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Government education expenditures and income inequality: evidence from provinces of Turkey

Introduction

Inequality in per capita incomes between households within a region or within a country, between regions within a country and between countries in the world has been sustained to a substantially high degree, particularly during recent decades. Even though almost all countries have, over a long period, executed various public policies so as to reduce inequality to an acceptable level, it is still rigorously debated as an important problem and accepted by many social scientists nowadays as one of the major reasons for many socio-economic problems in various economies. At the same time, the unequal distribution of human capital and investment across individuals or spatial units is also agreed on by most scholars today as one of the vital causes of income inequality across those economic units.

Meanwhile, education efforts are well-known to most economists as the foremost source of human capital accumulation. A large number of economists have studied from various perspectives the effects of educational efforts on earnings and other incomes, and on their distribution across economic units. Research on the theme regarding the former has been carried out more or less within a theoretical context. For instance, some empirical findings on this issue are proposed in Cohn and Addison (1998) from three different sorts of methods. However, research regarding the latter has been carried out largely without reliance on a theoretical framework, although Becker (1993) has recently developed a basic theoretical model. Thus far, a mass of literature has piled up on these themes and many empirical studies have found that rates of return from educational efforts stand at significant magnitudes. For example, Psacharopoulos (1994) and Psacharopoulos and Patrinos (2004) present successive reviews of such various empirical studies. However, empirical work regarding the effects of educational efforts on income distribution across economic units is emerging only lately and the evidence is as yet ambiguous. A selected set of studies with different findings on this issue, drawn from the relevant literature, is reviewed below.

Schultz (1963), Saint-Paul and Verdier (1993), Eckstein and Zilcha (1994) and Zhang (1996) have developed particular models predicting that aid to public education reduces the degree of income inequality over time. Sylwester (2002), employing cross-country data, reaches the conclusion that a rise in public education expenditure of an additional one percentage point of GDP leads to a significant drop in the gini coefficient (as a measure of income inequality across the countries, when it is constrained between 0 and 1) by between 0.01 and 0.017 points. De Gregorio and Lee (1999), exploiting cross-country panel data and a time series between 1960 and 1990, find that education factors – a more equal distribution of and greater participation in education – play an important role in improving income distribution. The influence of education expenditure on reducing income inequality in developed countries is relatively higher. In addition, public sector social expenditures contribute to a more equal distribution of income. On average, one more year of school attainment decreases the Gini coefficient by between 0.006 and 0.018 points. A one percentage point rise in so-

cial spending from national income decreases the Gini index by about 0.002 points. Park (1996), relying on the data of 59 countries, finds that, as the further educational attainment of employees has a balancing influence on income distribution, a further deviation in educational attainment between employees increases income inequality. Checchi (2000) analyses the relationship between income inequality and educational achievement and reaches the conclusion that there exists a strong, negative relationship between education years and income inequality. Also, it appears that income inequality is related negatively to per capita income and positively to public education expenditures and to the capital/output ratio. Simpson (1990), using a data set of 62 countries for the 1965-75 period, finds an inverted U-shaped relationship between schooling rates and income inequality.

On the other hand, Sylwester (2000), in his other cross-country empirical work, develops some evidence that income inequality is increased by public education expenditures. In addition, public education expenditure is found to be positively correlated with near-term economic growth, whereas it affects it negatively within the current term. Hende, Shapiro and Willen (2005) conclude that raising the number of students in higher education by providing more financial support, thus encouraging affordable education, could increase income inequality further. Jallade (1982) finds that primary education does not have a significant impact on income inequality in Brazil. Jimenez (1986) argues that additional public education spending does not benefit all the poor and does not diminish income inequality. Turrini (1998) concludes that public investment in human capital, owing to technological shocks, could increase inequality between the earnings of skilled and unskilled employees and also that public investment in education raises income inequality between generations. Fields (1980) reaches the conclusion that additional resource allocation to public education in many developing countries does not reduce the extent of income inequality. Ram (1989) reviews theoretical and empirical studies and comes to the conclusion that there is no strong evidence to support the view that increases in education expenditure lower income inequality.

Thus, most of the research into the impact of education investment on income inequality across economic units presently focuses on data from developed countries, whereas inequality is much higher and a more serious problem in less developed or developing countries than it is in developed ones. So, we need more empirical research and evidence from less developed or developing countries on this topic in order to suggest to them more sound national education policies considering income inequality.

Furthermore, as yet we have few studies on the Turkish experience investigating the impact of education investment on income inequality across economic units, while the findings of those efforts that we do have differ from each other. Kasnakoğlu and Erdil (1994) conclude that public education expenditure had a significant impact on economic and political change in Turkey in the period 1975-91. Baş (2000), using cross-sectional data on 19 Turkish provinces, finds a strong negative correlation between inequality in education and inequality in income. A 0.01 percentage point rise in the education inequality index (scaled between 0 and 1), decreases the Gini index (as an income inequality index) by 0.007 points. Sarı (2003), employing household data from two Turkish provinces (Bolu and Düzce), produces evidence that university graduates have the influence of improving income distribution, while primary school

graduates have the influence of worsening income distribution between households in different income categories within each province. In addition, he suggests that vocational education could be an important policy tool in diminishing income inequality between households.

The Turkish government has for a long time implemented various public policies aimed at reducing the huge economic gaps between regions and provinces, but inequalities have not declined so far and have even increased during some periods. Given its status as accession candidate to the European Union (EU), Turkey is expected by the European Commission (EC) to reduce inequality in per capita incomes across its provinces (which are the lowest level of spatial units). The EC has stood by the development programmes which bring about sustainable development in less developed regions by relying on their own assets and amenities. In this regard, investments in education have taken a particular scope and priority within the EU, provided that the suggested education programmes are proven to promote sustainable developments in lagging regions and, hence, to diminish the gap between the relevant regions and developed ones. For example, a pioneering contribution by Lucas (1988) defines a theoretical model considering the role of human capital accumulation in sustainable development in the economy.

Consequently, this article statistically tests whether education expenditure by central governments at the national level has any significant effect on the per capita income distribution across provinces in Turkey over time. Employing certain control variables (related to macro-economic and public policy) at the national level which are assumed to be most likely to have a significant influence on inequality, a multiple time series regression analysis is carried out in order specifically to test whether both sorts of government expenditure by the ministry of education and on higher education have any significant impact on income inequality among the provinces between 1975 and 2001.

The findings of this work suggest that expenditure by the ministry of education has a significant impact on reducing inequality. However, government higher education expenditure has the significant impact of escalating inequality where the expenditures of the ministry of education are included alongside other variables in the model, otherwise they do not have any significant effect on it. This result could be due to a very high linear association between these two variables (see Table B3 in the Appendix and Figure 2). Consequently, the estimates and tests on the impact of higher education expenditure on inequality do need to be interpreted carefully. Moreover, enrolment rates in secondary education have a significant influence in terms of promoting inequality. The control variables under consideration also have significant influences on inequality in the expected direction.

A basic contribution of this study to the literature is that it is a pioneering one that empirically investigates the effects of government education expenditure on income inequality across all of the previously defined 67 Turkish provinces by employing a time series data set over a considerably long period.

The rest of this article is organised as follows. Income inequality across economic units and Turkey's educational efforts compared to those of other countries in the world are explained in the next section. The variables and methodology of the work are then presented, followed by the release of the empirical findings. The final section looks at the conclusions.

Income inequality and education efforts

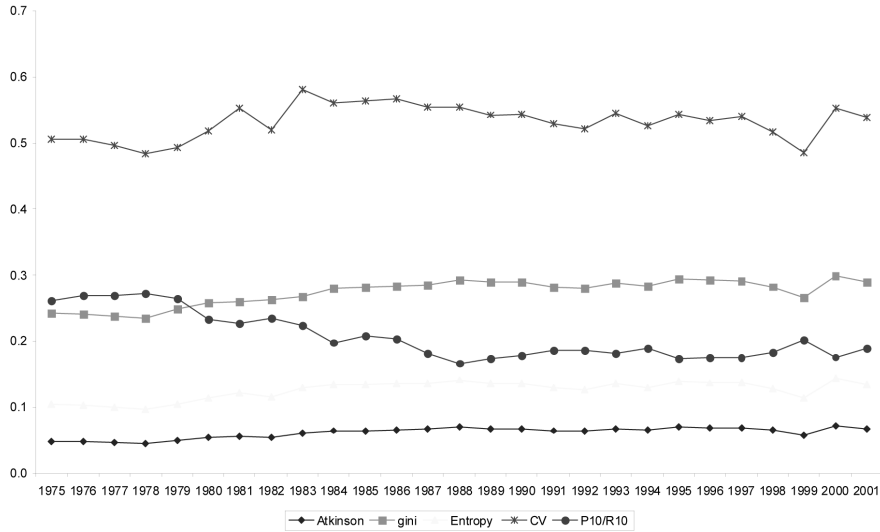
There exist huge disparities in terms of the resources allocated to education, per capita income levels, long-run economic growth rates and income inequality rates between all countries. The results of household research on 91 countries show that cross-country income inequality, as measured by the gini coefficient, increased from 0.628 in 1988 to 0.66 in 1993. The Gini coefficient measuring income inequality within a country takes on values between 0.20 and 0.63 (Milanoviç, 1999; Thorbecke and Charumilind, 2002). Countries as Norway, Sweden, Denmark, Hungary and Belgium have the most equal income distribution, with gini coefficients of around 0.25, whereas such countries as Brazil, Panama, Zambia, Mali and Niger have the most unequal income distribution, with gini coefficients over 0.50. With a few exceptions, countries with greater per capita income levels and larger resources devoted to education are generally those with more equal income distributions (UNDP, 2004). Beyond such countries as Brazil and South Africa, with a very poor situation in terms of income distribution, Turkey, with a gini index of 0.44 in 2002, occupies a similar place to a group of countries including Peru, the Russian Federation and some European countries with a high level of income inequality (World Development Report, 2002).

Trends concerning various indices of per capita income inequality between the Turkish provinces for 1975-2001 are displayed in Figure 1.[1] Turkey has 81 provinces today, 14 of which were counties in several of the former 67 provinces in the near past, having split from the dependent provinces in various years. Per capita GDP data for these 14 counties, employed to calculate income inequality indices for the provinces, are combined with those of their former provinces; hence, the original 67, as existed in the initial year of the time series data, are the subject of this work.

All the indices demonstrate that, overall, inequality is increasing gradually in some periods while being sustained, but not declining, in others. There appears to be a very strong and highly significant linear association, especially between the Atkinson, Gini and Generalised Entropy indices, as well as the ratio of the poorest ten provinces to the richest ten (P10/R10). Atkinson (1983), a particularly useful source, demonstrates the causes of the disparities between the different inequality indices. Nevertheless, there exists a significant linear association between these inequality indices and the coefficient of variation (CV), albeit to a smaller extent (Table A1 in the Appendix). The trend in P10/R10 demonstrates that the gap in per capita incomes between the poorest and the richest provinces was rising in the first half of the period, while being maintained during the rest of it (Figure 1). This may imply that the overall distribution of per capita income between the provinces is influenced substantially by variations in the per capita income gap between the poorest and richest provinces.

1 The same data and trends regarding income inequality across the Turkish provinces between 1975 and 2001 are partially employed in Karadeniz *et al*. (2005).

Figure 1 – Trends of indices in per capita income inequality between provinces in Turkey, 1975-2001



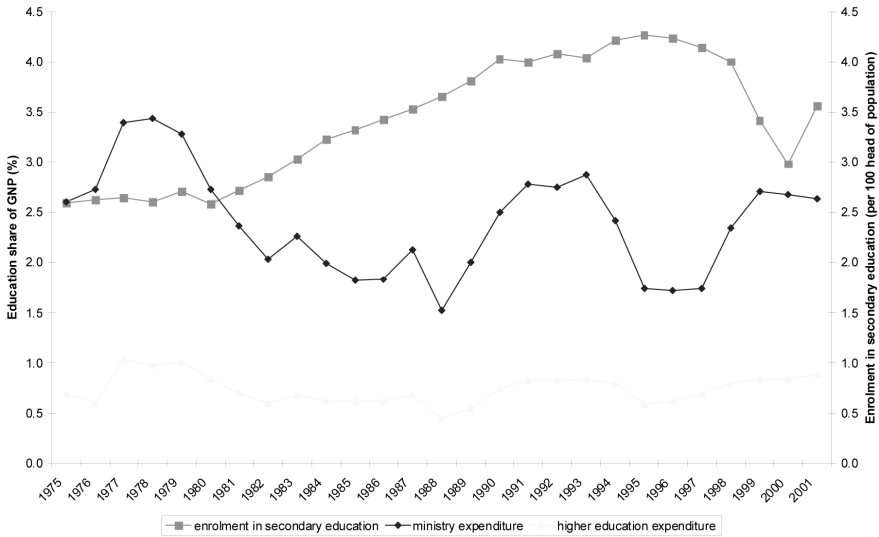
At the same time, education indicators for Turkey have thus far not demonstrated an encouraging performance. In 2001, Turkey devoted just 3.7% of its GNP to education spending. This rate is less than half the share allocated by countries that have a similar per capita income level as Turkey (World Bank, 2003). On the 2001 data, roughly 15% of the population aged 15 and over in Turkey is illiterate, comparable to Peru and Brazil, while the percentage of illiterate women, at about 23%, describes a much poorer situation. The share of education spending in aggregate public sector expenditure has declined enormously, from 18% to 9% in the 1990-2000 period (SIS, 2002).

Trends in various national education indicators for Turkey in the 1975-2001 period are displayed in Figure 2. Expenditure on education by the Ministry of Education is much more volatile than government expenditure on higher education in this period. Both types of education expenditure peaked between 1977 and 1979, with around 3.4% of GNP as regards the former and around 1% for the latter; hence, a total of approximately 4.4%. They dropped to their lowest level in 1988 with, respectively, about 1.5% and 0.4%; hence, a total figure of close to 2%. Hereafter, they demonstrated a gradual and somewhat cyclical rise, especially as regards Ministry of Education expenditure. In particular, government education expenditure declined to another low, of respectively around 1.7% and 0.6% – and hence a total of about 2.3% of GNP – between 1995 and 1997, afterwards rising once again.

In contrast, the rate of enrolment in secondary education was at its lowest with about 2.6 enrolments per hundred people in the 1977-1979 period; thereafter, it climbed sharply, reaching a peak of about 4.3 between 1995 and 1997 before declining ahead of another rise in 2001.

Overall, the Turkish government has devoted relatively little GNP resource to education expenditure, with an average of 2.41% via the Ministry of Education and 0.74% via the higher education institutions – hence, a total of 3.15% – in the 1975-2001 period. At the same time, an average of 3.42 people per hundred head of the population has been enrolled in secondary education during this period.

Figure 2 – Trends of education indicators in Turkey, 1975 – 2001



Variables and methodology

It is observed that countries that have higher per capita income levels and higher economic growth rates in the long run may have allocated greater resources to their education expenditure as well. In turn, greater investments in human capital are expected to lead to higher economic growth rates in the economy and a more equal distribution of income across economic units. However, the experienced results rest on a multivariate process and are affected by various factors in different ways in various economies, some of which are impossible to observe and measure. Consequently, empirical results require empirical work to be conducted, considering the operation of the economy being examined.

A statistically testable theory that is consistent with general economic theory has not been developed with which to explain income distribution or income inequality, while an empirical model geared towards it has not been explicitly specified, despite the pioneering attempt by Becker (1993). Therefore, many empirical studies on this issue have exploited various variables that are assumed to be most likely to have a significant influence on income distribution, in order to test whether education and other interested variables have thus far had any significant effect on income inequality in the economy under consideration. Some empirical studies, for instance, use particular macroeconomic variables such as inflation and unemployment (Mocan, 1999; Blejer and Guererro, 1990), public fiscal policy variables (Auten and Carroll, 1999;

Feenberg and Poterba, 1993) and proxies for agriculture, industrial factors, financial development and level of education (Motonishi, 2005).

Specification of the empirical model follows the same path in this work. We are interested more specifically in testing whether government expenditures by the Ministry of Education (*ministry*) and by higher education institutions (*higher*) have any significant impact on income inequality across the Turkish provinces, by exploiting a time series regression analysis on an available annual data set from 1975 to 2001; the 2001 data set is currently the most recent and matched one concerning the Turkish provinces. The data set employed in this study and the descriptive statistics are presented in Appendix B. The gini index (*gini*), an independent variable measuring income inequality across provinces over time, is employed because it is a commonly used index of inequality. Moreover, there appears to be a highly significant correlation between the gini index and our calculated other income inequality indices, as displayed in Table A1 of Appendix A. Hence, it does not make a significant difference which one is employed in the analysis. In addition to the interested independent variables of education expenditures, first of all the rate of enrolment in secondary education (*secondary*), followed by that of an inflation index (*inflation*), government spending on social security (*socsec*) and two time dummies (*dum1* and *dum2*) are run as control variables against *gini*. Definitions of the variables and sources for the data are included below following the conclusions to this article.

We have also considered certain other variables that are assumed to be most likely to have a significant influence on income inequality across the provinces. In order to avoid spurious regression, the unit roots of all variables are searched first; unfortunately, however, such variables as employment, per capita income, the share of agriculture in the economy, public sector investment, government interest payments and investment incentives have not been found stationary at the reliable lags. In addition, significant co-integration is not found when all those considered variables are employed. Hence, we have simply explored the above variables which are stationary at a reliable lag. A meticulous textbook by Enders (2004) presents a clear explanation on this point and the unit root tests are furnished in Table A1 in Appendix A.

The considered time series regression model may be specified in a linear form in terms of its parameters as follows:

$$gini_t = \beta_0 + \beta_1\, secondary_t + \beta_2\, ministry_t + \beta_3\, higher_t + \sum_{i=1}^{n} \theta j X_t + \varepsilon_t \qquad (1)$$

$$X_t = (inflation_t, socsec_t, dum1_t, dum2_t)$$

where vector X_t stands for the control variables explained above; t characterises the annual time series observations on the variables from 1975 to 2001; β_i *(i=0, 1, 2, 3)* symbolises the parameters of a constant and three sorts of education variables; θ_j *(j=1, 2, 3, 4)* represents the parameters of the various control variables regarded in the model; and ε implies a random error term with its conventionally assumed properties. Primarily, we intended to estimate the model as efficiently as we could with as limited a number of parameters (control variables) as possible considering the degrees of freedom given the available time series data. To a substantial extent, the annual time series data on the Turkish provinces are only available for incomes of the provinces and are unavailable for the other considered variables in this work. Therefore, the re-

search exploits data measuring the dependent variable of inequality in per capita incomes across the provinces at the level of spatial unit, whereas it employs a data set measuring the independent variables at the national level.

Therefore, extra caution should be had regarding the policy implications of the empirical findings. Having assumed that the distributions of national government education expenditures, or other considered variables across the provinces, have followed the same patterns as the national ones, this implies that, for example, as national government education expenditure increase then so has the distributional equality (or inequality) of that expenditure between provinces in the period under observation. This means that provinces have benefited more equally (or unequally) from national government education expenditure. Thereby, if we estimate a negative value for the parameter of the national education expenditure variable, we can conclude that the further equal (or unequal) distribution of education spending across the provinces decreases the inequality (or equality) of incomes between them. Otherwise, we can simply conclude that a rise in national education expenditure reduces income inequality between provinces, regardless of whether a rise in national education expenditure reduces or increases the level of education inequality between them. The same interpretation also follows for the other independent variables measured at the national level.

The rate of enrolment in secondary education is employed as a basic proxy controlling for the extent of human capital in the economy. On average, this can reduce income inequality between provinces if a higher rate of enrolment takes place in low income provinces relative to high income ones; otherwise, it is expected to increase it over time. Inflation is commonly accepted to make income distribution worse, but government spending on social security is ordinarily expected to improve income distribution across economic units. One of the time dummies controls for the different influence that 2000 had relative to the rest of the period; the other controls for that of 1975-1980 relative to the rest of the period. The deepest level of the brutal economic crisis, which erupted in February 2001, was experienced in 2000. The disparate impact of 1975-1980 relative to the rest of the period can be attributed to it being marked by a closed economy model dominated by central government intervention in all fields of socio-economic life; after which a more or less export-oriented economic model, with free open market rules and a minimum level of government interference in socio-economic life, has been experienced in Turkey.

Despite these restrictions, specific findings on this subject will make fundamental sense, providing knowledge very rare both for Turkey and for other developing countries.

Empirical findings

The time series regression specified in equation (1) above is estimated first by employing the education variables alone to check how strongly by themselves they are related to the inequality in per capita GNPs between the provinces. Estimates of four different models using the method of least squares are presented in Table 1. Estimates of the parameters on rates of enrolment in secondary education (*secondary*) and on education expenditure by the Ministry of Education (*ministry*) are highly significant (at the 1% level) in all four models. However, the estimate of the parameter as regards government higher education expenditure (*higher*) is barely significant (at the 10%

level) where the *ministry* variable is included in model (4), but it is not significant when it is excluded from the model (3).

At the same time, Durbin-Watson (DW) statistics suggest a very serious problem of autocorrelation between error terms on the basis of the estimates of these four equations. Thus, the Yule-Walker estimates of the corresponding models in Table 1 are obtained so as to eliminate this problem (see results in Table 2). A first order autoregression procedure provides estimates of the parameters without any significant autocorrelation between residuals in all four regressions. However, the parameter estimates of *ministry* are statistically significant at the 5% level while those of *higher* are not significant even at the 10% level. Explanation degrees of the estimated regressions (R^2 for regression) are substantially lower, but they are still at very high levels, especially in model 2 (about 0.59) and model 4 (about 0.62) in which the *ministry* variable, in addition to the *secondary* variable, is contained. The variation in the *secondary* variable by itself explains about 0.39 of the variation in income inequality (*gini*) between 1975 and 2001. Hence, seeing how the contribution of the *secondary* and *ministry* variables in the model is made at quite a high level, the influence of the *ministry* and, particularly, of the *higher* variables on the level of inequality seems conditional on other factors.

Table 1 – Least squares estimates with education variables
Dependent variable: *gini* and number of observations: 27

Variable	Model 1	Model 2	Model 3	Model 4
constant	0.1868*** (0.0136)	0.2347*** (0.0125)	0.1967*** (0.0168)	0.2305*** (0.0120)
secondary	0.0255*** (0.0036)	0.0205*** (0.0029)	0.0244*** (0.0033)	0.0209*** (0.0028)
ministry		-0.0127*** (0.0026)		-0.0169*** (0.0031)
higher			-0.0089 (0.0147)	0.0177* (0.0092)
Adj. R^2	0.6330	0.7198	0.6251	0.7269
F-Stat. for Reg.	45.84***	34.40***	22.67***	24.07***
St. Error of Reg.	0.0117	0.0102	0.0118	0.0101
D.W.	1.00***	1.15***	1.04***	1.21***

Note: White heteroskedasticity-consistent standard errors & covariance are used in all regression estimates.

*, ** and *** imply that the parameter estimates are statistically significant at levels of successively 10%, 5% and 1%. Standard errors are contained in parentheses.

Conventional tests of the corresponding models in Table 1 are provided in Table A3 of Appendix A. Redundancy test statistics for the variables which are excluded from the full model suggest omitted variable bias in all four models. The Jarque-Bera statistic implies that residuals from the estimates are not normally distributed in all four regressions. Lagrange multiplier (LM) test statistics of Breusch-Godfrey at the first three lags display a significant serial correlation between the residuals, particularly in the first three models. Ramsey reset test statistics at the first three lags demonstrate that the estimated parameters are not stable in any of the four models, which suggests a misspecification in the estimated regressions and/or structural problems in the data.

Table 2 – Yule-Walker estimates of corresponding models in Table 1
Dependent variable: *gini* and number of observations: 27

Variable	Model 1	Model 2	Model 3	Model 4
constant	0.2002*** (0.0192)	0.2398*** (0.0245)	0.2005*** (0.0227)	0.2370*** (0.0242)
secondary	0.0216*** (0.0056)	0.0187*** (0.0049)	0.0219*** (0.0056)	0.0190*** (0.0048)
ministry		-0.0123** (0.0051)		-0.0159** (0.0059)
higher			-0.0022 (0.0117)	0.0144 (0.0126)
R^2 for Reg.	0.3862	0.5898	0.4182	0.6215
St. Er. of Reg.	0.0103	0.0096	0.0106	0.0096
D.W. (lag = 1)	1.83	1.78	1.80	1.75

Note: *, ** and *** imply that the parameter estimates are statistically significant at levels of successively 10%, 5% and 1%. Standard errors are contained in parentheses.

Considering such serious problems, and in order to achieve unbiased and more efficient estimates, a couple of particular control variables were next employed in the specifications. The parameter estimates from the method of least squares for all the considered variables are presented in Table 3. Estimates of all the parameters in the first two models are statistically significant at the 1% level, while those of *higher* and *socsec* are not significant even at the 10% level, although that of *inflation* is yet significant at the 5% level in model 3. On the basis of other statistics, the performance of model 3 is below that of both the first two models. These findings recommend that, in particular, *secondary* by itself, and then *ministry* when specific control variables are considered in the specification, are significant factors in explaining income inequality. The impact size of *ministry* depends a little on *higher* beside certain other variables, whereas that of *higher* is, to a great extent, conditional on *ministry* beside other variables. This consequence is most likely due to a high and significant linear association between these two variables (0.885) (see Table B3 in Appendix B).

On the other hand, DW statistics identify a very serious problem of autocorrelation between the residuals of the estimates of all three regressions. Moreover, conventional tests of the models in Table 3, which are submitted in Table A4 in Appendix A, imply most significantly a specification problem in model 3 as well as a serial correlation between error terms in model 1. Given these problems, in order to eliminate the autocorrelations between the residuals and hence to achieve more efficient parameter estimates, particularly in the first two models, Yule-Walker estimates of the corresponding models in Table 3 are also provided (see Table 4). A second order auto-regression procedure endows us with estimates of the parameters without any significant autocorrelation between the residuals as regards the first two regressions. However, the estimates from model 3 contain auto-correlated residuals even at a third order auto-regression, while performance is also a little lower relative to the first two models.

Table 3 – Least squares estimates with all the considered variables
Dependent variable: *gini* and number of observations: 27

Variable	Model 1	Model 2	Model 3
constant	0.2358*** (0.0103)	0.2394*** (0.0100)	0.2199*** (0.0117)
secondary	0.0193*** (0.0020)	0.0186*** (0.0019)	0.0185*** (0.0026)
ministry	-0.0132*** (0.0019)	-0.0102*** (0.0023)	
higher	0.0122*** (0.0041)		-0.0053 (0.0115)
inflation	0.0022*** (0.0003)	0.0022*** (0.0003)	0.0015** (0.0006)
socsec	-0.0053*** 0.0010)	-0.0047*** (0.0010)	-0.0036 (0.0022)
dum1	0.0299*** (0.0014)	0.0291*** (0.0015)	0.0275*** (0.0028)
dum2	-0.0127*** (0.0033)	-0.0134*** (0.0037)	-0.0212*** (0.0036)
Adj. R^2	0.9588	0.9515	0.9020
F-Stat. for Reg.	87.36***	86.00***	40.86***
St. Er. of Reg.	0.0039	0.0042	0.0060
D.W.	1.46***	1.64**	1.33***

Note: White heteroskedasticity-consistent standard errors & covariance are used in all regression estimates.
*, ** and *** imply that the parameter estimates are statistically significant at levels of successively 10%, 5% and 1%. Standard errors are contained in parentheses.

There thus appears to be merely a trivial difference between the results from Table 3 and Table 4, in contrast to that between Table 1 and 2, allowing us to interpret the findings more confidently from models 1 and 2 in Table 4. The regressions explain a high proportion, consecutively around 0.98 and 0.96, of the variation in income inequality. A national rise in the rate of enrolment in secondary education (*secondary*) increases income inequality across the Turkish provinces. *Ceteris paribus*, if the average enrolment rate of 3.42% (per hundred people) is increased by a single percentage point to 4.42%, the inequality level (as measured by the *gini* index) increases by about 0.019 points, from an average of 0.274 to 0.293 at the margin.

On the other hand, a national increase in expenditure by the Ministry of Education (*ministry*) reduces inequality. A one percentage point increase in expenditure from an average of 2.41% of GNP to 3.41% lowers the *gini* index to an average of 0.260, with a reduction of approximately 0.014 points when government higher education expenditures (*higher*), beside all the control variables, are employed in model (1). However, its impact in reducing inequality is about 0.01 points if the *higher* variable is excluded, in model (2). The impact of *higher* on the *gini* index is statistically significant only conditionally, in particular on *ministry* as well as on certain other factors, taking it in the direction of worsening income distribution. A one percentage point rise in government higher education expenditure, from an average of 0.74% of GNP to 1.74%, elevates the *gini* index by roughly 0.017 points to an average of 0.291.

Table 4 – Yule-Walker estimates of corresponding models in Table 3
Dependent variable: *gini* and number of observations: 27

Variable	Model 1	Model 2	Model 3
constant	0.2350*** (0.0073)	0.2400*** (0.0090)	0.2129*** (0.0125)
secondary	0.0195*** (0.0015)	0.0185*** (0.0020)	0.0196*** (0.0030)
ministry	-0.0143*** (0.0023)	-0.0103*** (0.0024)	
higher	0.0165*** (0.0047)		0.0010 (0.0070)
inflation	0.0021*** (0.0006)	0.0023*** (0.0007)	0.0019** (0.0009)
socsec	-0.0055*** (0.0013)	-0.0050*** (0.0016)	-0.0052** (0.0024)
dum1	0.0298*** (0.0035)	0.0292*** (0.0047)	0.0306*** (0.0058)
dum2	-0.0125*** (0.0029)	-0.0133*** (0.0036)	-0.0208*** (0.0046)

Variable	Model 1	Model 2	Model 3
R^2 for Reg.	0.9796	0.9633	0.9210
St. Er. of Reg.	0.0035	0.0044	0.0057
D.W. (lag = 2)	1.94	2.01	
D.W. (lag = 3)			1.62*

Note: *, ** and *** imply that parameter estimates are statistically significant at levels of successively 10%, 5% and 1%. Standard errors are contained in parentheses.

Furthermore, inflation has a significant impact in worsening income distribution, whereas government social security expenses (*socsec*) do indeed have the consequence of diminishing income inequality. A five-point decline in the consumer price index (*inflation*) from an average of 10% to 5% lessens the *gini* index by just about 0.001 point, from 0.274 to 0.273. If government expands *socsec* by one percentage point to 2.1% of GNP, it reduces the *gini* index by around 0.006 points to 0.268. Additionally, some unobservable factors per unit of change enhance inequality with a rise of around 0.03 points to 0.304 in 2000 relative to the rest of the period (*dum1*), but decrease it with a decline of about 0.013 points to 0.261 in the years between 1975 and 1980 relative to the rest of the period (*dum2*).

So, some variables carry significant influences as regards the reduction of income inequality while others bear significant influences towards its increase. The highest impact on reducing inequality comes from *ministry* and *dum2*, whereas the impacts of *inflation* and *socsec* in reducing it operate to a fairly poor extent, i.e. around the margin. At the same time, the greatest impact towards worsening income distribution results from *dum1*, *secondary* and *higher*.

Conclusion

An increase in education expenditure by the Ministry of Education reduces the level of inequality in per capita GNP across the Turkish provinces. However, the impact of government higher education expenditure on income inequality is statistically significant only conditionally, in particular on expenditure by the Ministry of Education as well as on certain other factors, and in the direction of worsening income distribution. A national rise in the rate of enrolment in secondary education also increases inequality. Hence, these results may suggest that relatively poor provinces have benefited from the expenditure of the Ministry of Education more than have rich ones. In contrast, relatively rich provinces have benefited from government higher education expenditures more than have poor ones. Nevertheless, a higher rate of enrolment in secondary education at the national level may imply a higher rate of enrolment in rich provinces relative to poor ones, or *vice versa*. Moreover, we cannot be sure that a greater rate of enrolment in secondary education within a province guarantees the enhancement of incomes therein. Therefore, in order to establish a certain conclusion on this finding, we need data which measures the distribution between provinces over time.

Governments have attempted to use social security expenditure as a primary policy tool in diminishing inequality and they have had a statistically significant, albeit relatively quite weak, impact on it. Inflation has a significant impact on worsening income distribution, but also at a relatively poor level. Additionally, some unobservable factors enhanced inequality in 2000 relative to the rest of the period but reduced it between 1975 and 1980 relative to the rest of the period to a rather strong extent albeit around the margin.

Furthermore, provided that one of the fundamental objectives of the national government is to diminish income inequality across the provinces, raising the expenditure of the Ministry of Education appears to be the more powerful national public policy tool relative to social security expenditure and to the public policy of reducing inflation at the margins. Moreover, given the widespread argument that such factors as inflation and government transfer payments have distorting impacts by imposing excessive burdens on the economy, social security expenditure as a public policy tool can distort the efficient allocation of resources and hence lead to conflict with the objective of economic development. On the other hand, both higher enrolment rates in secondary education and the devotion of more resources to higher education expenditure may contribute relatively much more to human capital accumulation, and hence to economic development, since relatively rich provinces benefit relatively more from these than do poor ones.

In conclusion, expenditure by the Ministry of Education and, to a much smaller extent, public policies aimed at reducing inflation can be used to lessen income inequality by promoting development at the same time. Expenditure by the Ministry of Education can contribute to human capital accumulation in the economy since poor provinces will benefit more from these relative to rich ones. Reducing inflation leads to stability in prices and hence allows entrepreneurs to predict the long-term future more clearly and to invest more in the economy; alongside it, albeit to a smaller degree, it diminishes income inequality.

Statistical appendix

Definition of the variables:

gini: the gini index measures inequality in per capita GDP across the 67 Turkish provinces.

secondary: the rate of national enrolment in secondary education per hundred people in Turkey.

ministry: the rate of government education expenditure by the Ministry of Education as a proportion of GNP.

higher: the rate of government higher education expenditure as a proportion of GNP.

inflation: the mean annual average consumer price index, as an indicator of inflation, is fixed at 1.

socsec: the rate of government expenditure on social security as a proportion of GNP.

dum1: the time dummy variable controlling for 2000 relative to the rest of the period.

dum2: the time dummy variable controlling for the term 1975-1980 relative to the rest of the period.

Data sources:

1. Figures for the provinces' gross domestic product (GDP) at fixed 1987 prices were obtained from Özötün (1980; 1988) for 1975-1987 and from the State Institute for Statistics (SIS, 2003) for 1988-2001. SIS has been called Turkey's Institute for Statistics (TUİK) since 2005.
2. Government education expenditure by the Ministry of Education and government higher education expenditure were acquired from Kasnaǩoglu and Erdil (1994) for 1975-1991 and from the Ministry of Education itself (ME, 2003) for the rest of the period.
3. Data on enrolment in secondary education and on the consumer price index were collected from the State Institute for Statistics (SIS, 2003).
4. The rate of government expenditure on social security compared to GNP was obtained from the State Planning Organisation (SPO, 2004).

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Appendix A

Statistics of certain tests:

Table A1 – Pearson correlation coefficients across the various income inequality indices

	gini	Atkinson	Entropy	CV
Atkinson	0.9963 (0.0001)			
Entropy	0.9759 (0.0001)	0.9844 (0.0001)		
CV	0.6675 (0.0001)	0.6944 (0.0001)	0.8096 (0.0001)	
P10/R10	-0.9711 (0.0001)	-0.9746 (0.0001)	-0.9316 (0.0001)	-0.5707 (0.0019)

Note: Probability levels of significance are contained within parentheses.

Table A2 – Tests for unit roots in the levels

Variables[a]	Augmented Dickey-Fuller test statistics Akaike Information Criterion	
	Intercept	Trend and Intercept
gini (7)	-3.174**	-2.474
secondary (8)	-3.284**	0.935
ministry (8)	-3.826**	-3.276
higher (1)	-3.316**	-3.259*
inflation (3)	-6.216***	-7.452***
socsec (5)	-2.146	-3.694**

Note: (a) Maximum lags within the parentheses.
*, ** and *** imply that estimates are statistically significant at levels of successively 10%, 5% and 1%.

Table A3 – Conventional tests of the corresponding models in Table 1

Statistics for Tests	Model 1	Model 2	Model 3	Model 4
Redundant Variables Test:				
~ F	33.92***	28.81***	39.84***	33.33***
Log likelihood ratio	66.44***	58.04***	65.91***	56.20***
Jarque-Bera	6.97**	57.31***	9.59***	60.53***
Breusch-Godfrey Serial Correlation LM Test (Lag):				
(1) ~ F	7.39**	3.83*	6.28**	3.34*
~ X^2	6.35**	3.86**	5.79**	3.56*
(2) ~ F	3.61**	1.84	3.26*	1.94
~ X^2	6.45**	3.87	6.17**	4.21
(3) ~ F	2.30	1.22	2.08	1.31
~ X^2	6.46*	4.01	6.19	4.44
ARCH LM Test (Lag):				
(1) ~ F	0.05	0.26	0.06	0.11
~ X^2	0.05	0.27	0.07	0.12
(2) ~ F	0.04	0.12	0.04	0.18
~ X^2	0.08	0.26	0.09	0.41
(3) ~ F	0.34	0.07	0.31	0.51
~ X^2	1.15	0.25	1.08	1.69
White Heteroskedasticity (with no cross terms) Test:				
~ F	1.16	0.51	0.75	0.33
~ X^2	2.38	2.30	3.26	2.41
Ramsey Reset Test (Lag):				
(1) ~ F	13.28***	5.75**	12.76***	8.74***
Log likelihood ratio	11.89***	6.02**	11.92***	9.03***
(2) ~ F	9.09***	3.12*	7.65***	4.92**
Log likelihood ratio	15.73***	6.75**	14.26***	10.38***
(3) ~ F	5.80***	2.01	5.08***	3.14**
Log likelihood ratio	15.74***	6.82*	14.72***	10.41**

Note: *, ** and *** imply that statistics are significant at levels of successively 10%, 5% and 1%.

Table A4 – Conventional tests of the corresponding models in Table 3

Statistics for Tests	Model 1	Model 2	Model 3
Jarque-Bera	0.14	0.28	0.76
Breusch-Godfrey Serial Correlation LM Test (Lag):			
(1) ~ F	1.33	0.48	2.88
~ X^2	1.86	0.66	3.56*
(2) ~ F	3.59*	0.49	1.42
~ X^2	8.01**	1.39	3.68
(3) ~ F	2.39	0.79	1.87
~ X^2	8.37**	3.30	6.69*
ARCH LM Test (Lag):			
(1) ~ F	0.02	0.02	1.33
~ X^2	0.02	0.02	1.36
(2) ~ F	0.28	0.26	0.83
~ X^2	0.62	0.57	1.75
(3) ~ F	0.25	0.44	0.94
~ X^2	0.86	1.47	2.97
White Heteroskedasticity (with no cross terms) Test:			
~ F	0.51	0.43	2.46*
~ X^2	8.17	5.68	16.37*
Ramsey Reset Test (Lag):			
(1) ~ F	0.19	1.23	5.80**
Log likelihood ratio	0.28	1.69	7.19***
(2) ~ F	0.52	1.25	4.98**
Log likelihood ratio	1.61	3.52	11.89***
(3) ~ F	1.20	1.89	5.75***
Log likelihood ratio	5.48	7.79*	18.92***

Note: *, ** and *** imply that statistics are significant at levels of successively 10%, 5% and 1%.

Appendix B

Data and descriptive statistics:

Table B1 – Data with regard to the variables employed in the regressions

Year	gini	second-ary, %	minis-try, %	higher, %	inflation	socsec, %	dum1	dum2
1975	0.2424	2.5961	2.6064	0.6917	0.00008	0.1300	0	1
1976	0.2407	2.6256	2.7257	0.5996	0.00009	0.4400	0	1
1977	0.2371	2.6514	3.3981	1.0332	0.00011	0.6400	0	1
1978	0.2348	2.6030	3.4360	0.9689	0.00017	0.9800	0	1
1979	0.2492	2.7112	3.2780	1.0105	0.00027	0.7100	0	1
1980	0.2586	2.5822	2.7263	0.8424	0.00055	0.8400	0	0
1981	0.2602	2.7223	2.3690	0.6977	0.00073	0.7000	0	0
1982	0.2621	2.8547	2.0342	0.6015	0.00094	0.6400	0	0
1983	0.2680	3.0307	2.2575	0.6843	0.00124	0.8200	0	0
1984	0.2797	3.2333	1.9900	0.6143	0.00183	0.5600	0	0
1985	0.2815	3.3271	1.8267	0.6156	0.00266	0.5900	0	0
1986	0.2831	3.4254	1.8321	0.6231	0.00358	0.5600	0	0
1987	0.2846	3.5292	2.1327	0.6806	0.00496	0.5600	0	0
1988	0.2922	3.6545	1.5240	0.4421	0.00862	0.5800	0	0
1989	0.2892	3.8111	2.0022	0.5501	0.01408	0.6100	0	0
1990	0.2890	4.0282	2.4981	0.7485	0.02257	0.3100	0	0
1991	0.2816	4.0027	2.7795	0.8312	0.03746	0.2500	0	0
1992	0.2797	4.0806	2.7507	0.8266	0.06372	0.3600	0	0
1993	0.2879	4.0426	2.8792	0.8341	0.10583	0.6900	0	0
1994	0.2832	4.2170	2.4155	0.8020	0.21833	1.0100	0	0
1995	0.2941	4.2713	1.7379	0.5888	0.42269	1.3800	0	0
1996	0.2919	4.2403	1.7199	0.6154	0.76254	2.2400	0	0
1997	0.2914	4.1412	1.7427	0.6884	1.41603	2.5900	0	0

Year	gini	second-ary, %	minis-try, %	higher, %	inflation	socsec, %	dum1	dum2
1998	0.2822	4.0057	2.3449	0.7973	2.61152	2.6200	0	0
1999	0.2656	3.4151	2.7051	0.8418	4.31260	3.5100	0	0
2000	0.2989	2.9858	2.6810	0.8375	6.68452	2.6400	1	0
2001	0.2890	3.5664	2.6377	0.8897	10.30231	2.9000	0	0

Table B2 – Descriptive statistics of the variables employed in the regressions

	gini	second-ary, %	minis-try, %	higher, %	inflation	socsec, %	dum1	dum2
Mean	0.2740	3.4207	2.4093	0.7389	1.0000	1.1100	0.1481	0.1852
Median	0.2816	3.4300	2.4200	0.7000	0.0086	0.6900	0.0000	0.0000
Maxi-mum	0.2989	4.2700	3.4400	1.0300	10.3023	3.5100	1.0000	1.0000
Mini-mum	0.2348	2.5800	1.5200	0.4400	0.0001	0.1300	0.0000	0.0000
Std. Dev.	0.0193	0.6088	0.5253	0.1462	2.4184	0.9500	0.3620	0.3958
Skew-ness	-0.7908	-0.0727	0.2205	0.2037	2.7995	1.2640	1.9809	1.6209
Kurtosis	2.3133	1.5094	2.2821	2.4405	10.1319	3.1828	4.9239	3.6273
Jarque-Bera (Prob.)	3.3446 (0.1878)	2.5233 (0.2832)	0.7985 (0.6708)	0.5389 (0.7638)	92.4898 (0.0000)	7.2272 (0.0270)	21.8217 (0.0000)	12.27 (0.0022)
Obs	27	27	27	27	27	27	27	27

Note: Probability levels of significance are contained within parentheses.

Table B3 – Pearson correlation coefficients across the variables employed in the regressions

	gini	secondary	ministry	higher	inflation	socsec	dum1
secondary	0.8046 (0.0000)						
ministry	-0.6433 (0.0003)	-0.4595 (0.0158)					
higher	-0.4002 (0.0386)	-0.2358 (0.2364)	0.8850 (0.0001)				
inflation	0.2951 (0.1351)	0.0658 (0.7444)	0.1095 (0.5866)	0.2863 (0.1477)			
socsec	0.3088 (0.1170)	0.2435 (0.2210)	-0.0680 (0.7360)	0.2037 (0.3081)	0.7718 (0.0001)		
dum1	0.2580 (0.1938)	-0.1414 (0.4817)	0.1030 (0.6092)	0.1382 (0.4917)	0.4698 (0.0134)	0.3238 (0.0995)	
dum2	-0.8350 (0.0001)	-0.6246 (0.0005)	0.6314 (0.0004)	0.4025 (0.0374)	-0.2009 (0.3151)	-0.2698 (0.1735)	-0.0935 (0.6428)

Note: Probability levels of significance are contained within parentheses.