Economic growth and welfare state: a debate of econometrics

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Abstract

This study econometrically test the impacts on economic growth of public social expenditure and its four major components: income support, pension benefits, public health and other social services. I use a two-way fixed effect model for panel data of all OECD nations, which includes most of the determinants of growth in previous growth empirical studies for either cross section or panel data as control variables and check possible endogeneity of the variables of interest: welfare measures by Durbin-Wu-Hausman test. The empirical analysis shows a robust negative correlation between welfare spending rate, pension spending rate and GDP growth. The policy implication of this study is: Despite possible positive impact from some sub-components of government welfare expenditures on social services other than public health, overall the total government public social expenditure has a negative effect on economic growth. The source of this impact is pension spending rate, which has a self-reinforcing effect. The self-reinforced rising pension spending rate slows down economic growth (through inhibiting investment rate and productivity growth), which in the end will make the financing of welfare expenditure unsustainable. To prevent such a crisis, introducing more working-age immigrants, particularly skillful immigrants is a feasible way to deter population ageing, slowing down of economy and eruption of sovereign debt crisis in the long run.

Keywords: welfare state, economic growth, endogeneity, pension, population ageing

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The impact of welfare state on economic growth is a long-standing debate. To a great extent, this is a debate of econometrics as evidences provided by previous empirical literature are mixed and inconclusive. For decades, the economic impact of Europe's socialist (or "social democratic") welfare state has been fiercely debated among economists and politicians of left wing and right wing. If econometric studies on this impact could be based on randomized experimental data like clinical trials, such debate would never emerge. Unfortunately, facing only observational data, with very few opportunity of applying "natural experiments", the only option to get valid (consistent) estimation is to use instrumental variable (IV), at least for endogeneity test and fixed effect model for panel data to control for country-specific heterogeneity or country-common global trend. Many econometric issues may bias the estimation of the effects of welfare variables on growth. The following section on literature review will show such problems in some previous econometric studies on the relationship between economic growth and welfare state.

The structure of this paper is as follows. Section I of Basic theory following the introduction presents some theoretical models and hypothesis on the subject. Section II is literature review for previous empirical studies on this topic, the problems of econometric specifications of them are discussed. Section III presents description of welfare measures, and other contents of the data, including variable definition, data sources and time coverage of each variable; Part IV provides a preliminary analysis of the relationship between welfare variables and growth; Part V presents the model specification, endogeneity test for welfare variables and estimation results; Part VI is a set of robustness checks; Part VII discusses the mechanism through which welfare variables affect growth rate and the policy implication of the finding in this paper; Part IV is conclusion.

I BASIC THEORY BEHIND THE DEBATE

Generally, economic theories concerning the economic role of government has never reached consensus between economists. Because government welfare expenditure is financed by tax, the

economic impact of welfare spending is equivalent to the effect of taxation on economic growth. As Disney (2000) summarized, taxes on factors can affect the optimal level of the capital stock, although not its growth rate in equilibrium in the standard model (Blanchard and Fischer (1989)). However, in an endogenous growth model, the nature of public spending matters: expenditure on "productive" capital rather than transfers can have a positive long run impact on growth, while taxes will offset this, especially if they distort the relative returns on factors (Barro, 1990). Taxes on labor may also adversely affect the return on investing in human capital (Heckman, 1976) but the net return to human capital is itself affected by the tax structure (King and Rebelo, 1990). Taking into account that the role human capital plays in economic growth is widely accepted, welfare spending and tax collection matters for growth.

A classical theoretical model explaining the effect of taxation is Barro and Sala-i-Martin (2004, p147-148)'s extension of the Ramsey (1928) Growth model, which explicitly models consumer optimization. Using a phase diagram, they show that the imposition of taxes on the income from capital (taxes on asset income and firms' earnings) leads to reductions in steady state capital per unit of effective labor and steady state consumption per unit of effective labor in the long run. These effects arise because the taxes reduce the incentive to save. If a government raises tax rate on the income from capital, in the course of the transition to the new steady state, both investment and consumption will decrease, leading to lower economic growth. Similarly, they illustrate the effect of government purchases financed by a lump-sum thus non-distorting tax, which is a reduction in steady state consumption per effective labor but unchanged steady state capital per effective labor. In either case, government intervention adversely affects economic growth. This paper will econometrically test this hypothesis that welfare spending decreases investment.

There may be other channels through which welfare state affects growth. One hypothesis is welfare expenditure financed by tax imposed on firms increases business cost thus providing a disincentive to research and development (R&D) conducted by enterprises, which hinder productivity growth, the ultimate engine of economic growth. This paper will also econometrically test this hypothesis that welfare expenditure has negative effect on productivity growth.

The main goal of this paper is not a survey of theory, but finding the problems causing inconsistency of the findings in previous empirical studies on this topic and using a more rigorous econometric model and more recent and comprehensive data to confirm whether data supports a significant effect of welfare on growth. If it is confirmed, I want to identify which part of welfare expenditure is most relevant to affecting growth. I also want to derive policy implication of econometric estimation of economic impact of welfare state.

II PROBLEMS IN THE PREVIOUS EMPIRICAL STUDIES

There is a substantial literature on the relationship between welfare spending and economic growth in terms of either level or growth rate of GDP or per capita GDP. Atkinson (1995) summarized 9 such studies conducted in the 1990s, which showed mixed results. He questioned the validity of empirical evidences presented in these studies from three perspectives: possible reverse causality, lack of dynamic specification and poor measurement of the size of the welfare state. Atkinson's book (1995) argues that there is very little correlation between economic performance and welfare expenditure. Among all the studies mentioned by Atkinsons (1995)' paper and book, one prominent problem is too few control variables included in the regressions for growth, so omitted variable bias is apparent. For example, Weede (1991) applies cross-sectional and pooled regression analyses of growth rates on employment in agriculture as a percentage of civilian employment, age of democracy, and social security transfers as a percentage of GDP, no convergence term or other typical conditions for convergence.

On the other side of empirical findings, Tullio (1987) finds that "the tax-financed growth in government expenditure which has occurred in the last 20-25 years has caused unemployment and slowed down the rate of economic growth during the period." Grier and Tullock (1989) find that the growth of government consumption is significantly negatively correlated with the economic growth in three of four subsamples, including the OECD. Their results are based on pooled OLS regressions on five-year averaged data for 24 OECD countries from 1951 to 1980. This averaging over time is for netting out cyclical fluctuations, but it can destroy information contained in the sample, as the authors admit. As a consequence, their OECD sample has only 144 observations. This averaging approach not only substantially decreases statistical power but

also cannot "iron out" business cycles well as the starting year, ending year and interval of averaging is arbitrarily set. Arbitrary averaging across time cannot make sure the effects of booms and downturns of economy cancel out each other. In my view, the correct way of addressing business cycle shock is including fixed effects of years in model so that global booms or downturns can be explicitly incorporated while using investment rate to capture country-specific cyclic fluctuations. The goal of empirical growth study should be investigating the effect of variable of interest on growth after controlling for these global and country-specific cyclic shocks. Averaging across time for the intervals of five years or ten years is not appropriate way to control for these two cyclic shocks. Another problem of their study is also related to the small sample size resulting from the averaging. In addition to growth of government consumption share of GDP, only four control variables are included: inflation (level and change), population growth and convergence term. The most important determinant of growth, investment/saving rate is missing. Other widely accepted growth determinants, such as human capital and international trade openness are also missing. So we have reason to believe the results of their estimation may suffer from omitted variable bias.

Barro and Sala-i-Martin(2004)'s cross section regressions of the growth rates of per capita GDP find that the estimated coefficient of the government consumption ratio (subtracting the estimated ratio to real GDP of real spending on defense and noncapital real expenditures on education) is negative and significant: −0.062 (0.023). The main weakness of Barro and Sala-i-Martin(2004)'s econometric processing, however, is that they take account of the likely endogeneity of the explanatory variables by using lagged values as instruments. The effect of government consumption, for example, may last for a period of time so that it is likely that previous government consumption affects current economic growth rate. Because the strict exogeneity of their IVs is questionable, the consistency of estimates may also be questionable.

Lindert (2003) even directly claimed that welfare state is a free lunch and argued that there is no clear net GDP cost of high tax-based social spending on GDP. He claimed that although it might seem obvious that social spending has a negative impact on growth and productivity, data refuses to confess that things work out that way. However, some econometric problems in his empirical findings cast doubt on validity of his econometric estimation results. For example, he used two-stage-least-square (2SLS) estimation to test the economic effect of heavy taxation and

redistribution of welfare states on growth of GDP per capita, in which the instrumental variables (IVs) he used for social spending and tax rates are age distribution, voter turnout rates, average income, religion, ethnic fractionalization, and openness to trade (table 1). It seems that we can have sufficient reasons to suspect exgoeneity of these IVs for at least some of them are almost certain to be correlated to unobservable or omitted potential determinants of per capita income growth. For example, a country with higher proportion of youth, and higher openness to international trade tends to have higher growth (see Barro and Sala-i-Martin (2004, p530) for the latter effect). Also, the effect of religion on economy is widely accepted (see for example, Barro, McCleary (2003)). Average income, of course receives feedback effect from GDP growth rate. Endogenous explanatory variable(s) may lead to bias, but if instrument variable is not truly exogenous, the IV estimate's bias is even larger than OLS estimate. In addition, he actually run two-stage least square regressions manually by replacing the values of potentially endogenous variables with the predicted values obtained from the first stage regressions on all exogenous variables. Standard econometrics tells us that this manual implementation of two-stage least square can get correct parameter estimate but incorrect standard error thus all statistical tests based on second stage t statistics may not be valid.

Beraldo et. al. (2009)'s empirical analysis based on 19 OECD countries observed between 1971 and 1998 finds that public welfare expenditure on health positively affects growth. The problem of their estimation method still is too few of growth determinants were included as control variables in addition to welfare variables. For most of their estimation results (table 1-4), only capital stock and labor were used as control variables. This kind of growth accounting method subsume all the important determinants of growth in theory (particularly convergence term and investment/saving rate) to residual of regression and inevitably brings about severe omitted variable bias, not to mention the bias from measurements-in-error arising from imprecise estimate of capital stock. They did notice the possibility of endogeneity and used IV estimation in their robustness checks part. They used lagged values (t-1 up to t-3) of the welfare expenditure variables as instruments. They also included Gini index as additional IV and checked for overidentification by using Sargan test. It is known that Sargan test for IV validity can only be used for over-identified IV based on the assumption that just-identified IV(s) is truly exogenous. Using lagged values of possibly endogenous variables as instruments is never an appropriate way

to ensure strictly exogeneity of the instruments for panel data. As Angrist & Krueger (2001) pointed out, "One of the most mechanical and naive, yet common, approaches to the choice of instruments uses atheoretical and hard-to-assess assumptions about dynamic relationships to construct instruments from lagged variables in time series or panel data. The use of lagged endogenous variables…is problematic if the equation error or omitted variables are serially correlated". As the following section VI demonstrates, growth regression always has residual error serially correlated. So Beraldo et.al. (2009)'s approach of using one to three period lagged values of endogenous variable (health spending expenditure) as instrument variables makes the exogeneity of these IVs very questionable. The strict exogeneity of Gini index is also doubtful. Growth and Gini index are highly likely to be related to each other as there might be a trade-off between economic efficiency and income re-distribution. Because of this, their conclusion that health expenditure positively affects growth may not be valid. Actually my study using one different IV for endogeneity test finds that public welfare expenditure on health has no significant effect on growth after adjusting for serial correlation.

To sum up, previous growth literature of empirical studies have the following problems: 1) too few control variables in addition to variable of interest: either no convergence term or with convergence term but too few conditions for conditional convergence, which leads to likely omitted variable bias; 2) no endogeneity test for possible omitted variable bias or bias from reverse causality; 3) using inappropriate instrument variable to correct for endogeneity bias; 4) inappropriate processing of panel data by using averaging across time.

This paper aims to specifically address these problems by using two-way fixed effect estimation for panel data of all OECD nations using the latest data from several official sources (see table 1), with instrument variable used for endogeneity test and a set of robustness checks subject to the model.

III THE WELFARE AND THE DATA

The "welfare" in the concept of welfare state used in this paper refers to public social spending, which measures the amount of resources committed by the government in the areas of pensions,

benefits (social support) and health. A traditional argument for much social spending is to prevent disadvantage and thus enhance equity.

This study is based on a panel model of all 34 OECD member states: The OECD Social Expenditure Database. Social expenditure is classified as public when general government (i.e. central administration, local governments and social security institutions) controls the financial flows. For example, sickness benefits financed by compulsory contributions from employers and employees to social insurance funds are considered "public", whereas sickness benefits paid directly by employers to their employees are classified as "private".

According to this data, public social expenditure averaged 19% of GDP across 34 OECD countries in 2007. Country differences in spending levels were wide. Mexico and Korea spent between 6 and 10% of GDP. France and Sweden spent about 20 percentage points more. Public spending is a feature of the continental European countries. Between 1982 and 2007, this ratio has risen by 2.5 percentage points on average across OECD countries.

According to OECD (2011), countries with a more equal income distribution, as measured by the Gini coefficient, tended to have higher social spending, however, bigger rises in social spending experienced over the last generation in some countries do not appear to have contributed to reductions in income inequality.

As for the composition of welfare expenditure, the largest category of public social spending concerns old-age and survivor pensions: on average across the OECD, amounting to almost 7% of GDP. On average across the OECD, income transfers to the working-age population amounted to almost 5% of GDP, and within the latter category, public spending targeted to families with children and to persons on unemployment benefits each represented nearly 1.3% of GDP. On average public expenditure on health services amounted to 6% of GDP in 2003 while spending on other social services was about 2% of GDP.

The variables used in the paper, data source and time coverage of each variable are presented in table 1. Four variables are used to represent welfare state: public social welfare expenditure as percentage of GDP (public_social) and four components of it: 1) income support to households which do not have sufficient other resources to support themselves (income_support), 2) pension expenditure to the old-age and survivor (pension_exp), 3) public expenditure on health services (health_exp) and 4) spending on other social services (otherwelf). The first two items are cash

benefits while the last two items are government expenditure on public social services. All the welfare measures are in percentage of GDP.

Welfare expenditure rate is a better measure for welfare state than government consumption as percentage of GDP because government purchases of goods and services for citizens financed by tax may have externality benefits (for example, through education and R&D) while welfare spending is more relevant to transfer payment part of government spending which is more likely to affect individual's incentive to work or individual firm's incentive to make investment so that welfare spending rate is a better measure for non-productive effect of government intervention in economy, which is the interest of this paper.

The main data source of welfare expenditure and its components, OECD Social Expenditure database covers the years 1980 – 2007. Over this period, public social expenditure as a percentage of GDP, on average across OECD, increased from 15.6% to 19.2%. Public pension spending (6.4% of GDP) and public health expenditure (5.8% of GDP) are the largest social spending items (Adema et. al. (2001)). The data of welfare variables between 2008 and 2012 are projected thus removed from analysis.

Table 1 The variable definitions, data sources and time coverage of data

variable	Definition	Data source	Time coverage
dtot2	Change in terms of trade	WDI2010	1981 - 2010
gdppcg	GDP per capita growth rate(annual %)	WDI2010	1961 - 2005
health_exp	Public social expenditures on Health as % GDP	SOCX	1980 - 2007
hours	Average hours actually worked: Hours per year per person in employment	OECD Factbook 2010	1980 - 2012
income_support	Public social expenditures on income support to the working-age population as % GDP	SOCX	1955 - 2007
inflation	Inflation rate: Consumer price indices (CPI): annual growth in percentage	OECD Factbook 2010	1959 - 2008
invrate	Investment rate: the share of total GDP that is devoted to investment in fixed assets	OECD Factbook 2010	1976 - 2006
loglypc	Log of one-period lag of per capita GDP, measured in Purchasing Power Parity(PPP) constant 2000 international $	WDI2010	1982 - 2009
lres	One-period lag of the number of researchers per thousand employed, full-time equivalent	OECD Factbook 2010	1980 - 2012
pension_exp	Public social expenditures on pension as % GDP	SOCX	1980 - 2007
popg	Population growth rate	OECD Factbook 2010	1951 - 2010
public_social	Public Social Expenditure as percentage of GDP	SOCX	1980 - 2007
road	Road fatalities Per million inhabitants	OECD Factbook 2010	1990 - 2008
otherwelf	Welfare spending on other social services as percentage of GDP	SOCX	1955 - 2007
road_paved	The paved road as percentage of total roads	WDI2010	
trade_open	International trade openness	WDI2010	1960 - 2008
migrate	Net migration rate: The difference between immigration into and emigration from the area during the year per 1 000 inhabitants	OECD Factbook 2010	1955 - 2008
mf_prodg	Multi-factor Productivity growth	OECD StatExtract	1985 - 2010

Note: WDI2010: World Development Indicator 2010 Edition, World Bank. SOCX: The OECD Social Expenditure Database

IV PRELIMINARY INFORMAL ANALYSIS

Is there any correlation between annual growth rate and annual welfare variables? As a preliminary check of the relationship between the two, the correlation coefficients between each welfare variable and GDP per capita growth rate and the p values are shown below:

Table 2 Correlation coefficients between welfare variables and GDP per capita growth rate

	Public_social	Income_supprt	Pension_exp	Health_exp	otherwelf
gdppcg	-0.1164***	-0.0854**	-0.0604	-0.1517***	-0.0839**
p value	0.0017	0.0199	0.1042	0	0.0267

*** significant at 1% level, ** significant at 5% level, * significant at 1% level.

It appears that except pension spending, all other welfare measures have significant negative correlation with the growth rate. If an OLS regression of growth against only one explanatory variable, total welfare spending rate is run for the pooled data of all OECD nations between year 1980 and 2005, a strongly significant estimate, -0.046, is obtained for the parameter of welfare spending rate with a p value 0.0017. However, the validity of this estimate is suspicious. This naive regression does not address potential omitted variable bias properly so the magnitude or even direction of the estimated coefficient may be biased. Actually the result in the next section of formal analysis indicates that pooled OLS regression with no other control variables gives a much lower estimate than true value (-0.046 vs. -0.185). The similar pattern can be found for other welfare variables, indicating the necessity to perform formal analysis.

Since our data on growth rate covers from year 1961 to 2005, the analysis of this paper is not affected by financial crisis occurred in 2008.

V THE MAIN MODEL AND RESULTS

The specification of the model used in this paper is:

$$y_{it} = \theta_t + x_{it}\gamma + w_{it}\delta + c_i + u_{it} \qquad t=1,2,\ldots,T \qquad (1)$$

where x_{it} is 1 x 7 vector and contains 7 observable explanatory variables which are assumed to be strictly exogenous, including one state variable representing convergence term[2]: lagged value of log of per capita GDP (loglypc). The rest of the explanatory variables in x_{it} are the conditions for conditional convergence of income, which include one state variable representing human capital: lagged value of the number of researchers per thousand employed workers, five environmental and control variables: population growth rate (popg), inflation rate(inflation), international trade openness(trade_open), terms of trade shock (dtot2) and investment rate(invrate). w_{it} is key variable(s) of interest, one or more welfare measure (public_social, pension_exp, health_exp, income_support and otherwelf), which may be endogenous. c_i is unobservable country fixed effect (FE) or country heterogeneity, which may include some institutional variables with high time constancy, such as measures of rule of law. θ_t is a fixed effect term for aggregate time, which captures global trend of some growth determinants that are common to all OECD countries, such as worldwide technology progress or global economic downturns or booms. u_{it} are idiosyncratic errors, which also absorb some omitted variables, such as financial development level or the quality of government financial regulation. This is a two-way fixed effect model for unbalanced panel data. The reason to choose fixed effect (FE) model rather than random effect (RE) model is for controlling unobservable time-invariant country heterogeneity and global time trend of technology despite the fact that RE estimator may have higher efficiency than FE estimator when unobservables are not correlated with included explanatory variables. The choice of seven control variables closely follows most of other empirical studies on growth, particularly, Barro and Sala-i-Martin (2004).

The implementation of this two-way FE model is the classical approach of Least Squares Dummy Variable Regression (LSDV): adding two sets of dummy variables for country and year, respectively to the OLS regression of (1).

V.I Test Endogeneity of Welfare Variables

[2] The technical rationalization of using lagged values as convergence terms for growth for panel data is in Appendix.

It is likely that changes in economic growth induce changes in welfare spending. Higher GDP growth, which is translated to higher tax income for government may increase welfare expenditure due to more resources for re-allocation. Beraldo et. al. (2009) point out that a well documented stylized fact is that (total) expenditure in health rises with per capita GDP. On the other hand, opposite effect may arise through another channel: higher growth indicates good economy, more job opportunity and higher income for working people, so it may be a disincentive for dependence on welfare benefits, particularly unemployment benefits. In short, there may exist reverse causality or feedback effect from growth rate to welfare expenditure, which violates strict exogeneity assumption for the latter. If this assumption fails, the consistency of FE estimate on welfare variable is questionable. Omitted variables, whose data is unavailable or unobservable to us, may also be the source of endogeneity, as discussed before.

I apply classical Durbin–Wu–Hausman (DWH) test to check whether welfare spending is endogenous in our growth regression thus whether IV estimation is necessary. Davidson and MacKinnon (1993) suggest an augmented regression test, which can easily be formed by including the residuals of each endogenous right-hand side variable, as a function of all exogenous variables and instrument variable(s), in a regression of the original model. The key requirement for this approach is that we can correctly identify all other strictly exogenous variables except suspicious endogenous variable(s) and we can find a valid IV. We assume that all explanatory variables in x_{it} of (1) are strictly exogenous and we suspect that welfare measure in w_{it} may be endogenous. The IV has to be strongly correlated to w_{it} but has no direct impact on y (is uncorrelated with the unobservable error u_{it}).

The choice of IV is the trickiest part of DWH test or IV regression. Beraldo et. al. used lagged values (up to three period) of possibly endogenous variables (health spending variables). These IVs are of course strongly correlated with endogenous variables but the exogeneity of them is highly suspicious, as explained in section II.

The instrument variable (IV) chosen for welfare variables is road fatalities per million inhabitants (road) whose data comes from OECD Factbook 2010. Road fatality means any person killed immediately or dying within 30 days as a result of a road injury accident. Suicides involving the use of a road motor vehicle are excluded. The justification of the validity of this IV is elaborated as follows.

Death rate from road accidents presumably cannot affect growth rate and seems to have nothing to do with the omitted variables that affect growth rate, such as country-specific technology progress or quality of financial regulation. However, this rate may be related to welfare spending rate in this way: in welfare states with higher welfare expenditure by government and more generous welfare benefit programs, people tend to have more leisure time and slower life pace. To prove this, a simple fixed effect model of hours on each welfare variable is run where hours, as defined before, is average hours actually worked per year per person in employment. The first four rows of table 3 clearly show that average annual hours actually worked per worker in OECD nations have strong negative association with total welfare spending rate and its four components. The estimate of public_social indicates that on average, in an OECD country, one percentage point increase in welfare spending rate leads to a reduction of working hours by about five hours in one year. Similarly, one percentage point increase in pension spending rate leads to a decrease in average annual working hour of nearly ten hours (9.8). This decrease is translated into a decrease in lifetime working time for all average workers, which essentially leads to a trend of rising proportion of retirees in the population as retirement age (or social security eligibility age) is fixed while average lifetime working time is decreasing for everyone. The effect of welfare expenditure on average lifetime working time has profound policy implication for welfare state, as discussed later.

Interestingly, Welfare spending on other social services as percentage of GDP (otherwelf) has significant positive effect on working hours. This may imply that although three biggest parts of welfare expenditure and total welfare spending provide disincentive to working, welfare spending on other public social services provide incentive to working.

Different patterns of time allocation between working and leisure lead to different life paces. The life pace is presumably closely related to the probability of traffic accidents. As the second step of the test on my hypothesis of the relationship between road fatality rate and welfare level, a simple fixed effect model of road fatality rate on hours is run, the estimate shown in table 2 is 0.0576, meaning that on average, one more extra working hour increases the road fatality rate (per million people) by about 0.06. Consequently, when a simple FE regression of road fatality on total welfare spending rate is run, welfare has a strongly significant estimate -2.01, implying that one percentage point increase in welfare spending relative to GDP is translated into a drop of

road fatality rate by 2.01 percentage point (per million inhabitants). As the table 2 shows, similar relationships can be found for other welfare variables (income_support, pension_exp, health_exp) but not for otherwelf.

Table 3 The relationships between working hours, road fatality and welfare variables

Dependent variable	Independent variable	coefficient	SE	P value for SE	R-square	obs
hours	Public_social	-4.4143	1.1136	0.0000	0.96	698
	Income_support	-4.0495	1.8387	0.028	0.95	710
	Pension_exp	-9.7614	2.3246	0.000	0.96	693
	Health_exp	-22.8939	3.6359	0.000	0.95	706
	otherwelf	13.1506	4.0490	0.0012	0.96	673
road	hours	0.0576	0.0176	0.001	0.88	574
	Public_social	-2.0141	0.4415	0.0000	0.89	564
	Income_support	-2.6313	0.8069	0.001	0.88	575
	Pension_exp	-2.8680	0.9061	0.002	0.88	564
	Health_exp	-5.3748	1.5245	0.000	0.88	572
	otherwelf	-0.3952	1.8835	0.834	0.88	546

Note: SE=Standard Error. Obs=observation number. All the regressions include both time and country fixed effects.

Table 4 Results of IV relevance and strength test and DWH test

Dependent variable	F value of IV test	P value of IV strength test	P value of DWH test
public_social	10.53	0.0013	0.6199
income_support	5.24	0.0228	0.6576
pension_exp	6.86	0.0093	0.8089
health_exp	20.98	<.0001	0.8945
otherwelf	1.52	0.218	0.6998

Note: All the regressions for IV strength test include independent variables of IV road, loglypc, lres, popg, invrate, inflation, trade_open, dtot2 and dummy variables for years and countries. All the regressions for DWH test include dependent variable of gdppcg and independent variables of loglypc, lres, popg, invrate, inflation, trade_open, dtot2, dummy variables for years and countries as independent variables and residual from the IV strength test. DWH=Durbin–Wu–Hausman

The overall IV relevance test is performed by running a FE model of a welfare variable on the IV, five exogenous environmental and control variables and two pre-determeined state variables, i.e., all variables in x_{it} of (1). The table 3 indicates that the IV is a strong IV only for public_social and health_exp according to Sotck and Yogo (2005)'s thumb rule of F value exceeding 10 for one endogenous variable. It is a weak IV for other welfare variables, except otherwelf, which is not significant, implying that road is not relevant to other welfare spending. Although road is a weak IV for income_support and pension_exp, it can still be used in Durbin-Wu-Hausman endogeneity test for these two variables for two reasons. Firstly, the IV strength test for these two variables are all significant at 5% level, actually one at 1% (pension_exp) and one at 3% level(income_support). Secondarily, because we have only one endogenous variable, the IV road is just-identified. Just-identified IV is approximately median-unbiased even when it is weak.

The Durbin–Wu–Hausman test can be performed as follows: we first regress a welfare measure on all the explanatory variables in x_{it} of (1) (loglypc, lres, trade_open, popg, inflation, dtot2 and invrate), an instrument variable for welfare (road), dummy variables for each country and

dummy variables for each year and obtain the residual, $\hat{v}_2$. Then we simply include $\hat{v}_2$ along with unity, all the variables in x_{it} and w_{it} of (1) and dummy variables for nations and years in an OLS regression of gdppcg and obtain the t statistic on $\hat{v}_2$. The p values for the estimated parameters of $\hat{v}_2$ for all welfare measures are presented on the last column of table 3. We cannot find evidence of endogeneity for any welfare variable at 10 percent significance level against a two-sided alternative, so 2SLS estimation is not necessary for ensuring consistency of the estimate of welfare variable (assuming that we trust the instrument). A LSDV approach will be adopted for estimation the growth effects of the welfare variables.

V.II The LSDV Estimation Results

Table 5 The LSDV Estimation results for welfare variables

predictor	variant1	variant2	variant3	variant4	variant5
Income_support	-0.013 (0.0955)				
Pension_exp		**-0.603 (0.218)*** **			
Health_exp			-0.4977 (0.3238)		
otherwelf				-0.2343 (0.221)	
Public_social					**-0.1853 (0.0794)** **
dtot2	2.9008 (1.8965)	1.1087 (1.9801)	2.8382 (2.2435)	1.7065 (1.7123)	2.2034 (2.3365)
inflation	-0.1116 (0.0216)***	-0.1517 (0.0377)***	-0.114 (0.0196)***	-0.2241 (0.0406)***	-0.1184 (0.0242)***
invrate	0.3302 (0.1079)***	0.2878 (0.1042)***	0.3967 (0.1293)***	0.2939 (0.0805)***	0.3611 (0.1377)**
loglypc	-7.3329 (3.0927)**	-8.7525 (2.4189)***	-7.7058 (3.378)**	-7.2789 (2.6071)***	-8.834 (3.3212)**
lres	0.3054 (0.0904)***	0.1936 (0.0714)**	0.2386 (0.0852)***	0.2837 (0.1036)**	0.2518 (0.0906)***
popg	-1.0853 (0.4308)**	-0.8489 (0.4367)*	-1.1493 (0.4583)**	-1.0707 (0.4309)**	-1.0058 (0.4448)**
trade_open	0.1951 (0.0418)***	0.1633 (0.0353)***	0.1681 (0.0398)***	0.2067 (0.0426)***	0.1653 (0.0403)***
Intercept	67.9173 (30.5119)**	88.9508 (23.3852)***	74.9386 (33.1601)**	68.4603 (26.1319)**	87.0262 (32.2678)**
Adjusted R	0.49	0.51	0.48	0.54	0.48
Nobs	409	402	407	392	407

*** significant at 1% level, ** significant at 5% level, * significant at 1% level. All the regressions have dependent variable of unemp and include dummy variables of countries and years as independent variables. Within parenthesis are standard error robust to arbitrary form of heteroskedasticity or serial correlation (Wooldrige (2001, p275)). Adjusted R=adjusted R square. LSDV=Least Square Dummy Variable model

We can see that public_socail and pension_exp are significant at 5% and 1% level, respectively, which indicates that overall welfare state, in terms of total welfare expenditure relative to GDP, has negative impact on economic growth and the very part of welfare expenditure that is most relevant to detrimental impact on growth is pension expenditure.

All the control variables are strongly significant (at either 1% or 5% level), except dtot2 (terms of trade shock), and have expected sign. The convergence term (loglypc) has a negative

coefficient and that for human capital (lres) has a positive coefficient. International openness and investment rate have positive effect on growth while inflation rate and population growth rate have negative impacts. This finding is consistent across all six welfare measures.

VI ROBUSTNESS CHECKS

VI.I Unit Root Test for Panel Data

Because my data is a panel data set, I perform unit root test for panel data to avoid spurious regression. There are a variety of tests for unit roots (or stationarity) in panel datasets, this paper uses Fisher-type (Choi (2001)) test because it can be applied to unbalanced panel data. This test combines the p-values from N independent unit root tests, as developed by Maddala and Wu (1999). Based on the p-values of individual unit root tests, Fisher's test assumes that all the panels contain a unit root thus are non-stationary under the null hypothesis against the alternative that at least one panel is stationary. The p values[3] associated with the Inverse chi-squared p statistics for the tests of unit root for all the variables used in this paper indicate stationarity of all of them. The detailed results are available upon request.

VI.II Test Slope Poolability of Model (1)

The main advantage of pooled cross-country time-series data for the analysis of growth equations is that the country-specific effects can be controlled for by using a fixed-effect estimator. However, this estimator generally imposes homogeneity of all slope coefficients, allowing only the intercepts to vary across countries.

In order to test the slope homogeneity across panel units for model (1), I change the specification of model (1) to (1'):

$$y_{it} = \theta_t + x_{it}\gamma_i + w_{it}\delta_i + c_i + u_{it} \qquad (1')$$

[3] All tests are ADF unit-root tests on each panel and include a nonzero drift, by using STATA command: xtunitroot fisher varname, dfuller lags(2) drift.

which is estimated by adding a set of interaction terms to (1) , each of which is the interaction of each of 8 explanatory variable with dummy variables for 34 OECD countries. The equality of each slope in model (1'), γ_i and δ_i can be tested by an F statistic that all the coefficients estimated for each level of each interaction term are jointly zero. The F statistics and associated p values for the interaction terms for 13 explanatory variables (including 5 welfare variables) indicate that no interaction term is significant at 5% level so the null hypothesis of homogenous slope and heterogenous intercepts in model (1) cannot be rejected, verifying the validity of our model specification. The detailed results are available upon request.

VI.III Test Persistence of Growth: Dynamic Specification

It is likely that output growth has persistence so we may need to allow for a vector of lagged values of the dependent variable (gdppcg) as an explanatory variable so that growth persistence can be estimated. For a dynamic FE model:

$$y_{it} = z_{it}\gamma + \rho_1 y_{i,t-1} + c_i + u_{it} \qquad (2)$$

To test persistence (state dependence), first-differencing equation (3) gives:

$$\Delta y_{it} = \Delta z_{it}\gamma + \rho_1 \Delta y_{i,t-1} + \Delta u_{it} \qquad (3)$$

Following Wooldrige (2001, pp. 299), to test for state dependence in per capita GDP growth rates, after allowing for unobserved country effects, the model is applying IV regression to equation (6) with y_{it}=gdppcg but without any other explanatory variables Δz_{it}, where $y_{i,t-2}, y_{i,t-3}$ are used to instrument $\Delta y_{i,t-1}$. Further, so that we do not have to worry about correcting the standard error for possible serial correlation in Δu_{it}, I use just the differenced equations for each consecutive pairs of years from 1964 to 2005 for all countries separately.

The F statistic for joint significance of $y_{i,t-2}, y_{i,t-3}$ in the first stage regression for $\Delta y_{i,t-1}$ yields p-value of 0 and the R-squared from this IV relevance test regression is 0.75, indicating they are strong instruments. The 2SLS estimation of the first-differenced equation (6) without Δz_{it} gives

an estimate of the coefficient of $\Delta y_{i,t-1}$ for each consecutive pairs of years from 1964 to 2005 respectively, whose significance can be used to test the null hypothesis of no state dependence. Among 42 IV regressions, only year 1982, 1984 and 2002 have significant lagged difference of per capita GDP growth at 5% significance level, indicating that overall, there is no state dependence for gdpcg, we do not need to put the lag of it as regressor and there is no need to extend the econometric model to dynamic specification for our data.

VI.IV Informal Test of Exogeneity of the IV

Standard econometrics tells us that there is no formal way of testing strict exogeneity of instrument variable used in 2SLS regression or Durbin-Wu_Hausman endogeneity test(over-identification test is based on true exogeneity of at least one IV). However, in our case, we can informally test some of the possible channels through which the IV, road may be correlated with u_{it} in (1).

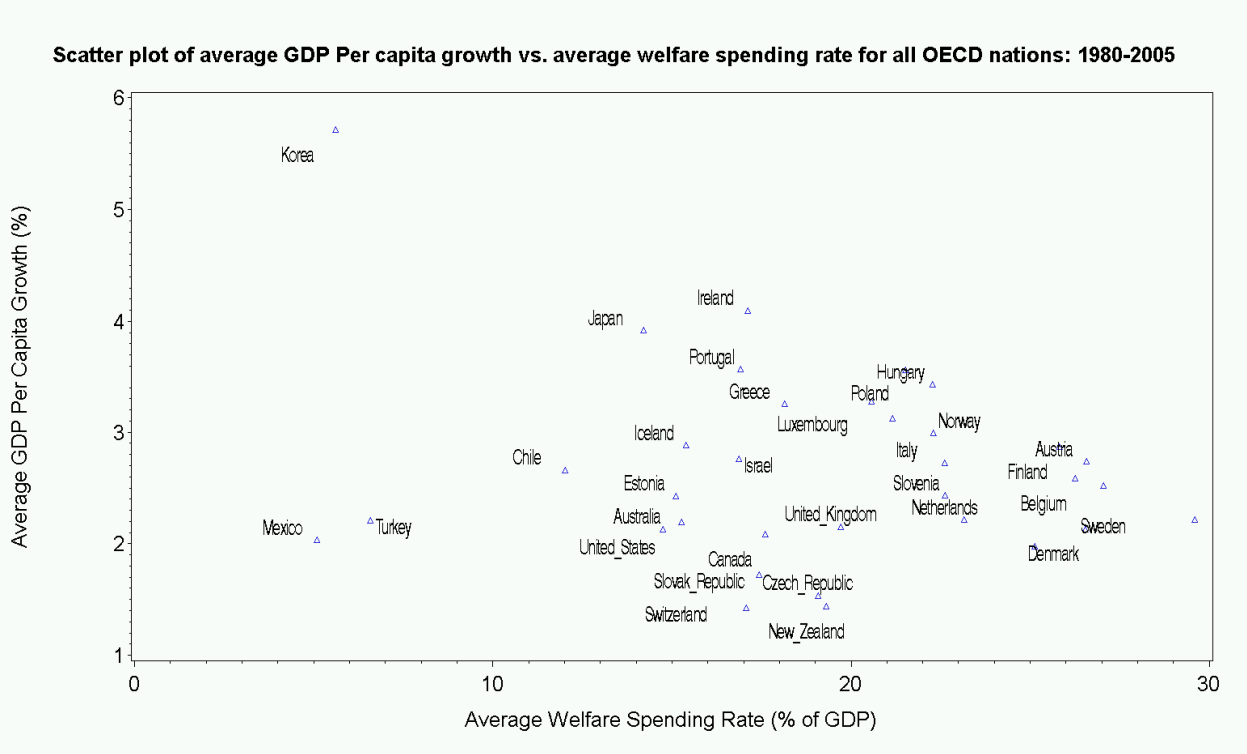
One possible opposition to the strict exogeneity of the IV road is that road fatality rate may be related to road condition or quality that is the result of infrastructure investment expenditure, which in turn may affect economic growth. In other words, IV is related to an omitted variable, road quality, which is correlated with infrastructure investment and is subsumed in u_{it} of (1).

To prove if road quality can directly affect growth, I use one proxy variable for road quality: the paved road as percentage of total roads in a country, the data of which comes from World Development Indicator (WDI) 2010 of World Bank. I add this variable, road_paved to model (1). The p value for the coefficient of this variable is 0.533 for robust standard error. The correlation between road and road_paved is easily verified by running a fixed effect model of road on road_paved (with time and country fixed effects), the parameter and the associated p value for the coefficient of road_paved are -0.746 and 0.01, respectively, indicating that road_paved has higher correlation with road. These results clearly rule out the possibility that road quality of a nation can directly affect economic growth rate thus supporting the strict exogenetity of the IV road and the validity of ensuing DWH test.

VI.V checking robustness to business cycles

One possible criticism of the finding in table 4 may be the model is based on annual panel data thus incorporating business cycles rather than long term growth, so the significant effects for public_social and pension_exp on growth (gdppcg) may not represent a true fundamental long-term causal relationship but a co-movements between these welfare variables and growth rate due to the shocks of business cycles (despite the inclusion of time fixed effect) impacting both of them. As discussed in section II, previous literature use five-year averaged data in fixed effect model estimation to netting out cyclical fluctuations. This approach , however, cannot "iron out" business cycles well as the starting year, ending year and interval of averaging is arbitrarily set. To check if the observed growth effect of welfare variables, these three variables (public_social, pension_exp and gdppcg) are averaged across time for each country and a scatter plot is presented as figure 1 below.

Figure 1



We can see that except developing countries Mexico and Turkey, all other nations show an apparent negative correlation between growth and welfare spending. After "ironing" out the

short-term fluctuations of business cycles, the negative correlation between growth and welfare becomes much clearer, compared with figure 1. A similar relationship can be found and illustrated between growth and pension-to-GDP ratio. These scatter plots of course do not control for other determinants of growth, particularly convergence term, so the evidence from them is less valid and reliable than the model estimation before. However, they clearly demonstrate that the claims by many economists (Atkinson (1995), Lindert(2003)) that there is very little correlation between economic performance and welfare expenditure may not be consistent with real data.

VII DISCUSSION ON THE MECHANISM AND POLICY IMPLICATION

The discussion in section I reveals one mechanism through which welfare spending impacts on growth: decreasing investment because tax on the income from capital reduces the incentive to save for businesses. In addition, as mentioned there, a hypothesis that welfare expenditure has negative effect on productivity growth due to its disincentive effect on R&D is also proposed. The first four rows of table 6 test and validate these two hypotheses. The FE estimates for investment rate give strong evidence to support the first hypothesis: one percentage increase in pension spending rate is associated with about 0.6 percentage increase in investment rate. The fact that this estimate is higher than that of total welfare spending rate (public_social) implies that some other components of public social expenditure may have positive effects on investment that counteract the impact of pension to some extent. Pension spending rate is found to have strong negative effect on multi factor productivity growth while total welfare spending rate is not, probably due to the same reason: some components of total welfare have positive impacts on productivity, which offset that from pension spending rate.

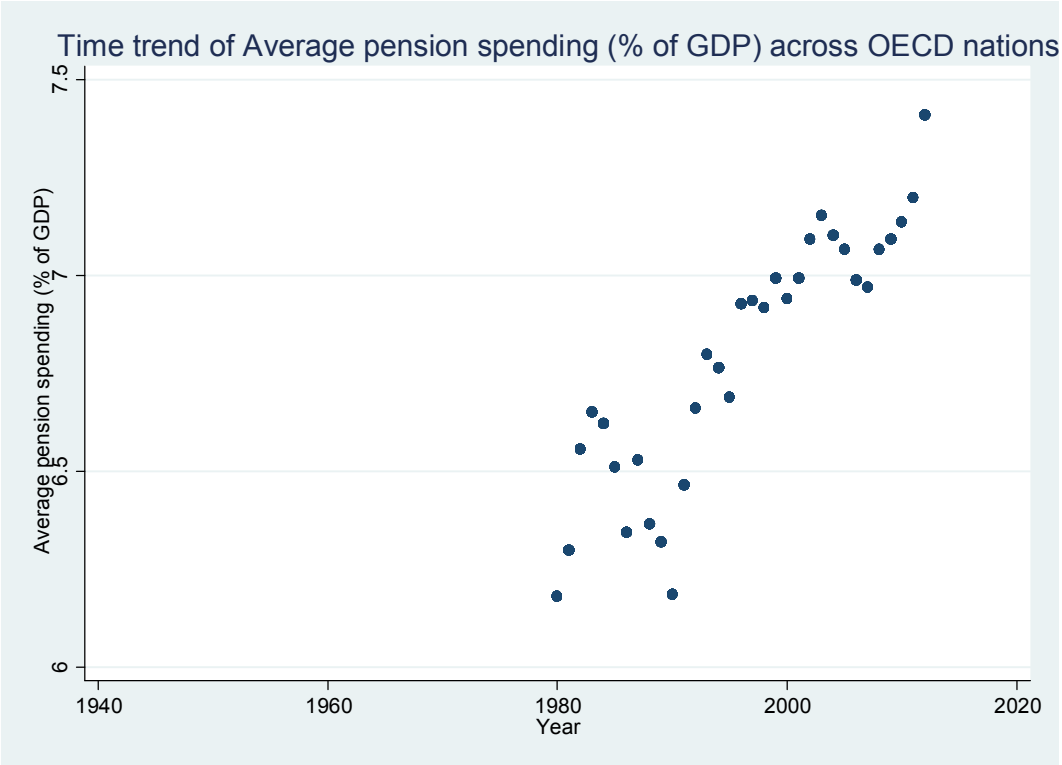
Table 6 FE models on welfare variables and net migration rate

Dependent variable	Independent variable	nobs	r_square	result
invrate	pension_exp	821	0.6564	-0.58 (6.3782)***
invrate	public_social	826	0.2909	-0.354 (7.77)***
mf_prodg	pension_exp	451	0.3797	-0.25 (2.9112)***
mf_prodg	public_social	451	0.3684	-0.038(1.03)
pension_exp	migrate	709	0.9004	-0.05 (4.4258)***

*** significant at 1% level, ** significant at 5% level, * significant at 1% level. All the regressions have included dummy variables of countries and years as independent variables. Within parenthesis are t value robust to arbitrary form of heteroskedasticity or serial correlation (Wooldrige (2001, p275)).

The estimation results in the last section imply that the long term crisis of welfare state lies in its pension system. The following figure 2 illustrates the trend of the average pension expenditure (% of GDP) across OECD nations between 1980 and 2007.

Figure 2 Time trend of average pension expenditure (% of GDP) across OECD nations between 1980 and 2007



The striking rise in cross-country average pension expenditure rate validates our previous prediction on the rising proportion of retirees in the population, derived from the effect of welfare expenditure on lifetime working time for average workers discussed in section V (page 15). It reflects two facts: first, steady increase in social security tax rate due to expansion of welfare state; second, increasing trend of ageing population due to the combination of decreasing lifetime working time and longer life expectancy due to better health service provided by welfare state. The policy implication of this paper is if this trend continues, the negative impact on economic growth of pension benefit expenditure suggested by the preceding econometric analysis will make it unsustainable to finance the welfare programs in the long run, which means that a more extensive crisis like the current European Sovereign Debt Crisis may occur and spread to more welfare states in the future if no policy reform is initiated.

Since pension benefit expenditure is the main part of welfare spending that hinders growth, the immediate growth-promoting policy implication is either lowering social security tax rate or raising full retirement age (equivalently, increasing the contribution period needed to qualify for full pensions) or reducing proportion of retirees in the population. Lowering social security tax implies benefit cut, which inevitably will encounter fierce resistance from senior voters. Raising retirement age is also unpopular. As shown before, people in generous welfare states tend to work less time due to disincentive effect of welfare benefits (see the first panel of table 3). Increasing lifetime working time by raising social security eligibility age will also be most likely to bring about strong political opposition. The most hopeful solution then goes to the last option: reducing proportion of retirees in the population by introducing more working-age immigrants. Admitting working-age immigrants, particularly those with high skills is hypothesized to be able to deter the trend of ageing of population, to decrease pension benefit expenditure as a percentage of GDP and thus to facilitate economic growth.

This hypothesis is tested by a fixed effect regression of pension expenditure rate on net migration rate (with dummy variables for both countries and years), which is defined as the difference of immigrants and emigrants of a country in one year, divided (usually) per 1,000 inhabitants (considered on midterm population). The last row of table 6 indicates a strongly significant and negative effect of net migration rate on pension spending rate. This finding is consistent with

Muysken and Ziesemer (2011)'s conclusion that immigration can help to alleviate the burden ageing presents for the welfare states of most Western Economies.

VIII CONCLUSION

This study econometrically test the impacts on economic growth of public social expenditure and its four major components: income support, pension benefits, public health and other social services. I use a two-way fixed effect model for panel data of all OECD nations, which includes most of the determinants of growth in previous growth empirical studies for either cross section or panel data as control variables and check possible endogeneity of the variables of interest: welfare measures by Durbin-Wu-Hausman test. The empirical analysis shows a robust negative correlation between welfare spending rate, pension spending rate and GDP growth. In particular, the estimates suggest that a 1% increase in welfare spending as percentage of GDP would increase the per capita GDP growth rate by 0.19%. This estimate is close to that of Weede (1986) (-0.19 to -0.21) and slightly higher than that of Nordstrom (1992) (-0.12%). Among four major components of welfare spending, pension is identified as the only important source of detrimental effect on growth. The fact that the coefficient estimate of pension spending rate (0.60) is higher than that of total welfare spending rate suggests that some sub-components of total welfare expenditure (such as welfare expenditure on public education), whose data is not available, may have positive effects on growth, which offset the impact of pension to a certain degree. All these results appear to be robust after controlling for convergence conditional on human capital level, population growth, inflation, international trade openness, terms of trade shock and investment rate. As a set of further robustness checks, I also perform unit root test for panel data, slope poolability test, dependent variable persistence test (dynamic specification test), informal check of IV exogeneity and checking estimation robustness to business cycles.

The policy implication of this study is: Despite possible positive impact from some sub-components of government welfare expenditures on social services other than public health, overall the total government public social expenditure has a negative effect on economic growth. The source of this impact is pension spending rate. An increase in pension benefit expenditure as

a percentage of GDP leads to a decrease in annual working hours for all average workers, which is translated into a decrease in lifetime working time for average workers, which essentially leads to a trend of rising proportion of retirees in the population, which leads to a strengthened trend of rising pension benefit expenditure as percentage of GDP. In short, welfare spending on pension benefits has a self-reinforcing effect. The self-reinforced rising pension spending rate slows down economic growth (through inhibiting investment rate and productivity growth), which in the end will make the financing of welfare expenditure unsustainable. To prevent such a crisis, introducing more working-age immigrants, particularly skillful immigrants, is a feasible way to deter population ageing, slowing down of economy and eruption of sovereign debt crisis in the long run.

Appendix

Technical rationalization of using lagged values as convergence terms for growth for panel data

In model (1) of the text, conditional convergence terms are represented by one-period lagged values of log of per capita GDP and number of researchers per million employed people. In cross section regressions for growth, convergence term is for a fixed starting year. For panel data, variable for a fixed year is unestimable. Using lagged value as convergence term is derived from Barro and Sala-i-Martin(2004)'s Log-Linearization of Ramsey model (section 2.8 Appendix 2A, p132) around the steady-state position, which can be written as

$$\log[\hat{y}(t)] = e^{-\beta t}\log[\hat{y}(0)] + (1-e^{-\beta t})\log(\hat{y}^*) \qquad (1)$$

where β>0, $\hat{y} = \frac{Y}{\hat{L}} = \frac{Y}{L*T(t)}$ is output per unit of effective labor (the product of raw labor and the level of technology) and $\hat{y}^*$ is the steady-state output per unit of effective labor , which is a constant.

The corresponding production function is

$$Y(t) = F[K(t), L(t)*T(t)] = F(K, \hat{L})$$

where Y is the flow of output, K is capital input (in units of commodities), L is labor input (in person-hours per year), and T (t) is the level of the technology, which is assumed to grow at the constant rate x $\geq$ 0. Hence, T (t) = e^{xt} . Y exhibits constant returns to scale in K and L, and each input exhibits positive and diminishing marginal product.

For our panel data, the discrete version of the equation (1) can be written as

$$\log(\hat{y}_t) = e^{-\beta t}\log(\hat{y}_0) + (1-e^{-\beta t})\log(\hat{y}^*) \qquad (1')$$

Where the subscripts refer to years, y_0 is the first year in the available panel data (in our case, year 1961).

Lagging one period for (1') and re-arrange, we get

$$\log(\hat{y}_0) = \frac{\log(\hat{y}_{t-1}) - (1 - e^{-\beta(t-1)})\log(y^*)}{e^{-\beta(t-1)}} \qquad (2)$$

Substituting (2) into (1') yields

$$\log(\hat{y}_t) = e^{-\beta}\log(\hat{y}_{t-1}) + \log(\hat{y}^*)(1 - e^{-\beta}) \qquad (3)$$

Subtracting $\log(y_{t-1})$ from both sides of (2) yields

$$\log(\hat{y}_t) - \log(\hat{y}_{t-1}) = (e^{-\beta} - 1)\log(\hat{y}_{t-1}) + \log(\hat{y}^*)(1 - e^{-\beta}) = \alpha\log(\hat{y}_{t-1}) + c_0 \qquad (4)$$

Where left-hand-side of (4) is growth rate of per capita GDP, $\alpha = e^{-\beta} - 1$ is convergence parameter and c_0 is a constant intercept.

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