Fixed</td>
<td>Fixed</td>
<td>Adjust</td>
</tr>
<tr>
<td>Current account balance to GDP ratio</td>
<td>Fixed</td>
<td>Adjusts</td>
<td>Fixed</td>
</tr>
<tr>
<td>Gross rates of return on capital</td>
<td>Adjust</td>
<td>Fixed</td>
<td>Fixed</td>
</tr>
</tbody>
</table>

While with a simultaneous equations model it is not possible to analyze the effects of a shock strictly as a sequence of events, it is useful to start from the point at which the shock appears.

\(^5\) In the model we actually use income elasticities of consumption. Holding the elasticities constant (for the two income groups) means that marginal propensities remain approximately fixed (as income changes are relatively small).
Below we analyze results of the “b” variant of each simulation, i.e. the one assuming “intermediate” elasticity of supply for high earners. Similar explanations can be easily repeated for other variants, using simulation results provided in Tables 2–5. The initial effect of a reduction of the higher marginal tax rate is the increase in net real wage:

\[ \text{wren}^{(h)} \approx \text{wrg}^{(h)} + \text{wtxc}^{(h)} \]
\[ 7.69 \approx 0.49 + 7.20 \]

\[ \text{wren}^{(l)} \approx \text{wrg}^{(l)} \approx 0.93 \]

where:
- \( \text{wren} \) – net real wage,
- \( \text{wrg} \) – gross real wage,
- \( \text{wtxc} \) – contribution of a change in effective tax rate to the change in net wage.

Superscripts \((h)\) and \((l)\) denote high and low income brackets, respectively.

Variables in the above equations – as well as in all the following equations – are written in the percentage change (or log-differences) form (percentage changes are denoted by lowercase letters). All equations discussed here should be treated as idealized representation of actual model mechanisms. Moreover, they are written in the linearized form, which is an approximation of the underlying equation for levels variables. Thus these equations only hold approximately when filled with actual simulation results obtained from the full model. Thus, we consequently use the \( \approx \) sign in all equations, even though in a few cases there is a strict equality at the adopted level of accuracy.

Equation 1 shows that the high earners net real wage increases by 7.69%, which is mainly due to the tax cut (7.20% – the direct effect of the shock), and partly (0.49%) due to the induced increase in gross real wage (the latter being an economy-wide or general equilibrium effect – mainly stemming from labor productivity increase caused by capital expansion). For low income earners the change in real net wage (0.93%, practically equal to the change in gross real wage) is an indirect effect of the tax reform.

The impact of real wage on labor supply is represented by the following equation (we do not explicitly model the choice between consumption and leisure, but directly use the wage elasticities of labor supply instead\(^6\)):

\[ l \approx S_L^{(h)} \cdot E_L^{(h)} \cdot \text{wren}^{(h)} + S_L^{(l)} \cdot E_L^{(l)} \cdot \text{wren}^{(l)} + S_L^{(o)} \cdot l^{(o)} \]
\[ 0.14 \approx 0.11 \cdot 0.075 \cdot 7.69 + 0.72 \cdot 0.075 \cdot 0.93 + 0.17 \cdot 0.09 = 0.05 + 0.06 + 0.015 \]

where:
- \( l \) – effective (wage-bill weighted) labor supply (equal to aggregate labor demand),
- \( S_L^{(i)} \) – share of a given group of labor in total labor cost (wage-bill),
- \( E_L^{(i)} \) – uncompensated wage elasticities of labor supply,

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\(^6\) The elasticities of labor supply with respect to non-labor income are set to zero, in line with Bargain, Orsini, Peichl (2011) results.
$I^{(o)}$ – labor supply of individuals not falling under the progressive tax scale (including those paying 19% business linear tax or lump sum taxes, as well as farmers, and the grey economy).

The results show that the contributions of high and low earners to total labor supply increase are very similar (i.e. changes of labor supply of both groups makes total labor supply increase by approximately 0.05–0.06%), although only the former group is directly affected by the tax cuts.

Changes in gross real income of taxpayers falling under the progressive schedule are almost fully explained by changes in their labor income (pensions are assumed constant in real terms, income from capital rentals increase only slightly and their share is small), i.e.:

$$\text{irg}^{(h)} \approx S_{ij}^{(h)} \cdot (I^{(h)} + \text{wrg}^{(h)})$$
$$0.86 \approx 0.84 \cdot (0.58 + 0.49) \quad (4a)$$

$$\text{irg}^{(l)} \approx S_{ij}^{(l)} \cdot (I^{(l)} + \text{wrg}^{(l)})$$
$$0.63 \approx 0.65 \cdot (0.07 + 0.95) \quad (4b)$$

where:

\text{irg}^{(i)} – gross real income in a given taxpayer group,
\text{S}_{ij}^{(i)} – share of labor income in total income,
\text{I}^{(i)} – labor supply of a given taxpayer group.

As with the wages, the percentage change in net real income for low-income earners is approximately equal to the change in gross income, while for high earners there is additionally the tax cut effect:

$$\text{irn}^{(h)} \approx \text{irg}^{(h)} + \text{itxc}^{(h)}$$
$$7.91 \approx 0.86 + 7.05 \quad (5a)$$

where:

\text{irn}^{(i)} – net real income,
\text{itxc}^{(i)} – contribution of tax cut to the change in income.

Under closure 1, total household consumption is linked to net income by appropriate elasticities. For individuals falling under the progressive tax schedule, this amounts to:

$$\text{cr}^{(h)} \approx E_{C}^{(h)} \cdot \text{irn}^{(h)}$$
$$6.35 \approx 0.81 \cdot 7.91 \quad (6a)$$

$$\text{cr}^{(l)} \approx E_{C}^{(l)} \cdot \text{irn}^{(l)}$$
$$0.50 \approx 0.84 \cdot 0.61 \quad (6b)$$

where:

\text{cr}^{(i)} – real private consumption,
\text{E}_{C}^{(i)} – elasticity of consumption with respect to income.
The above (percentage) changes compose the change in total household consumption:

\[
cr = S_c^{(h)} \cdot cr^{(h)} + S_c^{(l)} \cdot cr^{(l)} + cr^{(o)} \tag{7}
\]

\[
0.80 \approx 0.06 \cdot 6.35 + 0.72 \cdot 0.50 + 0.06 = 0.38 + 0.36 + 0.06
\]

where:

- \(cr^{(h)}\) – total household consumption,
- \(S_c^{(h)}\) – share of high/low earners in total consumption (these shares are rough approximations based on national accounts, income tax and household budget data),
- \(cr^{(o)}\) – contribution of other households (i.e. other than those under progressive tax schedule) to the change in total consumption.

As can be seen, both income groups contribute almost equally to the private consumption increase (0.36–0.38 p.p.).

A similar approach can be used to explain the changes in household savings. In this case nominal income (\(\text{inv}^{(i)}\)) replaces real income (used in (6a) and (6b)) – however, since consumption prices in this simulation are almost unchanged relative to the GDP prices (numeraire), percentage changes of real and nominal income are almost identical. Percentage changes in savings of high and low earners are given as:

\[
s^{(h)} \approx E_s^{(h)} \cdot \text{inv}^{(h)} \tag{8a}
\]

\[
12.59 \approx 1.56 \cdot 7.98
\]

\[
s^{(l)} \approx E_s^{(l)} \cdot \text{inv}^{(l)} \tag{8b}
\]

\[
4.29 \approx 6.48 \cdot 0.67
\]

where \(E_s^{(i)}\) are income elasticities of savings (their values are implied by elasticities of consumption used in (6a) and (6b)).

Decomposing the total increase in household savings (5.56%) shows that the major contribution (3.53 p.p.) comes from the high earners group:

\[
s \approx S_s^{(h)} \cdot s^{(h)} + S_s^{(l)} \cdot s^{(l)} + sc^{(o)} \tag{9}
\]

\[
5.56 \approx 0.28 \cdot 12.59 + 0.30 \cdot 4.29 + 0.75 = 3.53 + 1.29 + 0.75
\]

where:

- \(S_s^{(h)}\) – shares of high/low income earners in total household savings,
- \(sc^{(o)}\) – contribution of other households to the change in total household savings.

Total savings in the economy (\(st\)) increase by 1.50%:

\[
st \approx S_{HH} \cdot s + stc^{(o)} \tag{10}
\]

\[
1.50 \approx 0.23 \cdot 5.56 + 0.24 = 1.26 + 0.24
\]

where \(S_{HH}\) – share of household savings in total savings.
Households contribute 1.26 p.p. to total savings increase, while other institutional sectors (mainly the corporate sector) contribute 0.24 p.p. (current account balance is assumed fixed – relative to GDP).

Under closure 1 we assume that investment \((invr)\) is driven by the change in savings. We have:

\[
invr \approx ST/INV \cdot st - invp
\]

\[
1.49 \approx 1.06 \cdot 1.50 - 0.10
\]

where:

- \(ST/INV\) – ratio of savings to investment,
- \(invp\) – investment deflator.

As a consequence of investment increase, long-run fixed capital stock \((k)\) increases by 1.54%.\(^7\)

\[
k \approx invr
\]

\[
1.54 \approx 1.49
\]

Coupled with the increase in effective labor input (0.13%) this forms the supply-side effect of the flat tax reform, which amounts to 0.81% increase in real GDP:

\[
gdpr \approx S_K \cdot k + S_L \cdot l
\]

\[
0.81 \approx 0.48 \cdot 1.54 + 0.52 \cdot 0.13 = 0.74 + 0.07
\]

where \(S_K\) and \(S_L\) are value added shares of capital and labor, respectively.\(^8\)

We conclude that if investment is savings-driven the main economic impact of flat tax comes from increased capacity due to capital expansion. Labor supply effect makes for roughly only 10% of the GDP increase.

Of course, the above results should not be interpreted as a simple recursive sequence of the economy’s responses to the initial shock. The magnitude of the effects discussed to this point has already been affected by the demand-side and structural characteristics of the economy – e.g. the elasticity of demand for commodities, and – indirectly – production factors, commodity-structure of demand, import intensities of productct’s supply etc. Below we discuss the most important points.

According to equations (4a) and (4b), changes in household pre-tax household incomes result from both changes in labor supply, and wages – the latter being subject to competitive wage setting mechanisms in the economy. Assuming that the prices of effective factor inputs are equalized among industries and that marginal factor pricing is at work, the following relation might be derived (see Adams 2005):

\[
k - l \approx \sigma_{KL} \cdot plk
\]

\[
1.41 \approx 0.5 \cdot 2.68
\]

---

\(^7\) In line with long run analyses using static CGE models we assume that investment-to-capital ratios by industries are fixed. That is, if investment in a given industry goes up by \(x\)%, then the long-run capital stock also increases by \(x\)%.

\(^8\) To calculate the shares, implied labor income of the self-employed was subtracted from the gross operating surplus.
implying that if capital-labor ratio increases, then the price of capital must fall relative to the price of labor. In this case the ratio of wage to rental rate (price of labor to price of capital) increases by 2.68% ($plk$ represents the percentage change of that ratio; $\sigma_{KL}$ is the elasticity of substitution between capital and labor).

Two additional relations determine percentage changes of capital and labor prices ($lp$ and $kp$, respectively):\(^9\)

\[
k_p \approx (S_k - 1) \cdot plk
- 1.41 \approx (0.48 - 1) \cdot 2.68
\]

\[
l_p \approx S_k \cdot plk
1.27 \approx 0.48 \cdot 2.68
\]

Equations (14) and (16) imply that the easier it is to substitute capital for labor (i.e. the higher the elasticity of substitution), the larger wage increase might be expected, and thus the larger the impact of the reform on labor and capital supply (the latter through the income-savings-investment channel).

The assumption that the analyzed shock does not cause a shift in the benchmark current account deficit to GDP ratio implies real depreciation, which damps the effects of the reform. Production, consumption and investment enhancement increases the demand for imports, and so to preserve the trade balance exports must grow as well – but that requires a reduction in export prices.\(^10\) This effect is illustrated by the two following equations (Adams 2005):

\[
mp_{Tr} \approx gdp_{Tr} + \sigma_M \cdot dmp_{Tr}
0.95 \approx 0.96 + 1.5 \cdot 0.02
\]

\[
xr \approx E_X \cdot tot
1.20 \approx -4 \cdot (-0.30)
\]

where:

- $mp_{Tr}$ – imports of products,
- $gdp_{Tr}$ – GDP including products (tradables) only, and excluding services,
- $\sigma_M$ – elasticity of substitution between domestic and imported varieties of a given good (Armington elasticity),\(^11\)
- $dmp_{Tr}$ – ratio of domestic to import prices of tradables,
- $xr$ – exports,
- $E_X$ – elasticity of export with respect to relative (domestic to world) prices,
- $tot$ – terms of trade (ratio of export to import prices – the latter being also a proxy of world prices).

\(^9\) Writing those equations we take into account that the GDP deflator acts as numeraire (see Adams 2005). Therefore, the left hand side terms can be interpreted as real capital and labor prices (i.e. the prices deflated with the GDP price index).

\(^10\) We follow Dixon and Rimmer (2002, pp. 222–225) who argue that for small open economies foreign demand is highly, though not perfectly elastic. It means that export expansion requires some degree of real depreciation of the domestic currency (deterioration of the terms of trade). The elasticities of export with respect to relative (domestic to foreign) prices are set to -4.

\(^11\) The reported Armington elasticity value (1.5) is a rough approximation of an average elasticity. The model operates with different elasticities for individual commodities.
Equation (18) shows that the export increase of 1.20% (necessary to preserve the balance of payments) requires terms of trade deterioration of 0.30%. Worth noticing, there is almost no substitution effect for domestic and imported products, as the change in relative domestic to import prices (excluding non-tradables) is very close to zero (0.02%).

Terms of trade deterioration implies real depreciation of the domestic currency, amounting to 0.38%. Consequently, the prices of imported products, expressed in zlotys, increase by 0.38% relative to the domestic prices. However this effect can be quite diverse for different commodities. For example the price of domestic private consumer goods is almost unchanged (relative to the domestic goods as a whole), and therefore CPI increase is actually due to the price increase of imported consumer goods. On the other we might observe unit cost increases in labor intensive sectors, such as education, health and administration, where there are no direct efficiency gains stemming from larger capital stocks (this is why government consumption prices grow by 0.27%). Changes in consumer prices (cp) and the prices of investment goods (ip) can be decomposed as follows:

\[
\begin{align*}
    cp & \approx S_{CD} \cdot cdp + S_{CM} \cdot mp \\
    0.06 & \approx 0.88 \cdot 0.01 + 0.12 \cdot 0.38 \\
    ip & \approx S_{ID} \cdot idp + S_{IM} \cdot mp \\
    0.10 & \approx 0.69 \cdot (-0.02) + 0.31 \cdot 0.38
\end{align*}
\]

where:
- cdp – price of domestic-produced consumption products,
- idp – price of domestic-produced investment products,
- mp – price of imported commodities,
- \( S_{CD}, S_{CM} \) – share of domestic and imported products in consumption, respectively,
- \( S_{ID}, S_{IM} \) – share of domestic and imported products in investment demand, respectively.

Finally, percentage changes in average gross real wage (wrg) and the gross rate of return (ror – ratio of capital rental rate to the price index of investment goods) are obtained as:

\[
\begin{align*}
    wrg & \approx lp - cp \\
    1.21 & \approx 1.27 - 0.06 \\
    ror & \approx kp - ip \\
    -1.51 & \approx -1.41 - 0.10
\end{align*}
\]

From equations (19) and (21) it is clear that a smaller increase in import prices would result in a larger increase in real wage, and, consequently, a stronger response of labor and capital supply (i.e. real depreciation constrains real wage growth). The scale of import price increase (real depreciation) depends on how elastic the foreign demand is (i.e. it depends on the value of \( E_x \) in equation (18)) – the more elastic the foreign demand, the smaller the real depreciation (import price increase or terms of trade deterioration) is sufficient to preserve the trade balance. This means that more elastic foreign demand would lead to larger gains from the analyzed reform, and vice versa. Similarly, smaller real depreciation would lead to a slighter decrease in the rate of return.
Regarding tax revenues of the general government (Table 2), we can see that the drop in personal income tax receipts (-5.36%) is accompanied by an increase in revenues from indirect taxes (1.01%). There is also a positive change in CIT receipts, implied by the fact that the drop in all-income-tax revenues is smaller (-3.53%) than the drop in PIT only. In total, tax revenues show 0.71% decrease. According to our assumptions this constrains government consumption (-0.35%), but still total (private and public) consumption records an increase (0.54%).

Table 2
Selected macro results (percentage changes)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Simulation</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>a</td>
</tr>
<tr>
<td>GDP</td>
<td>0.72</td>
<td>0.81</td>
<td>0.89</td>
<td>0.03</td>
</tr>
<tr>
<td>Capital</td>
<td>1.43</td>
<td>1.54</td>
<td>1.65</td>
<td>0.03</td>
</tr>
<tr>
<td>Effective labor</td>
<td>0.06</td>
<td>0.13</td>
<td>0.20</td>
<td>-0.01</td>
</tr>
<tr>
<td>Gross rate of return on capital (ratio of capital rental rate to the price of new capital)</td>
<td>-1.43</td>
<td>-1.51</td>
<td>-1.58</td>
<td>0.00</td>
</tr>
<tr>
<td>Gross real wage (CPI-deflated)</td>
<td>1.17</td>
<td>1.21</td>
<td>1.24</td>
<td>-0.31</td>
</tr>
<tr>
<td>Capital rental rate</td>
<td>-1.35</td>
<td>-1.41</td>
<td>-1.46</td>
<td>0.18</td>
</tr>
<tr>
<td>Gross nominal wage</td>
<td>1.22</td>
<td>1.27</td>
<td>1.31</td>
<td>-0.20</td>
</tr>
<tr>
<td>Real exchange rate (increase = depreciation of domestic currency)</td>
<td>0.34</td>
<td>0.38</td>
<td>0.42</td>
<td>0.32</td>
</tr>
<tr>
<td>Terms of trade (ratio of export to import prices)</td>
<td>-0.28</td>
<td>-0.30</td>
<td>-0.32</td>
<td>-0.18</td>
</tr>
<tr>
<td>Current account deficit to GDP ratio (change in p.p.)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.16</td>
</tr>
<tr>
<td>Personal income tax revenues</td>
<td>-5.45</td>
<td>-5.36</td>
<td>-5.27</td>
<td>-6.24</td>
</tr>
<tr>
<td>Total income tax revenues (PIT + CIT)</td>
<td>-3.61</td>
<td>-3.53</td>
<td>-3.46</td>
<td>-4.07</td>
</tr>
<tr>
<td>Revenues from taxes on products</td>
<td>0.94</td>
<td>1.01</td>
<td>1.08</td>
<td>0.33</td>
</tr>
<tr>
<td>Total tax revenues</td>
<td>-0.78</td>
<td>-0.71</td>
<td>-0.63</td>
<td>-1.32</td>
</tr>
<tr>
<td>Domestic savings</td>
<td>1.47</td>
<td>1.60</td>
<td>1.72</td>
<td>1.08</td>
</tr>
<tr>
<td>Total savings</td>
<td>1.38</td>
<td>1.50</td>
<td>1.62</td>
<td>0.11</td>
</tr>
<tr>
<td>Total capital rentals</td>
<td>0.06</td>
<td>0.11</td>
<td>0.16</td>
<td>0.21</td>
</tr>
<tr>
<td>Total wage bill</td>
<td>1.28</td>
<td>1.40</td>
<td>1.51</td>
<td>-0.21</td>
</tr>
</tbody>
</table>

*All non-price variables should be interpreted as volumes; GDP deflator is constant (numeraire).
The long-term economic impact of the flat tax in Poland...

Varying elasticity of labor in the high-income group does not qualitatively alter the results. Differences in results are not very large (e.g. GDP response between 0.72% and 0.89%), mainly because the high-earners-labor-supply channel does not seem to be very significant here – the strongest impact comes from increased savings, and, what follows, increased investment and capital stock.

4.2. Simulations 2 and 3

In simulation 1 we assumed that domestic savings effectively determine the size of investment, and, what follows, long-run capital stocks. Within the closure applied in this simulation the gross rate of return (ratio of capital rental rate to the cost of acquiring a unit of new capital) was allowed to decrease. As an alternative – the one usually applied in long-run simulations using static CGE models – one might assume that investors act to preserve the (industry-characteristic) rates of return. It might be interpreted as if investors have already chosen their minimum acceptable profit rate to pursue a given amount of investment (a given capital growth rate in each industry). This assumption, adopted in both simulation 2 and 3, now prevents the rates of return from falling – thus limiting the capital expansion observed in simulation 1. In other words, the assumptions of simulation 1 are only valid if we think of the supply of savings as an effective constraint for investment expansion in the long run.

Simulations 2 and 3 differ (from each other) with respect to another closure aspect: simulation 2 assumes that marginal propensities to consume are fixed, and so current account balance adjusts to facilitate changes in the economy’s potential output. In contrast, simulation 3 assumes that the balance of current account remains unaltered in the long run (there is no permanent shift in the balance), while the propensities to consume adjust. A rationale for the latter assumption might be that perhaps (aggregate) consumption function is a too simple concept. We implicitly assume the existence of economic mechanisms that are not represented in the model (e.g. intertemporal optimization), but that can e.g. force the propensity to consume to change or act to liquidate any shift arising in the current account balance. From that point of view our analysis with alternative closure rules might be considered as showing bounds of the economy’s response for a set of selected border assumptions.

The main finding from simulations 2 and 3 is that if investors act to avoid a fall in rates of return, the positive effects of introducing flat income tax (observed under the assumptions of simulation 1) are substantially dampened. GDP increases are very modest (or even negligible in simulation 2), ranging from 0.03% to 0.17%. The main driving force of the above effects is labor supply increase, which initially raises (very moderately, due to a moderate labor supply increase) rates of return on capital, and motivates investors to build new capacity (until the rate of return goes back to its initial level).

Further, it is worth noticing that the producer real wages (nominal gross wages deflated by output prices) of high-skilled workers decrease in both simulation 2 and 3 (by 0.74−1.24%). This is because the rise in labor supply pushes down its price, as a result of increased competition (labor...
is assumed to be mobile between sectors). At the same time, the low- and medium-skilled labor supply receives a weaker stimulus than the supply of high-skilled labor, and thus, as a now rarer factor, gets a relatively higher price. However, as low- and medium-skilled workers have a high share in export-oriented industries, terms of trade deteriorate significantly, dampening a possible output growth. This effect is stronger under flexible (simulation 2) than under the fixed (simulation 3) current account balance to GDP ratio.

Table 3
GDP components on the expenditure side (percentage changes)

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>Volumes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household consumption</td>
<td>0.76</td>
<td>0.80</td>
<td>0.84</td>
</tr>
<tr>
<td>Consumption of non-profit institutions</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Government consumption</td>
<td>-0.53</td>
<td>-0.35</td>
<td>-0.17</td>
</tr>
<tr>
<td>Investment</td>
<td>1.37</td>
<td>1.49</td>
<td>1.60</td>
</tr>
<tr>
<td>Change in inventories</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Exports</td>
<td>1.12</td>
<td>1.20</td>
<td>1.29</td>
</tr>
<tr>
<td>Imports</td>
<td>0.84</td>
<td>0.90</td>
<td>0.97</td>
</tr>
<tr>
<td>Total consumption (private and public)</td>
<td>0.47</td>
<td>0.54</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Prices (relative to the GDP deflator)

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>Household consumption</td>
<td>0.05</td>
<td>0.06</td>
<td>0.07</td>
</tr>
<tr>
<td>Consumption of non-profit institutions</td>
<td>0.29</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>Government consumption</td>
<td>0.28</td>
<td>0.27</td>
<td>0.26</td>
</tr>
<tr>
<td>Investment</td>
<td>0.08</td>
<td>0.10</td>
<td>0.12</td>
</tr>
<tr>
<td>Change in inventories</td>
<td>0.11</td>
<td>0.13</td>
<td>0.15</td>
</tr>
<tr>
<td>Exports</td>
<td>0.07</td>
<td>0.08</td>
<td>0.09</td>
</tr>
<tr>
<td>Imports</td>
<td>0.34</td>
<td>0.38</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Prices – domestic commodities only (relative to the GDP deflator)

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>Household consumption</td>
<td>0.00</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Consumption of non-profit institutions</td>
<td>0.29</td>
<td>0.29</td>
<td>0.30</td>
</tr>
<tr>
<td>Government consumption</td>
<td>0.28</td>
<td>0.27</td>
<td>0.26</td>
</tr>
<tr>
<td>Investment</td>
<td>-0.03</td>
<td>-0.02</td>
<td>-0.02</td>
</tr>
<tr>
<td>Change in inventories</td>
<td>-0.05</td>
<td>-0.05</td>
<td>-0.04</td>
</tr>
<tr>
<td>Exports</td>
<td>0.05</td>
<td>0.07</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Comparison of results of simulation 2 and 3 raises the question: to what extent would the increased factor inputs (labor and capital supply) actually be absorbed by net exports and consumption? This question cannot be answered with our model, as it lacks theory on joint determination of the two mentioned categories. The results indicate that the domestic, rather than the foreign absorption makes the economy better off (on the other hand we experience an improvement in the balance of trade in simulation 2, which can be treated as a form of postponed benefits).

Finally, and perhaps crucially, the results reveal unfavorable redistributive effects – the increase in real income of high earners is accompanied by the decrease in real incomes of persons falling into the lower income bracket (Table 5).

Moreover, under flexible current account balance the change in total consumption is negative (-0.18% to -0.23%), implying that in this case introducing flat tax would actually harm at least some household groups (unless we assume that utility of government consumption being cut is much lower than the utility of private consumption gain).

Decomposition results of simulation 2, based on the stylized model form, are presented below.

\[ wrn^{(h)} \approx wrg^{(h)} + wtxc^{(h)} \]
\[ 6.31 \approx -0.80 + 7.11 \]

\[ wrn^{(l)} \approx wrg^{(l)} \approx -0.16 \]

\[ I \approx S_L^{(h)} \cdot E_L^{(h)} \cdot wrn^{(h)} + S_L^{(l)} \cdot E_L^{(l)} \cdot wrn^{(l)} + S_L^{(o)} \cdot I^{(o)} \]
\[ 0.04 \approx 0.11 \cdot 0.075 \cdot 6.31 + 0.72 \cdot 0.075 \cdot (-0.16) + 0.17 \cdot (-0.03) = 0.05 - 0.01 - 0.00 \]

\[ irg^{(h)} = S_{Ll}^{(h)} \cdot (I^{(h)} + wrg^{(h)}) \]
\[ -0.30 \approx 0.84 \cdot (0.47 - 0.80) \]
Table 5
Results for household groups (percentage changes)

<table>
<thead>
<tr>
<th>Taxpayer group / variable</th>
<th>Simulation</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>a</td>
<td>b</td>
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<tr>
<td></td>
<td></td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td><strong>Low-income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real pre-tax income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees</td>
<td>0.94</td>
<td>0.97</td>
<td>1.01</td>
<td>-0.14</td>
<td>-0.16</td>
<td>-0.18</td>
<td>-0.03</td>
<td>-0.05</td>
<td>-0.06</td>
</tr>
<tr>
<td>Pensioners</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Self-employed</td>
<td>0.22</td>
<td>0.25</td>
<td>0.28</td>
<td>0.16</td>
<td>0.18</td>
<td>0.20</td>
<td>0.19</td>
<td>0.21</td>
<td>0.24</td>
</tr>
<tr>
<td>Receiving income from multiple</td>
<td>0.70</td>
<td>0.73</td>
<td>0.75</td>
<td>-0.12</td>
<td>-0.13</td>
<td>-0.15</td>
<td>-0.03</td>
<td>-0.04</td>
<td>-0.05</td>
</tr>
<tr>
<td>sources</td>
<td>0.61</td>
<td>0.63</td>
<td>0.65</td>
<td>-0.09</td>
<td>-0.11</td>
<td>-0.12</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.04</td>
</tr>
<tr>
<td>Total</td>
<td>0.61</td>
<td>0.63</td>
<td>0.65</td>
<td>-0.09</td>
<td>-0.11</td>
<td>-0.12</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.04</td>
</tr>
<tr>
<td>Real after-tax income</td>
<td>0.61</td>
<td>0.63</td>
<td>0.65</td>
<td>-0.09</td>
<td>-0.11</td>
<td>-0.12</td>
<td>-0.02</td>
<td>-0.03</td>
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<tr>
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<td>7.02</td>
<td>7.39</td>
<td>5.65</td>
<td>5.92</td>
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<td>6.08</td>
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<td>8.33</td>
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<td>6.96</td>
<td>6.53</td>
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<td>0.92</td>
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<td>5.35</td>
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<td>5.61</td>
<td>5.88</td>
<td>6.15</td>
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</table>
The long-term economic impact of the flat tax in Poland...

\[ irg^{(l)} \approx S_{ij}^{(l)} \cdot (l^{(l)} + wrg^{(l)}) \]
\[ -0.11 \approx 0.65 \cdot (-0.01 - 0.17) \]

\[ irn^{(h)} \approx irg^{(h)} + itxc^{(h)} \]
\[ 6.67 \approx -0.30 + 6.97 \]

\[ irn^{(l)} \approx irg^{(l)} \approx -0.11 \]

\[ cr^{(h)} \approx E_{C}^{(h)} \cdot irn^{(h)} \]
\[ 5.35 \approx 0.81 \cdot 6.67 \]

\[ cr^{(l)} \approx E_{C}^{(l)} \cdot irn^{(l)} \]
\[ -0.11 \approx 0.84 \cdot (-0.11) \]

\[ cr \approx S_{c}^{(h)} \cdot cr^{(h)} + S_{c}^{(l)} \cdot cr^{(l)} + cr^{(o)} \]
\[ 0.21 \approx 0.06 \cdot 5.35 + 0.72 \cdot (-0.11) - 0.03 = 0.32 - 0.08 - 0.03 \]

\[ s^{(h)} \approx E_{S}^{(h)} \cdot in^{(h)} \]
\[ 10.71 \approx 1.56 \cdot 6.80 \]

\[ s^{(l)} \approx E_{S}^{(l)} \cdot in^{(l)} \]
\[ 0.06 \approx 6.48 \cdot 0.01 \]

\[ s \approx S_{S}^{(h)} + S_{S}^{(l)} \cdot s^{(l)} + sc^{(o)} \]
\[ 3.09 \approx 0.28 \cdot 10.71 + 0.30 \cdot 0.06 + 0.07 = 3.00 + 0.02 + 0.07 \]

\[ st \approx S_{III} \cdot s + ste^{(o)} \]
\[ 0.15 \approx 0.23 \cdot 3.09 - 0.55 = -1.31 - 1.17 \]

\[ invr \approx ST/INV \cdot st - invp \]
\[ -0.04 \approx 1.06 \cdot 0.15 - 0.19 \]

\[ k \approx invr \]
\[ 0.06 \approx -0.04 \]

\[ gdpr \approx S_{K} \cdot k + S_{L} \cdot l \]
\[ 0.07 \approx 0.48 \cdot 0.06 + 0.52 \cdot 0.04 = 0.03 + 0.02 \]

\[ k - l \approx \sigma_{KL} \cdot plk \]
\[ 0.02 \approx 0.5 \cdot (-0.42) \]

In this case (as well as in the case of simulation 3 – see equation (14)) aggregation leads to a relatively big error – equations (14') and (14'') actually hold at a disaggregate (sectoral) level only. In other words, how overall \( plk \) is determined, can be shown only at the sectoral level in this case.
\[ kp \approx (S_k - 1) \cdot plk \]  
\[ 0.20 \approx (0.48 - 1) \cdot (-0.42) \]  
\[ lp \approx S_k \cdot plk \]  
\[ -0.22 \approx 0.48 \cdot (-0.42) \]  
\[ mr_{rt} \approx gdp_{rt} + \sigma_m \cdot dmp_{rt} \]  
\[ 0.12 \approx 0.49 + 1.5 \cdot (-0.25) \]  
\[ xr \approx E_X \cdot tot \]  
\[ 0.78 \approx -4 \cdot (-0.19) \]  
\[ cp \approx S_{CD} \cdot cdp + S_{CM} \cdot mp \]  
\[ 0.12 \approx 0.88 \cdot 0.08 + 0.12 \cdot 0.34 \]  
\[ ip \approx S_{ID} \cdot idp + S_{IM} \cdot mp \]  
\[ 0.19 \approx 0.69 \cdot 0.13 + 0.31 \cdot 0.34 \]  
\[ wrg \approx lp - cp \]  
\[ -0.34 \approx -0.22 - 0.12 \]  
\[ ror \approx kp - ip \]  
\[ 0 \approx 0.20 - 0.19 \]

Results of simulation 3:

\[ wrn^{(h)} \approx wrg^{(h)} + wtxc^{(h)} \]  
\[ 6.50 \approx -0.63 + 7.13 \]  
\[ wrn^{(l)} \approx wrg^{(l)} \approx -0.05 \]  
\[ \begin{align*} l & \approx S_l^{(h)} \cdot E_l^{(h)} \cdot wrn^{(h)} + S_l^{(l)} \cdot E_l^{(l)} \cdot wrn^{(l)} + S_l^{(o)} \cdot l^{(o)} \\ 0.05 & \approx 0.11 \cdot 0.075 \cdot 6.50 + 0.72 \cdot 0.075 \cdot (-0.05) + 0.17 \cdot (-0.01) = 0.05 - 0.00 - 0.00 \end{align*} \]  
\[ irg^{(h)} \approx S_{li}^{(h)} \cdot (\ell^{(h)} + wrg^{(h)}) \]  
\[ -0.13 \approx 0.84 \cdot (0.49 - 0.63) \]  
\[ irg^{(l)} \approx S_{li}^{(l)} \cdot (\ell^{(l)} + wrg^{(l)}) \]  
\[ -0.03 \approx 0.65 \cdot (0.00 - 0.05) \]  
\[ irn^{(h)} \approx irg^{(h)} + itxc^{(h)} \]  
\[ 6.85 \approx -0.13 + 6.98 \]  
\[ irn^{(l)} \approx irg^{(l)} \approx -0.03 \]  
\[ cr^{(h)} \approx E_c^{(h)} \cdot irn^{(h)} + cf^{(h)} \]  
\[ 5.88 \approx 0.81 \cdot 6.85 + 0.36 \]
\[
\begin{align*}
    cr^{(i)} & \approx E_{C}^{(i)} \cdot irn^{(i)} + cf^{(i)} \\
    0.32 & \approx 0.84 \cdot (-0.03) + 0.36
\end{align*}
\] (6b’)

where \( cf^{(i)} \) – percentage change in consumption due to a shift in average economy-wide propensity to consume.

\[
\begin{align*}
    cr & \approx S_{C}^{(h)} \cdot cr^{(h)} + S_{C}^{(i)} \cdot cr^{(i)} + cr^{(e)} \\
    0.57 & \approx 0.06 \cdot 5.88 + 0.72 \cdot 0.32 - 0.01 = 0.35 \cdot 0.23 - 0.01
\end{align*}
\] (7’)

\[
\begin{align*}
    s^{(h)} & \approx E_{S}^{(h)} \cdot in^{(h)} + sf^{(h)} \\
    9.79 & \approx 1.56 \cdot 6.92 - 1.01
\end{align*}
\] (8a’)

\[
\begin{align*}
    s^{(i)} & \approx E_{S}^{(i)} \cdot in^{(i)} + sf^{(i)} \\
    -11.85 & \approx 6.48 \cdot 0.03 - 12.04
\end{align*}
\] (8b’)

where \( sf^{(i)} \) – percentage change in savings due to a shift in average economy-wide propensity to consume.

\[
\begin{align*}
    s & \approx S_{S}^{(h)} \cdot s^{(h)} + S_{S}^{(i)} \cdot s^{(i)} + sc^{(e)} \\
    -0.71 & \approx 0.28 \cdot 9.79 + 0.30 \cdot (-11.85) + 0.10 = 2.74 - 3.56 + 0.10
\end{align*}
\] (9’)

\[
\begin{align*}
    st & \approx S_{HI} \cdot s + stc^{(e)} \\
    0.15 & \approx 0.23 \cdot (-0.71) + 0.31 = -0.16 + 0.30
\end{align*}
\] (10’)

\[
\begin{align*}
    invr & \approx ST/INV \cdot st - invp \\
    0.05 & \approx 1.06 \cdot 0.15 - 0.10
\end{align*}
\] (11’)

\[
\begin{align*}
    k & \approx invr \\
    0.14 & \approx 0.05
\end{align*}
\] (12’)

\[
\begin{align*}
    gdpr & \approx S_{k} \cdot k + S_{l} \cdot l \\
    0.13 & \approx 0.48 \cdot 0.14 + 0.52 \cdot 0.05 = 0.07 + 0.03
\end{align*}
\] (13’)

\[
\begin{align*}
    k - l & \approx \sigma_{KL} \cdot plk \\
    0.09 & \approx 0.5 \cdot (-0.21)
\end{align*}
\] (14’)

\[
\begin{align*}
    kp & \approx (S_{k} - 1) \cdot plk \\
    0.09 & \approx (0.48 - 1) \cdot (-0.21)
\end{align*}
\] (15’)

\[
\begin{align*}
    lp & \approx S_{k} \cdot plk \\
    -0.12 & \approx 0.48 \cdot (-0.21)
\end{align*}
\] (16’)

\[
\begin{align*}
    mr_{tp} & \approx gdpr_{tp} + \sigma_{M} \cdot dmp_{tp} \\
    0.24 & \approx 0.35 + 1.5 \cdot (-0.06)
\end{align*}
\] (17’)
\[ \begin{align*}
xr & \approx E_x \cdot \text{tot} \\
0.31 & \approx -4 \cdot (-0.08)
\end{align*} \] (18")

\[ \begin{align*}
cp & \approx S_{CD} \cdot cdp + S_{CM} \cdot mp \\
0.07 & \approx 0.88 \cdot 0.05 + 0.12 \cdot 0.16
\end{align*} \] (19")

\[ \begin{align*}
ip & \approx S_{IP} \cdot idp + S_{IM} \cdot mp \\
0.10 & \approx 0.69 \cdot 0.07 + 0.31 \cdot 0.16
\end{align*} \] (20")

\[ \begin{align*}
\text{wrg} & \approx lp - cp \\
-0.18 & \approx -0.12 - 0.07
\end{align*} \] (21")

\[ \begin{align*}
\text{ror} & \approx kp - ip \\
0 & \approx 0.09 - 0.10
\end{align*} \] (22")

### 5. Conclusions

Replacement of the progressive PIT schedule with a single 18% rate can raise domestic output in the long run by stimulating labor supply and capital expansion. However, the magnitude of the impact largely depends on adjustment mechanisms at work – especially those responsible for investment response. If the increased household savings were to be fully transformed into investment, GDP gain of 0.72–0.89% is observed. In contrast, if the necessary condition for investment increase is a rise in rates of return, this effect is considerably smaller – 0.03% to 0.17%. These results call for identification of long-term adjustment processes in the mentioned areas, that would help locate the expected effect of flat income tax more precisely between the above bounds.

The results suggest that output gains stemming from the flat tax introduction are small. However, these effects are likely to be larger once decrease in administrative costs and, in particular, increase in efficiency, are factored in. Further, the growth bonus arising from setting a single PIT rate may be much larger if the marginal tax rate for low income earners is reduced. Other positive supply side effects that we do not take into account include the impact of increased investment on accelerated technological progress (as suggested by endogenous growth theories), and a possible efficiency boost of workers flowing from the public to the private sector (due to government consumption reduction).

The flat tax in the analyzed form would lead to greater income inequality. Further, it is likely that once private consumption increase was paired with government consumption cuts, some (particularly low-income) households would experience a negative welfare change. Our approach does not allow us to investigate the impact that government consumption cuts might have on welfare of particular household groups. This would be possible to analyze only with a very detailed disaggregation of the household sector. However, contrary to the above, it could be assumed that the expenditure cuts are composed in such a way that does not bring Pareto deterioration. Determining the most appropriate composition of government expenditure cuts remains an interesting issue for further research.
References

Adams P.D. (2005), Interpretation of results from CGE models such as GTAP, *Journal of Policy Modeling*, 27(8), 941–959.


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