Paweł Kumor, Witold Pawlak, Jan Jacek Sztaudynger*

GROWTH AND INEQUALITY: DIFFERENCES IN OPTIMAL INCOME INEQUALITY BETWEEN SWEDEN, THE UNITED STATES AND POLAND

Introduction

Our hypothesis is that there exists a level of income inequality that is optimal for economic growth. If inequality is lower than optimal, the most creative, efficient and effective employees are not sufficiently remunerated and motivated to fully use their capacities and skills in economic activities. When the earnings of an employee possessing advanced skills and whose work yields great benefits for the company do not differ considerably from the earnings of other employees with poorer skills and low productivity, the employee may feel disappointed.[1] Such a situation will lower his work motivation and he will desire to improve his qualifications.

If the inequality of earnings is higher than optimal, employees with lower skills receive relatively low pay. This can be accompanied by feelings of injustice, exploitation and poverty. Such feelings are harmful for social bonds which will then weaken the ties between employees and employers and lower trust and social capital. An employee receiving low earnings is mainly motivated to work by the need to satisfy his minimum needs. As a result, employees with relatively low earnings do not display creative thinking and involvement in their work.

An employee who perceives a relatively large difference between his pay and that of other employees, neighbours or acquaintances may also experience disappointment, which may lead to lower productivity. Moreover, to make up for low earnings, such employees may adopt behaviors that are unfavorable for the company. Such

* Prof. Jan Jacek Sztaudynger, University of Lodz, sztaud@uni.lodz.pl; Mgr Paweł Kumor, University of Lodz, kumor@uni.lodz.pl; Witold Pawlak, BRE Bank S.A., University of Lodz.

Paweł Kumor MA and Witold Pawlak MA are PhD students at the Faculty of Economics and Sociology, and Jan Jacek Sztaudynger is a full professor at the same faculty, University of Lodz, Poland. We wrote the introduction and the final remarks together. Part 2 of the paper was written by J.J. Sztaudynger, parts 3 and 4 by W. Pawlak, and part 5 by P. Kumor. The research was financed from national funds for the years 2006–2009 for a research project entitled "Multi-equation Econometric Models of Economic Growth and Social Capital, Inequality of Earnings, Trust, Crime Rate and Unemployment", N111 023 31/2840.

[1] A. K. Sen (1973), On Ignorance and Equal Distribution, *American Economic Review* 63: 1022–1024 (quoted after: S. M. Kot (2000, 115)).

behaviors may include shortening of working time or using the company's assets for one's individual benefit. During parliamentary or self-government elections, such an employee may vote for parties declaring populist slogans, promising that living conditions will improve. Such political parties may not necessarily have a good economic program. On the one hand, high inequality of earnings intensifies a desire to improve one's professional qualifications and on the other hand it intensifies a desire to achieve high earnings through personal contacts and acquaintances.

It was our goal to build a model of economic growth and use it to estimate historically optimal inequality of income. We consider optimal inequality to be the level of inequality at which the production growth rate is the highest. Introducing an inequality variable to the model in the form of a parabolic shape[2] made it possible to estimate the optimal inequality. Our second hypothesis is that optimal income inequality is different for each economy. The model was applied to Sweden, the United States, and Poland.

Inequality and growth model

Economic growth is analyzed by means of a production function with fixed capital, labor, and technical-organizational level as the variables:

$$GDP_t = A_t f\,(K_t, L_t), \tag{1}$$

where:
GDP_t = Gross Domestic Product at constant prices;
L_t = labor;
K_t = fixed capital at constant prices;
A_t = total factor productivity which represents technical-organizational level.
Function (1) can be transformed into the form:

$$\mathring{GDP}_t = A_t f\,(\mathring{K}_t, \mathring{L}_t), \tag{2}$$

where circles above the variables denote the rates of growth. If we introduce the rate of investment in place of capital growth, which is often done in models of growth, function (2) will take the following form:

$$\mathring{GDP}_t = \mathring{A}_t f\,(I_t/GDP_t, \mathring{L}_t), \tag{3}$$

where:

$\mathring{GDP}$ = GDP growth rate;
I_t/GDP_t = investment rate (investment as % of GDP);
$\mathring{L}_t$ = labor growth rate;
$\mathring{A}_t$ = growth rate of total factor productivity (TFP).

[2] We chose a parabola as the simplest U shape.

Several other factors of growth can be taken into account in the model of growth: rate of inflation, output convergence, human capital, and social capital expressed by various inequality measures. These variables were not introduced into model (3). Hence, they are represented by the total factor productivity $\mathring{A}_t$, also called the Solow residual.[3]

Social capital is increasingly regarded as a key factor to the analyses of economic growth. Social capital is defined as a network of organizations, a set of norms, trust favorable for co-operation, and mutual benefits that create potential for solving social problems (Sirianni and Friedland, 1995). When defining social capital, Sztompka (2002, 222 and 224) stresses that such networks of organizations frequently appear during the process of setting up self-government and voluntary associations and informal groups. Trust is supplemented by solidarity and loyalty created by friends and networks of contacts. Sztompka emphasizes that mutual benefits not only have an economic-financial dimension, but also include power and prestige (2002, 368).

Gracia (2002, 190) defines social capital as the "ability of a society to co-ordinate social entities within a common project. Such a co-ordination ability can only be based on shared social values: on the culture of common good." Social capital paves the way for co-operation within society, aiding organization and co-ordination.

Research focused upon social capital has been carried out since the mid-1980s by such scholars as Putnam, Coleman, and Bourdieu. Social capital cannot be measured directly or in a scalar way, and the factors that determine social capital are also difficult to measure. It is only since the early 1990s that variables which indirectly represent social capital have been introduced to econometric models of growth. One such variable is income inequality.[4] Research on the impact of inequality on economic growth[5] began in 1993 by Galor and Zeira (see Ferreira 1999).

For the purposes of this study, the model of economic growth is supplemented with the GINI coefficient:

$$\mathring{GDP}_t = \mathring{A}_t f\,(I_t/GDP_t,\ \mathring{L}_t,\ GINI) \tag{4}$$

GINI = measure of income (earning) inequality (the GINI coefficient).

Conflicting opinions concerning the impact of income inequality on economic growth can be found in the literature. Some points to its negative impact and others to its positive impact. However, the opinion that income inequality has a negative impact upon the economic growth rate predominates by far. The mechanism of this impact can be explained as follows:

---

[3] It should be noted that the size of this residual decreases along with an increasing number of other economic growth factors not taken into account in the model (Solow, 1967, 45).

[4] An extensive collection of data about income inequalities in several countries can be found on the World Bank's website:

http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:20699070~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html (20.10.2006).

[5] Economists are also interested in a relationship between the level of income (development) and inequality of income, which was described by the Kuznets curve (1955).

1. the poorer the average elector (the median), the higher the taxes, the stronger the political pressures on the redistribution of income, the greater the disturbances (informal sector which undermines trust and social capital);
2. the growing inequality of income leads to social and political conflicts, what has a negative impact upon social capital;
3. poor people have fewer life opportunities than the rich and do not use their productive potential fully; hence they do not receive appropriate education or loans from banks as frequently;
4. the productivity of poor employees is limited as they cannot imagine that they will progress above a certain level (Persson and Tabellini 1994; Ferreira 1999; Morrissey et al. 2002).

The negative impact of an initial inequality of income on economic growth was confirmed, for example, by Persson and Tabellini (1994) and Barro (1999) for countries with a low GDP.[6] Some other studies, particularly those focused upon developed countries, reveal the positive influence exerted by income inequality on economic growth in the medium and short term (Barro 1999; Morrissey et al. 2002; Dollar and Kraay 2003).[7]

A positive impact can emerge when there is insufficient income or excessive taxation of the most productive and effective people in terms of GDP formation. If inequality of income is too low, motivation to work more efficiently is stifled. In other words, greater inequality of income will lead to the growth of productivity.

It is possible to reconcile the divergent findings of econometric research if we use a non-linear function to describe the relationship between inequality of earnings and economic growth. It is then possible to estimate the optimal level of the inequality $GINI^0$, optimal in the sense of maximizing economic growth (Cornia and Court 2001; Chen 2003, 206; Sztaudynger 2003, 76–77) (see Figure 1).

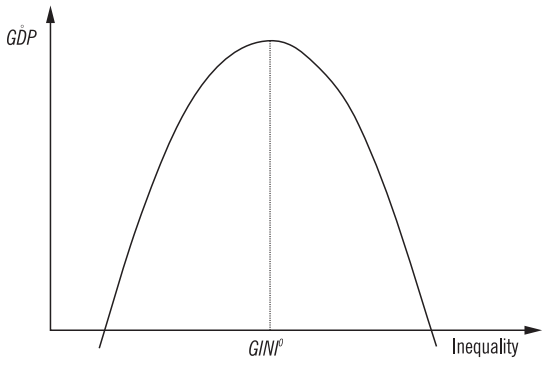

Figure 1: GDP growth as a function of inequality

Source: Cornia, Court (2001), Chen (2003, 206).

[6] Barro (1999) assumed that in the case of inequality of earnings, the parameter was increasing along with the GDP parameter. He obtained a negative estimation of the parameter in the case of such inequalities in the cross-sectional sample, with the parameter growing along with GDP growth.

[7] Dollar and Kraay make reference to studies carried out by Forbes (2000) and Li and Zou (1998).

Optimal income inequality in the United States and Sweden

The United States and Sweden were selected for empirical analysis, as they represent high and low inequality level respectively (Fig. 2). The sample covers the years 1960–2004,[8] and model (4) was used:

$$\mathring{GDP}_t = \mathring{A}_t f\,(I_t/GDP_t,\ \mathring{L}_t,\ GINI_t^2,\ GINI_t) \tag{4'}$$

The model includes GINI in the first and the second power, which creates considerable multicollinearity. Due to the fact that both $GINI^2$ and GINI represent the same economic phenomenon (income inequality), we apply two-step procedure. In the first step, $GINI^2$ and GINI were estimated as two separate variables. Then GINIC time series was formed:

$$GINIC = a*GINI^2 + b*GINI,$$

where *a* and *b* are estimates of GINI parameters from the first step. In the second step the variable created in this way was introduced to the model instead of $GINI^2$ and GINI, and the final estimation was carried out. This not only improved the significance of the remaining exogenous variables, but also preserved the non-linear character of the inequality influence.

In the next step, we estimate the impact of the GINIC variable.

Sweden (OLS method):

$$\mathring{GDP} = \underset{(-3.39)}{-26.43} + \underset{(4.07)}{0.32}\cdot \mathring{L} + \underset{(2.40)}{0.14}\cdot (I_C/GDP_C)_{-4} + \underset{(4.46)}{0.89}\cdot \Delta\,(I_C/GDP_C)$$
$$+ \underset{(3.35)}{1.00}\cdot (-0.038\cdot Gini^2_{-1} + 2.018\cdot Gini_{-1}) + \underset{(3.01)}{2.23}\cdot U7071 + \underset{(3.37)}{2.52}\cdot U7778 \tag{5}$$

$$R^2 = 0.769 \qquad S_e = 1.027$$

United States (OLS method):

$$\mathring{GDP} = \underset{(-3.08)}{-123.1} + \underset{(6.92)}{0,79}\cdot \mathring{L} + \underset{(2.00)}{0.12}\cdot \sum_{i=2}^{4} (I_C/GDP_C)_{-i} + \underset{(3.72)}{1.10}\cdot \Delta (I_C/GDP_C)$$
$$+ \underset{(3.14)}{1.00}\cdot \left(-0.060\cdot Gini^2_{-1} + 5.335\cdot Gini_{-1}\right) - \underset{(-2.95)}{2.80}\cdot U\ 74 \tag{6}$$

$$R^2 = 0.830 \qquad S_e = 0.912$$

[8] Data concerning GINI coefficients come from the World Income Inequality Database V 2.0b May 2007, United Nations University, World Institute for Development Economics: http://62.237.131.23/wiid/wiid.htm (11.01.2007). Data for Sweden (apart from employment) come from Statistica Sweden: http://www.scb.se/ (28.01.2007). The remaining data come from statistical yearbooks of International Financial Statistics from 2005 and earlier years.

where:

$\mathring{GDP}$ = GDP growth rate in % (GDP at constant prices);

$\mathring{L}$ = employment growth rate in %;

I_c/GDP_c = investment rate in % (current prices);

$\Delta (I_c/GDP_c)$ = investment rate increment;

Gini = GINI coefficient in %;

U7071,U7778, U74 = dummy variables.

In brackets there are the absolute values of t-Student's statistics.

Models (5) and (6) confirm the non-linear character of the impact exerted by income inequality on economic growth:

Sweden $$\boldsymbol{GINIC}_{-1} = -0.038 \cdot \boldsymbol{Gini}^2_{-1} + 2.018 \cdot \boldsymbol{Gini}_{-1} \quad (5')$$

United States $$\boldsymbol{GINIC}_{-1} = -0.060 \cdot \boldsymbol{Gini}^2_{-1} + 5.335 \cdot \boldsymbol{Gini}_{-1} \quad (6')$$

Economic growth in the analyzed period reaches its maximum for GINI at 44.5% (United States) and 26.6% (Sweden).

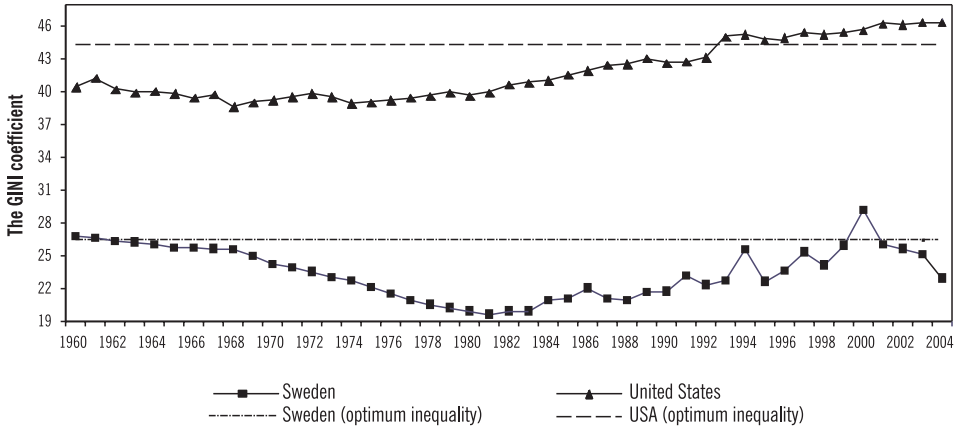

Figure 2. Income inequality – GINI coefficient (%) for Sweden and the United States 1960–2004

Source: WIID V 2.0b, UNU-WIDER.

We presume that the difference in optimum level is due to cultural and social discrepancies, as well as to the differences in the domestic policy of income redistribution in these economies.

Sweden is a country known for its social equality policy, whereas the United States is a country characterized by a marked hierarchy in society. Although the citizens of the United States formally have equal rights, there are still major inequalities in the education, property and wealth of white and colored people. These inequalities are passed on to the next generation.

The more the income inequality departs from the optimal level, the greater the losses in growth.

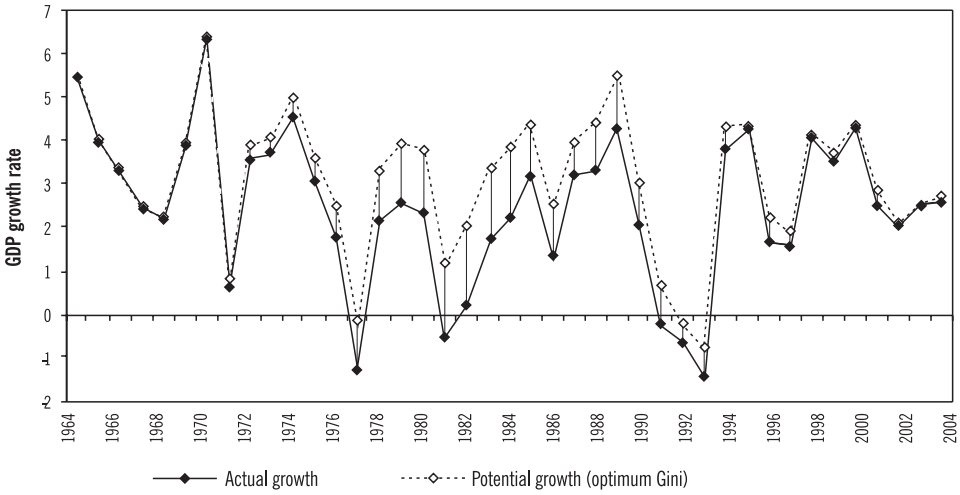

Figure 3. Sweden – actual and potential economic growth (optimal GINI)

Source: authors' calculations based on model (5).

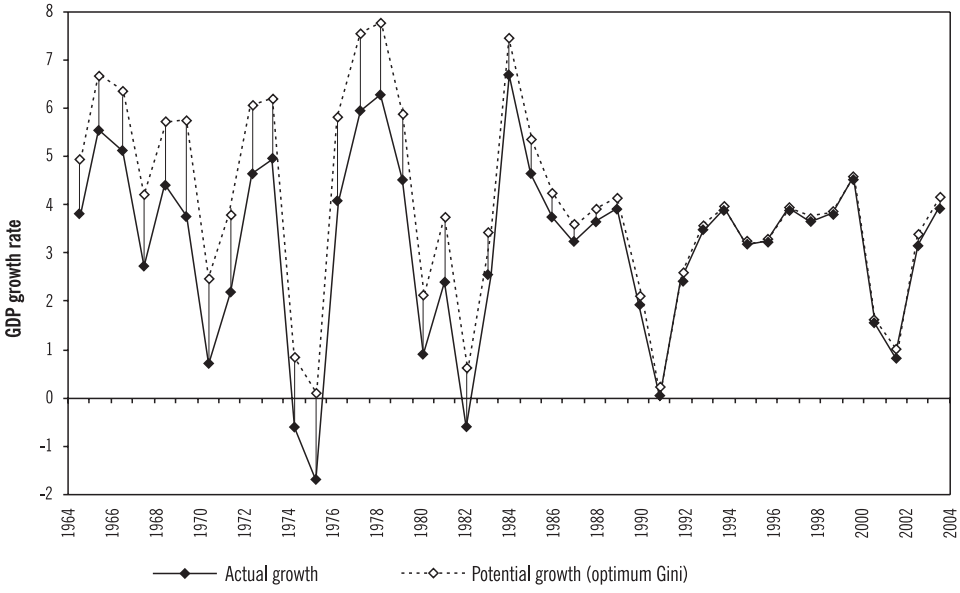

Figure 4. The United States – actual and potential economic growth (optimal GINI)

Source: authors' calculations based on model (6).

Due to non-optimal income inequality, the greatest losses in economic dynamics were recorded in the following years:

- 1974–1996 by Sweden (insufficient inequality – average 1% losses in growth dynamics annually);
- 1964–1990 by the United States (insufficient inequality – average over 1% losses in growth dynamics annually).

Estimation of the models for the United States and Sweden confirm the existence of optimal income inequality for economic growth. It can be concluded from these results that this optimum tends to vary for different economies.

Pooled estimation for the United States, the United Kingdom and Sweden

Attempts to estimate model (4'), collectively making allowances for income inequality for a group of countries, seem to confirm the above hypotheses.

Two variants of a model based on cross-sectional time data were tested for three countries in the years 1963–2002 (a total of 120 observations):[9]

I Variant:

$$\mathring{GDP} = \underset{(1.68)}{-23.97} + \underset{(11.5)}{0.78} \cdot \mathring{L} + \underset{(2.45)}{0.14} \cdot (I_c/GDP_c)_{-2} + \underset{(1.45)}{0.038} \cdot GiniSW^2_{-1} - \underset{(1.72)}{0.030} \cdot GiniUW^2_{-1} +$$

$$-\underset{(1.05)}{0.009} \cdot GiniUS^2_{-1} + \underset{(1.55)}{1.90} \cdot GiniSW_{-1} + \underset{(1.69)}{1.69} \cdot GiniUK_{-1} + \underset{(1.33)}{0.91} \cdot GiniUS_{-1} - \underset{(4.39)}{3.55} \cdot U74$$

$$R^2 = 0.592 \qquad S_e = 1.349$$

II Variant:

$$\mathring{GDP} = \underset{(0.35)}{1.13} + \underset{(11.2)}{0.75} \cdot \mathring{L} + \underset{(1.90)}{0.10} \cdot (I_c/GDP_c)_{-4} - \underset{(0.02)}{0.00006} \cdot Gini^2_{-1} - \underset{(0.14)}{0.025} \cdot Gini_{-1} - \underset{(4.23)}{3.52} \cdot U74$$

$$R^2 = 0.550 \qquad S_e = 1.392$$

In variant II, in which an attempt was made to estimate the common optimal income inequality for the three economies, the parameters at GINI^2 and GINI are statistically insignificant. Variant I, which makes allowances for any possible variations in parameters for GINI coefficients for particular countries, is a better variant. The optimal income inequality for maximizing economic growth occurs in this case for GINI equal to 28.6% (the United Kingdom), 52.4% (the United States), and 25.2% (Sweden).

Optimal income inequality – Poland

The growth of Polish GDP is explained by income inequality (model (4'), sample 1984–2006):[10]

[9] The analysis based on panel data was supplemented by the United Kingdom. The following symbols were used to differentiate the surveyed countries: SW – Sweden, UK – United Kingdom, US – United States.

[10] Statistical data come from Statistical Yearbooks of the Central Statistical Office and Kumor (2006). For samples starting earlier (1981–1983), we obtained partly insignificant estimations. We will analyze the problem of the stability of parameters in further studies, particularly from the viewpoint of the increasing GINI optimal coefficient.

$$\underset{(t\text{-}stud)}{\overset{\circ}{GDP}} = \underset{(-2.30)}{-56.76} + \underset{(5.96)}{0.85} \cdot \overset{\circ}{L} + \underset{(1.82)}{0.33} \cdot (I/GDP)_{-1} \underset{(-1.92)}{- 0.066} \cdot GINI_{-1}^{2} + \underset{(2.02)}{3.82} \cdot GINI_{-1}$$

$$JB = 0.03\,(0.98) \quad DW = 1.87 \quad LM_{\chi_2^2} = 4.76\,(0.09) \quad White = 13.64\,(0.06) \qquad (7)$$

$$R^2 = 0.789 \quad \bar{R}^2 = 0.743 \quad S_e = 2.18$$

where:

$\overset{\circ}{GDP}$ = GDP growth rate at constant prices (%);
$\overset{\circ}{L}$ = labor growth rate (%);
$(I/GDP)_{-1}$ = investment rate (one-year lag; %);
$GINI_{-1}$ = GINI coefficient of income (one-year lag; %);

Model (7) shows that the impact of income inequality on the GDP growth rate has the following form:

$$GINIC_{-1} = -0.066 \cdot GINIC_{-1}^{2} + 3.82 \cdot GINIC_{-1} \qquad (7')$$

Hence, for the value of the coefficient $GINI_{opt}$ equal to 28.8%, the GDP growth rate reaches its maximum.

Model (7) allows us to draw a parabola characterizing the influence exerted by income inequality on economic growth:

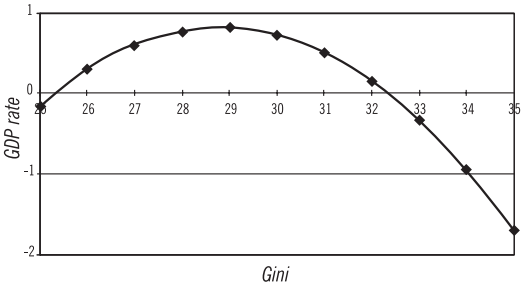

Figure 5: The impact of inequality on production growth[11]

Source: authors' calculations on the basis of model (7).

Summing up the estimations obtained in model (7), it can be seen that:

1. over the years 1984–2006, GINI earnings inequality exerted an influence on the GDP growth rate;
2. the hypothesis about the non-linear parabolic impact of pay variations on the GDP growth was confirmed;
3. in the years 1984–2006, the parabola achieved its maximum for earnings inequality at a GINI coefficient of about 28.8% – this result is an estimation of optimal earnings inequality in the analyzed period assuming that they were stable in that period;
4. significant estimations of the parameters with income inequality confirm that it is admissible to accept an assumption about the stability of optimal income inequality in the years 1984–2006. The effects of dismissing this assumption will be analyzed further.

[11] To improve comprehension of the graph, the function was shifted down without changing its shape. This makes it easier to observe the effects of the changes in earnings inequality.

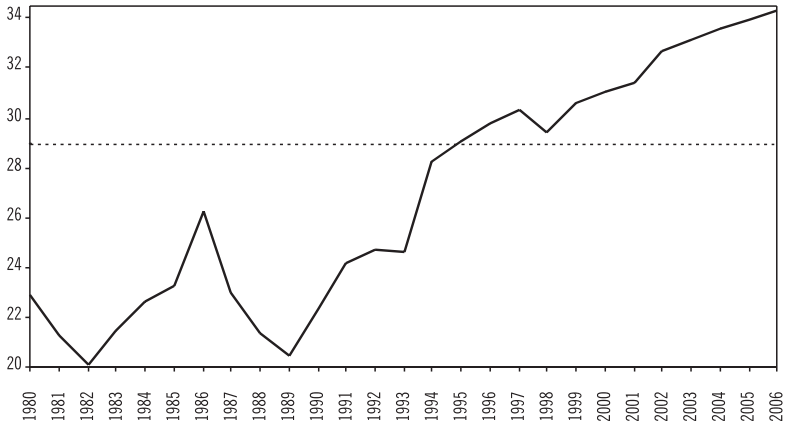

Figure 6. GINI inequality coefficient (%) in Poland, 1980–2006

Source: authors' calculations based on equation (5) and Kumor (2006).

It can be presumed from Figure 6 that:

1. the GINI coefficient was closest to its optimum value in the years 1994–1998;
2. earnings inequality was too low in the years 1980–1993;
3. in the years 1999–2006 earnings inequality was too high and grew, which resulted in a slowdown of economic growth.

Table 1 shows that the estimation of a slowdown in the production growth rate is due to an increase in the GINI coefficient by one percentage point: ΔGDP. The analysis focused upon the values of GINI coefficient 27–35, as such values were recorded in the last 10 years in Poland.

Table 1. Estimations of mariginal and full slowdowns in GDP growth (in percentage points)[12]

	Marginal	Total
27	0.3	–0.2
28	0.2	0.0
29	0.0	0.0
30	–0.1	–0.1
31	–0.2	–0.3
32	–0.4	–0.7
33	–0.5	–1.2
34	–0.6	–1.8
35	–0.8	–2.5

$GDP/\mathring{L}$ – estimates from model (7).

Source: authors' estimations.

[12] Losses of 0.1–0.2% should be considered insignificant (e.g., in Table 1).

The estimations in Table 1 indicate that increasing the GINI coefficient by one percentage point from its level of 29 (close to the optimal value) means that economic growth in the following year will be reduced by about 0.1 of a percentage point, therefore it is an influence of marginal significance. For subsequent higher levels of this coefficient, each subsequent increase by a unit brings about a larger reduction in economic growth. The last column in Table 1 presents estimations of losses in economic growth resulting from a deviation from the optimal value of the GINI coefficient. For instance, for a GINI value of 32, the loss of additional economic growth in the following year will reach 0.7 of a percentage point.

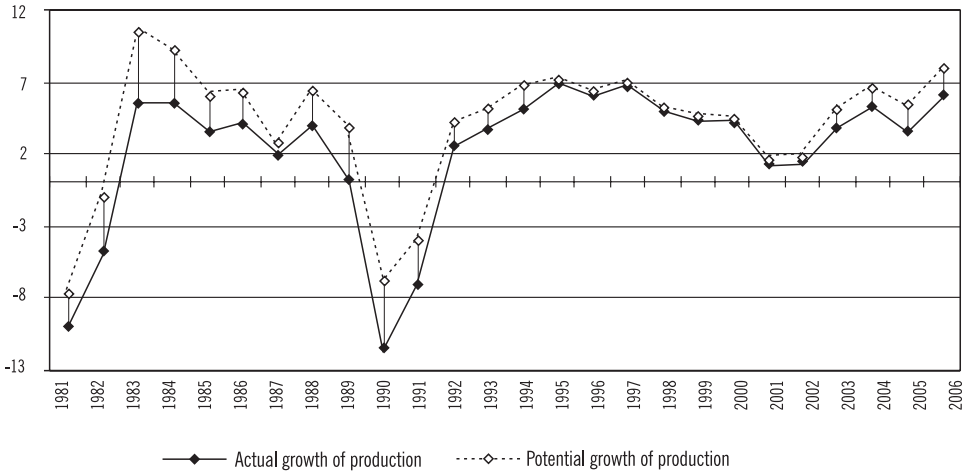

Figure 7. GDP growth – actual and potential (assuming optimal inequality of earnings $GINI_{opt}$)
Source: authors' estimations made on the basis of model (7).

Figure 7 shows two lines. The lower line reflects actual production growth and the upper line is a rough estimate of potential production growth if earning inequality had been at its optimum level. It should be noted that a major slowdown in growth was observed in the years 1981–1990, before the transformation of the economic system. Losses were due to earning inequality being too low. On the other hand, losses tended to increase following the year 2003 because earning inequality was too large.

For Sweden and the United States – in models (5) and (6) respectively – the parabolic GINI function was replaced by the variable (7'):

$$\boldsymbol{GINIC} = -0.066 \cdot \boldsymbol{GINI}^2 + 3.82 \cdot \boldsymbol{GINI}.$$

We will now analyze the stationarity of variables in model (4''):

$$\boldsymbol{\mathring{GDP}} = \boldsymbol{\mathring{A}f(I/GDP, \mathring{L}, GINIC)}. \qquad (4'')$$

Using the augmented Dickey-Fuller test (ADF), Philips-Perron test (PP), and Kwiatkowski-Philips-Schmidt-Shin test (KPSS), we carried out an analysis of the degree of integration of the variables found in the model.

Table 2. The order of variables integration

Variable	ADF	PP	KPSS
GINIC	I~(1)	I~(1)	I~(1)
$\mathring{GDP}$	I~(0)	I~(0)	I~(0)
$\mathring{L}$	I~(0)	I~(0)	I~(0)
I/GDP	I~(1)	I~(1)	I~(0)

Source: authors' calculations.

Despite a short sample of only 27 years, we discovered the stationarity of the GDP growth rate, the employment growth rate, and the first increases in the investment rate and the GINI coefficient.

The results of the integration analysis can be presented as follows:

$$\overset{I(0)}{\mathring{GDP}} = f\left(\overset{I(0)}{\mathring{L}},\ \overset{I\ (1)}{I/GDP},\ \overset{I(1)}{GINIC}\right) \tag{4''}$$

Equation (4'') shows that there are two explanatory variables (*GINIC*, *I/GDP*) integrated in the first degree, which is higher than the integration degree of the variable explaining the GDP growth rate (Charemza and Deadman, 1993). This shows that the variables from (4'') are cointegrated, which means that they remain in a long-term causal relationship:

$$\begin{gathered}\underset{(t\text{-}stud)}{\mathring{GDP}} = \underset{(-2.86)}{-56.76} + \underset{(6.15)}{0.85}\cdot\mathring{L} + \underset{(1.88)}{0.33}\cdot\left(I/GDP\right)_{-1} + \underset{(2.60)}{1.00}\cdot GINIC_{-1} \\ JB = 0.03\ (0.98) \quad DW = 1.87 \quad LM_{\chi^2_2} = 4.70\ (0.10) \\ White = 12.37\ (0.054) \quad R^2 = 0.789 \quad \bar{R}^2 = 0.756 \quad S_e = 2.12\end{gathered} \tag{8}$$

When analyzing the cointegration of variables, we used the error-correction mechanism (ECM) approach and the two-phase method of Engle-Granger. The result of the first phase, the OLS estimation of relationships between variables, was presented in model (8). We treat the residuals of model 8:

$$e = \mathring{GDP} + 56.76 - 0.85\cdot\mathring{L} = -0.33\cdot(I/GDP)_{-1} - GINIC_{-1} \tag{8'}$$

as a deviation of the GDP growth rate from its long-run equilibrium path.

In the next step we identified the order of residuals integration (8'). The ADF, PP, and KPSS tests point explicitly to the stationarity of residuals. The variables in equation (8) interact in such a way that their linear combination continues to be stationary. Hence, it can be presumed that there is a long-run relationship between the rate of employment, the rate of investment, the GINIC variable of income inequality, and the GDP growth rate.

The stationary residuals of model (8) allow us to build the error correction model ECM[13] (sample 1985–2006):

$$\Delta(\overset{\circ}{\boldsymbol{GDP}}) = \underset{(-4.45)}{-1.30 \cdot \boldsymbol{e}_{-1}} + \underset{(5.74)}{1.10 \cdot \Delta \overset{\circ}{\boldsymbol{L}}}$$

$$\boldsymbol{JB} = 2.50\ (0.29) \quad \boldsymbol{LM}_{\chi^2_2} = 0.87\ (0.65) \quad \boldsymbol{White} = 7.9\ (0.09) \tag{9}$$

$$\boldsymbol{R}^2 = 0.649 \quad \overline{\boldsymbol{R}}^2 = 0.632 \quad \boldsymbol{S}_{\boldsymbol{e}} = 2.37$$

where $\boldsymbol{e}_{-1}$ = stationary residuals estimated in model (8).

Estimation results (9)[14] show that the system is characterized by the long-run stability of the relationships between variables. The negative sign for the estimation of the parameter of error correction element (−1.30; see Charemza and Deadman, 1993) differs significantly from 0 and –2 (at 2% significance level). Meanwhile, it differs insignificantly from –1. Thus, the return of GDP growth to equilibrium is very fast. The results of any disturbance that throws the GDP growth from its trajectory of long-run equilibrium will be eliminated in the current year. This means that the variable GDP growth rate (lagged by 1 year) in model (9), which is part of the error-correction element (on the right side of the equation) and a part of the GDP growth rate (on the left side of the equation), can be removed.

On the basis of models (8) and (9), we obtain the following model (OLS, sample 1984–2006):

$$\underset{(\boldsymbol{t}\text{-}\boldsymbol{stud})}{\overset{\circ}{\boldsymbol{GDP}} = -54.49} + \underset{(-2.77)}{0.81 \cdot \overset{\circ}{\boldsymbol{L}}_{-1}} + \underset{(5.72)}{1.02 \cdot \Delta \overset{\circ}{\boldsymbol{L}}} + \underset{(5.33)}{0.40 \cdot \left(\boldsymbol{I}/\boldsymbol{GDP}\right)_{-1}} + \underset{(2.18)}{0.93 \cdot \boldsymbol{GINIC}_{-1}}$$

$$\boldsymbol{JB} = 0.60\ (0.74) \quad \boldsymbol{DW} = 2.17 \quad \boldsymbol{LM}_{\chi^2_2} = 4.08\ (0.13) \tag{10}$$

$$\boldsymbol{White} = 12.9\ (0.11) \quad \boldsymbol{R}^2 = 0.807 \quad \overline{\boldsymbol{R}}^2 = 0.764 \quad \boldsymbol{S}_{\boldsymbol{e}} = 2.09$$

All variables exert a significant influence.[15]

Final remarks

The questions: *is inequality too high or too low?* and *does inequality slow down economic growth?* are socially and economically important. These questions cannot be answered very convincingly on the basis of our initial calculations. However, the presented research findings are statistically significant. So, it can be stated that it is

[13] Procedures of Engel-Granger for the stationary explained variable, the GDP growth rate, were carried out on the basis of Charemza and Deadman (1993) and the recommendations of Dr. Majsterek, Faculty of Economics and Sociology, University of Lodz.

[14] Estimations were made using many variants with different lags and GINI increments (which were insignificant).

[15] The residuals in model (10) were submitted to integration degree tests (ADF, PP, KPSS).

highly probable that the proposed method creates an opportunity for estimating the optimal inequality of income.

One question that arises concerns the concept of optimal inequality. In our opinion, optimal inequality arises on the basis of social awareness and justice. If the earning inequality between the best educated and most efficient employees and the least educated and least efficient employees reflects social justice, then it is easier to co-operate successfully, strengthen social bonds, improve trust, and develop social capital. Thus, optimal inequality describes a situation in which the best co-operation is achieved in the process of GDP formation.

We estimated the optimal GINI inequalities for Sweden (26.6%), Poland (28.8%), and the US (44.5%). The optimal inequality is different for each country because of the cultural and historical context. It can reflect a different sense of social justice and balancing between equitable income for the most effective and least effective individuals in the formation of GDP. In our opinion, the optimal values for different countries are so different that a commonly used simple panel model is not appropriate.

We have made the assumption that optimal income inequality is constant over time. Since optimal income inequality results from a sense of social justice, a change over time seems probable.[16] We therefore verify the hypothesis that optimal income inequality grows over time. However, we do not know how the growth of optimal inequality can be limited.

We have not dealt with the question regarding who should reduce inequality in incomes. The tax system clearly plays a role here. Research on household incomes carried out by Aksman (2005) indicates that the effect of the redistribution of incomes in Poland in the years 2000–2002 was the lowering of inequalities (measured by the GINI coefficient) by an average 14.2%.

Social discussion is also important. We propose the following for employees with the highest earnings: if they agree to reduce inequalities in pay or reduce their future earning aspirations, then additional economic growth will take place, in which they will also participate.[17] An additional argument is a lower crime rate resulting from lower income inequality, which has been confirmed by many studies (Barro 2003; Fajnzylber et al. 2002; Sztaudynger 2004). As the parabola is relatively flat at the top, the GINI coefficient is not close to its maximum, so further reduction will not result in significant acceleration of economic growth.

A new research question arises here. *Does a higher than optimal inequality reduce employment?* We expect that this is the case. If inequalities in earnings are too large, relationships between partners in the labor market are damaged, which is reflected in a reduction in employee motivation and less frequent recruitment of new employees.

---

[16] We have tried to introduce an increase in inequality to reflect a hypothesis that the larger the change in this inequality, the lower the social tolerance for the change. However, this variable was insignificant.

[17] This argument will certainly not be convincing for persons with high earnings.

A search for optimal income inequality is a search for economic effectiveness. An important question is whether inequality that maximizes economic growth should have priority over social justice. An answer to this question was sought by Kwarciński (2006, 18) who quotes Rowles (1971): "social and economic inequalities should assume their form ... which would benefit most those most handicapped". Kwarciński (2006) reaches a conclusion that it is admissible to subordinate justice to effectiveness provided that any additional benefits obtained in this way will improve the situation of the poorest people. We intend to deal with this issue in future studies.

The last question we wish to ask is whether a similar approach can be used in the search for an optimal inequality in per capita GDP at a regional level that would maximize the GDP growth rate for the whole country. A similar optimal inequality in per capita GDP can be sought for a group of countries, whereby the whole group maximizes its economic growth rate.

References

Aksman, E. 2005. Redystrybucyjny efekt zasiłków społecznych i podatku dochodowego (The Redistributive Effects of Social Care Programs and the Income Tax). *Ekonomista* 6: 769–783.

Barro, R.J. 1999. Inequality and Growth in a Panel of Countries, Harvard University, www.economics.harvard.edu/faculty/barro/papers/p_inequalitygrw.pdf.

Barro, R.J. 2003. Nothing is Sacred. Economic Ideas for the New Millenium (in Polish). Warszawa: CeDeWu.

Charemza, W. W., and D. F. Deadman. 1993. *New Directions in Econometric Practice. General to Specific Modelling, Cointegration and Vector Autoregression*. Cambridge: Edward Elgar Publishing Limited.

Chen, B.-L. 2003. An Inverted-U Relationship Between Inequality and Long-Run Growth. *Economics Letters* 78: 205–212.

Córdoba, J.C., and G. Verdier. 2007. Lucas vs. Lucas: On Inequality and Growth, IMF Working Paper, International Monetary Fund WP/07/17, January, http://www.imf.org/external/pubs/ft/wp/2007/wp0717.pdf.

Cornia, G. A., and J. Court, J. 2001. Inequality, Growth and Poverty in the Era of Liberalization and Globalization. The United Nations University WIDER, Helsinki, http://www.wider.unu.edu/publications/pb4.pdf.

Dollar, D. and A. Kraay. 2002. Growth is Good for Poor. *Journal of Economic Growth* 7: 195–225.

Fajnzylber, P., D. Lederman, and N. Loayza. 2002. What Causes Violent Crime? *European Economic Review* 7: 1323–1357.

Ferreira, F. H. G. 1999. Inequality and Economic Performance. A Brief Overview to Theories of Growth and Distribution, www.worldbank.org/poverty/inequal/econ/index.htm.

Gracia, E. 2002. Kryzys argentyński w świetle nauki społecznej Kościoła (The Argentinian Crisis in the Light of the Social Teaching of Catholic Church), *Społeczeństwo* 2: 189–201.

Kordos, J. 1973. *Metody analizy i prognozowania rozkładów płac i dochodów ludności* (The Analysis and Forecasting Methods of the Earnings and Population Income Distribution). Warszawa: PWE.

Kot, S. M. 2000. *Ekonometryczne modele dobrobytu* (The Econometric Model of Welfare). Warszawa, Kraków: WN PWN.

Kumor, P. 2006. Nierównomierność rozkładu płac (Inequalities of the Salaries Distribution). *Wiadomości Statystyczne* 9: 1–12.

Kumor, P., and J. J. Sztaudynger. 2007. *Optymalna nierówność płac w Polsce – analiza ekonometryczna* (The Optimum Enequality of Earnings in Poland – the Econometric Analysis). *Ekonomista* 1.

Kuznets, S. 1955. Economic Growth and Income Inequality. *American Economic Review* 45, I (1): 1–28.

Kwarciński, T. 2006. *Sprawiedliwość czy efektywność? Wnioski z ekonometrycznego modelu wzrostu gospodarczego z historycznie optymalnym zróżnicowaniem płac* (Justice or Effectiveness? Conclusions on the Econometric Model of the Economic Growth with the Historically Optimum Inequalities of Earnings). *A paper for the conference "The Economic Growth, the Labor Market and International Integration"*. Łódź: Instytut Ekonomii UŁ.

Milewski, R. ed. 2004. *Podstawy ekonomii* (Foundations of Economics). Warszawa: WN PWN.

Morrissey, O., J. Mbabazi, and C. Milner. 2002. *Inequality, Trade, Liberalization and Growth. 5th conference Centre for the Study of Globalization and Regionalization*. Nottingham.

Persson, T. and G. Tabellini. 1994. Is Inequality Harmful for Growth? *American Economic Review* 3: 600–621.

Rawls, J. 1971. *A Theory of Justice*. Cambridge, Mass., London: Harvard University Press.

Sirianni, C., and L. Friedland. 1995. Social Capital and Civic Innovation: Learning and Capacity Building from the 1960s to the 1990s. A paper for a conference of American Sociological Association Annual Meetings, August 20, Washington D.C., http://www.cpn.org/crm/contemporary/innovation. html.

Solow, R. M. 1967. *Capital Theory and the Rate of Return* (in Polish). Warszawa: PWN.

Sztaudynger, J. J. 2003a. Próba ekonometrycznego określenia wpływu kapitału społecznego na wzrost gospodarczy (Attemps of Econometric Determination of Social Capital Impact on Economic Growth). *Gospodarka Narodowa* 11-12: 1–18.

Sztaudynger, J. J. 2003b. *Modyfikacje funkcji produkcji i wydajności pracy z zastosowaniami* (The Modifications of the Productivity Function and Labor Productivity with Applications). Łódź: Wydawnictwo Uniwersytetu Łódzkiego.

Sztaudynger, J. J. 2005. *Wzrost gospodarczy a kapitał społeczny, prywatyzacja i inflacja* (The Economic Growth versus Social Capital, Privatisation and Inflation). Warszawa: WN PWN.

Sztaudynger, M. 2004. Ekonometryczna analiza przestępczości w ujęciu terytorialnym (The Econometric Analysis of Crime in a Territorial Breakdown). *Wiadomości Statystyczne* 12: 50–62.

Sztompka, P. 2002. *Socjologia. Analiza społeczeństwa* (Sociology and the Analysis of Society). Kraków: Wydawnictwo Znak.

Welfe, W. ed. 2001. *Ekonometryczny model wzrostu gospodarczego* (The Econometric Model of the Economic Growth). Łódź: Wydawnictwo Uniwersytetu Łódzkiego.