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Income Inequality and Growth in Transition Economies

Are Nonlinear Models Needed?

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Abstract

This paper analyses the relationship between income inequality and growth in transition economies. The distinct and complex dynamics adherent to these economies lead to the proposition of new econometric models in the paper. However, empirical results do not support the proposed more flexible nonlinear functions. Further, the Kuznets hypothesis is clearly rejected by our data. On the contrary, a (first) half U pattern is found to be adequate for describing the inequality-growth relationship. Consequently, the rising inequality commonly observed in transition economies does not constitute part of the empirical regularity found by Robert Barro and others.

Keywords: Kuznets hypothesis, transition economies, functional form, inequality

JEL classification: O57, P20, O15

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1. Introduction

There exists a vast literature on the relationship between inequality and growth, largely centering around the famous Kuznets hypothesis. Despite hundreds of publications, the debate is not concluded and may never be. Changes in the fundamentals of various economies and availability of new data sets naturally give rise to different perspectives and may call for different approaches. Recent examples include Deininger and Squire (1998), Barro (2000), and Thornton (2001). As discussed below, the present paper is motivated in this spirit as well.

Focusing on transition economies is important, not merely because little, if any, effort has been made to formally test the Kuznets hypothesis in these economies. More importantly, transition economies were characterized or claimed to be more equitable in their socialism era, with a typical Gini index in the order of 0.2–0.25. Some even describe them as egalitarian societies. Prior to transition, these countries were of low income inequality and had experienced some economic growth over time. Unfortunately and unforeseen beforehand, economic transition has generally resulted in rising inequality but with negative or little positive growth. There are exceptions, such as Estonia which has enjoyed reasonable growth. Notwithstanding country-specific differences, the evolution of inequality-growth relationship for these economies as a whole differ fundamentally to their non-transition counterparts. Such fundamental differences justify a separate treatment and special focus.

Of particular significance is the issue facing policymakers in transition economies: does the claimed negative relationship (rising inequality with negative growth) represent a temporary phenomenon or in fact form a segment of the Kuznets curve? If the former, rising inequality in these countries can be viewed as an adjustment cost of transition. Further increase in inequality may occur in the long run as these economies enter the growth phase. Under this scenario, policy measures, potentially effective, could be used to tackle the problem if needed. Conversely, if the Kuznets hypothesis is accepted, government policy would be ineffective (Atkinson 1999). In the long run, the economy will get out of this problem in a natural way.

In addition to the above justifications of the paper, the following points are worth noting. First, confirmation of a Kuznets curve would lend support for growth-focused development strategies. This, in turn, would provide a basis for government not to intervene in income distribution during the transition period, or at least not treating it as a policy priority. Second, income distribution is closely related to other social problems such as poverty, crime, morale and political stability. The inequality-growth relationship, once identified, will allow judgement to be made on its likely prospect and can be used to assess the impact of inequality on many socioeconomic problems. Third, much has been written on transition economies and some, as reviewed below, are closely related to inequality. Although within-country studies exist, the present paper will contribute to cross-country studies of income distribution in transition economies and is of complementary value to existing works on other aspects of transition economies in general. In particular, it would help facilitate future studies in this area. Although reforming economies in Asia are not included in this study (see discussions later), findings from this paper will be useful for other economies in Asia including China and Viet Nam. Finally, as discussed later, the issue addressed in this paper is not resolved as different studies draw different conclusions (note, however, none of them directly tested the Kuznets hypothesis presumably due to lack of data).

Major points of departure of this paper from the literature include (a) a refined focus on transition economies of Europe and Central Asia, a broadly homogeneous group; (b) proposing and estimating *nonlinear* Kuznets curves along with conventional linear models; (c) use of high quality and consistent data that combine time series with cross-country observations. A particular advantage of focusing on transition economies is that they are homogeneous in terms of development mechanism, reform strategies and timing. More importantly, the pretransition economic systems including income distribution policies were more or less similar among them. Concerned about heterogeneity commonly observed in the literature, Kanbur (2000) calls for within-country studies. However, scarcity of inequality data for individual countries is still a hurdle. Hopefully, confining to transition economies is a step forward in addressing the heterogeneity problem. It is useful to note that earlier panel studies usually pool all data points in developing or developed countries. More recently both developing and developed countries are pooled together (e.g., Barro 2000, Thorton 2001).

This paper is among the first to empirically test the Kuznets hypothesis in a setting of cross-country transition economies. Despite the previously mentioned homogeneity, divergence in income distribution trend exists in the transition period of early 1990s to present. Previous studies and evidence as presented in Table 1 suggest that a roller-coaster pattern best describes the inequality-growth relationship in some economies. As a consequence, the traditional linear models are clearly inadequate as they only allow for one turning point. Even in the spirit of Kuznets (1956), there is no theoretical or empirical ground for one to confine to linear models. Thus, different forms of nonlinear functions will be proposed and estimated. Comparisons with the linear models will be undertaken. The experiment with nonlinear models in this paper is a valuable addition to the literature as both developed and developing countries are believed to possess inequality-growth curves with multiple turning points (Atkinson 1999, Ikemoto and Uehara 2000).

A long-standing problem with testing the Kuznets hypothesis relates to data. Ravallion (1997) and many others are overwhelmingly concerned about consistency, quality and coverage of sample observations. This is particularly important when panel data are used. As detailed in Section 3 of this paper, our data are of the best quality and consistency possible and we managed to come up with over 200 observations. Inequality data are comparable to Deininger and Squire (1996) in terms of consistency and quality. Growth data are exclusively from the World Bank's world development indicator database (WID).

The plan of the paper is as follows. The next section defines our research problem in more detail. Section 3 discusses the modelling strategy. It introduces nonlinear versions of the Kuznets curve. Data and model estimation results are presented in Section 4. Section 5 concludes.

2. The research problem further defined

Before preceding any further, it is necessary to discuss the definition of transition. It seems that there is no clear consensus on this term. For aid allocation purpose, OECD identifies and separately lists countries and territories in transition. Such a classification is hardly consistent with usual perceptions, which define transition as a process of reform from the socialist command system to a market system. Besides, the OECD list varies from year to year. The World Bank does not seem to follow the transition/non-transition classification. Neither does the United Nations.

Economic transition, according to Kolodko (2000), means abandoning the socialism system and embracing the capitalism. Since China, Viet Nam and the like have not declared death of socialism, they are not classified as transition economies by Kolodko. This is perhaps one of the reasons behind the OECD classification of countries. While not entirely in agreement with this classification, we choose to leave China and Viet Nam out in order to avoid confusion. This definition emphasises economic reform such as privatization, deregulation and market liberalization as much as political reforms including democratization, political liberalization and non-economic openness to the outside world. In passing, it is noted that a most striking difference between Asian reforming economies and their transition counterparts is that the latter were more industrialized and more affluent before reform began.

Given the above definition, it is possible to state that economic growth has suffered in all transition economies, dramatically in the FSU—former Soviet Union states (Doyle 1996)—and significantly in the CEE—Central and Eastern European countries (Rosser, Rosser and Ahmed 2000; Mikhalev 2000:49; Orlova and Ronnås 1999; Milanovic 1999:299). The drops in GDP were very sharp in the first year or two of transition. Recovery has been slow in general and has not reached the pretransition level for some FSU states. On the other hand, inequality has increased more severely in FSU than in the latter (Cornia and Popov 2001). Unlike the GDP, inequality basically maintained an increasing trend although levelling off or even slight decreases were observed lately in a small number of countries. Based on an analytical construction, Ferreira (1999) predicts that rising inequality in transition economies is inevitable and further development is unlikely to lead to its decreases. All of these studies seem to point to an initially negative and subsequently positive relationship between growth and inequality in transition economies. In other words, they all reject the notion of inverted U in transition economies.

On the other hand, relying on simulation results from a dynamic model, Dahan and Tsiddon (1998) concluded with an inverted U pattern of income distribution for countries under transition. This is partially supported by Aghion and Commander (1999) who constructed a general equilibrium model to simulate inequality and growth pattern in transition economies. Fan and Fan (2000) also asserted that the Kuznets inverted U applies to transition economies in general. All of these studies point to the existence of the Kuznets inverted U pattern.

In between these two contrary views, Keane and Prasad (2002) documented a rollercoaster pattern (spike, decrease and increase) for Poland and then generalized the pattern to all transition economies in general. The rollercoaster pattern was also present in Hungary (Kattuman and Redmond 1997). Most recently, Fedorov (2002) shows that inequality in Russia increased rapidly during 1991-6, levelled off and then declined. Meanwhile, Kattuman and Redmond (2001) perceive a long-run positive relationship between growth and inequality in Hungary. Garner and Terrell (1998) found the surprising results of stable inequality in Czech and Slovak republics.

The diverse conclusions or findings from previous studies highlight the importance of the issue to be addressed in this paper. They also call for two considerations. The first relates to the generality of a growth-inequality relationship in transition economies as a whole, rather than on an individual basis. On an individual basis, they all differ. One may still ask if the diverse relationships can be reconciled and generalized. This calls for a cross-country study. Put it differently, to draw general conclusion about inequality-growth links in transition economies requires empirical cross-country modelling. It is possible that taking the transition economies as a whole there does not exist any significant linkage between growth and inequality.

The second consideration, not unrelated to the first, is concerned with functional forms for the Kuznets curve. It seems that the growth-inequality curve, if existing, are likely to have two or multiple turning points. Therefore, the underlying pattern may not be uncovered with conventional models for testing the Kuznets curve as almost all of them, apart from a constant term, only possess two parameters. These models only permit one turning point. Clearly, a more general model accommodating multiple turning points is necessary in order to reconcile the diverse patterns in individual countries. Note, however, such a cross-country model typically comes with a low goodness of fit. Nevertheless, it is not our intention to address the within-country variation in inequality, nor cross-border difference in the inequality. We simply focus on testing the Kuznets hypothesis in transition economies as a whole.

In passing, it is noted that this study focuses on transition economies, not on a transition *period* of transition countries. In fact, we test the stability of our empirical model between pretransition and transition periods.

3. Modelling approach

As pointed out by Ram (1995:430), almost all empirical studies on the Kuznets hypothesis employ second degree polynomials in levels or logarithms of income. These models typically have two slope parameters, which only allow for one turning point in the underlying relationship. As argued earlier, this is inadequate for the transition economies (see Table 1 as well). It is also inadequate for the industrialized countries in view of the transatlantic consensus—a term due to Atkinson (1999)—meaning that the inequality-growth curve has doubled back after an inverted U.

To postulate new functional forms, a good starting point is the nonlinear exponential function appeared in Ram (1995:431):

$$INEQ=(1 - e^{-b1\,Y})\, e^{-\,b2\,Y} \qquad (1)$$

where INEQ=inequality measured by one of the many indicators, Y=level of development, usually represented by income or GDP. A distinct feature of this model is that when the mean income is zero (which implies zero income for everyone thus perfect equality), predicted inequality by the model is zero. The conventional linear specification often predicts high levels of income inequality when the mean income is zero. This, of course, is theoretically undesirable. Equation (1) was put forward to address this problem.

Despite its flexibility in allowing for different shapes of the underlying curve, model (1) like conventional models allows only one turning point, occurring at the income level of Ln [(1+b1/b2)/b1]. Further, b1 must not be zero, or there would be no turning point at all. In fact, b1=0 would mean perfect equality according to (1). Also, b2 must not be zero, or there would be no turning point either. A statistical problem is that one cannot even hypothesise a zero value for either of these parameters. In other words, the model does not allow for the possibility of insignificant relationship between development and growth. These are all restrictive.

It is important to point out that the Kuznets curve is supposed to involve only one independent variable—economic development. Given this, there is no reason why only two (slope) parameters must be maintained in model specification as long as addition of new terms and parameters does not bring about econometric problems, such as multicollinearity. It is true that there exists a minority of research in the literature which did propose multivariable Kuznets curve. This is against the original idea of Kuznets who intended to theorize an unconditional and general inequality-growth pattern. Also, the conditional approach is inappropriate in the sense that the control variables can be deemed redundant in testing the Kuznets hypothesis, since they are usually highly collinear with GDP or income. Needless to say, studies intending to discover determinants of inequality are not subject to this criticism. As a consequence of the above arguments, we amend equation (1) by a linear as well as a quadratic term to obtain

$$INEQ=(1 - e^{-b1\,Y})\, e^{-b2\,Y} + b3\,Y + b4\,Y^2 \qquad (2)$$

Two terms are added because only adding a linear term will not solve the single turning-point problem. With addition of a linear term alone, the unique turning point occurs at $-1/b2\,Ln(-b3/(b1(1-b2)))$. Further adding the quadratic term will allow for multiple turning points. Now, a closed-form solution for the turning points does not seem to exist any more. It is useful to note that the amended model (2) preserves the property of zero prediction when mean income is zero. Also, testing of bs=0 is now permissible.

An advantage of the amended model is that one can conduct model selection to choose between the exponential form of Ram or the commonly used polynomial form, based on a generalized likelihood ratio test. If b3=b4=0 is accepted, the nonlinear exponential form is preferred. If b1=b2=0 is accepted, the conventional linear function without a constant is preferred. It is possible that both of these forms can be rejected or accepted. In the case of accepting both, the model with higher loglikelihood value would be preferred. In the case of rejecting both, the amended form would be preferable or alternative models must be sought. Of course, instead of adding linear terms, one may like to add loglinear terms to (1):

$$INEQ=(1 - e^{-b1\,Y})\, e^{-b2\,Y} + b3\log Y + b4\,(\log Y)^2 + b5 \qquad (3)$$

A similar testing procedure as outlined above can be followed for model selection. One point deserves particular attention. That is, unlike in the linear case, a constant term can be added to the function with loglinear terms. See the exchanges between Ravallion (1997) and Ram (1997).

Work by Anand and Kanbur (1993) demonstrate that when inequality is measured by the Gini coefficient, neither linear nor loglinear specifications are recommended. Instead, they suggested a linear term combined with a reciprocal term. Following earlier amendments, a nested model of (1) and what is suggested by Anand and Kanbur can be expressed as

$$INEQ=(1 - e^{-b1\,Y})\, e^{-b2\,Y} + b3\,Y + b4\,(1/Y) + b5 \quad (4)$$

Equations (1)–(4) can be estimated once a stochastic error term is added. To facilitate model selection, the three conventional linear models contained in (2)–(4) (i.e., after imposing b1=b2= 0) will also be estimated. In view of the exchanges between Ravallion and Ram, whenever the linear model is involved, two versions will be estimated, one with and the other without a constant term.

4. Data and estimation results

Data for fitting the Kuznets curve has been a long-standing issue. As the Kuznets hypothesis essentially concerns a long-run relationship but sufficiently long time series of inequality indicators is lacking, most studies use cross-section data. This brings about all sorts of issues on consistency, coverage, quality and measurement and so on (Ravallion 1995, 1997). Although in a recent article, Robert Barro (2000) finds it non-essential to consider quality of inequality measures designated in Deininger and Squire (1996), others strongly argue for control for quality in modelling.

For this study, observations on inequality are obtained from the database compiled by the United Nations University's World Institute for Development Economics Research (UNU/WIDER 2000). It is the most comprehensive database on inequality available. It follows Deininger and Squire (1996) in the compiling process thus is fully compatible with their data. In total, it contains 5,050 Gini coefficients from 151 countries, 2,593 of which are provided by Deininger and Squire (1996). Among the 5,050 observations, 2,185 are of reliable quality and consistency (UNU/WIDER 2000). However, some of these 2,185 values are duplicates in the sense that two or more sources provided estimates for the same country and same year. Eliminating duplicates reduces the quality observations from 2,185 to 1,149.

A word on the Gini coefficient is in order. As argued by Fields (2001:32-3), the Gini satisfies the axioms of anonymity, income homogeneity, population homogeneity, and the transfer principle. It is as good as other inequality measures on other grounds. Dagnum (1990) proves that only the Gini ratio is supported by observed economic unit's behaviour as it is based on non-individualistic or interpersonal utility and disutility functions. Other inequality measures generally imply decreases in social welfare following a drop in income of an economic unit independent of what might happen to the overall income inequality. In contrast, the social welfare function underlying the Gini index is an increasingly function of the mean income and decreasing function of the income inequality Gini ratio. In short, the Gini index allows for a much more realistic interpretation of both social welfare and social income inequality than the Theil, the generalized entropy and the Atkinson inequality measures (Dagnum 1990:99).

GDP data are extracted from the World Bank's WDI database. We choose this rather than the Penn World Table because the WDI is more updated and it contains more variables than the latter. This is important as we plan to conduct further research linking inequality with other variables. In any case, the WDI data are consistent and widely used. Data before

1960 are not available. This is of little consequence as over 95 percent of the Gini estimates used in this paper are for 1980s and 1990s. Per capita GDP in 1995 US dollars will be used. There are many missing observations on GDP in the WDI database. When putting the high quality Gini and available GDP observations together, a total of 753 valid pairs are obtained. Restricting to the transition economies resulted in a total of 202 data points. This sample size is reasonable for our study. In fact, it is quite a large sample relative to Ram (1995) and Rosser, Rosser and Ahmed (2000) who used only 36 and 70 observations, respectively.

The countries included in the study are tabulated in Table 1, which also shows a range of variable values and data availability. Except Mongolia, all the countries included in this study possess multiple observations. Some have quite long time-series. To gauge some ideas about growth-inequality relationships, time profiles of Gini and GDP are depicted in columns 5 and 7, respectively in Table 1. Contrasting these profiles for individual countries indicates that some show a clear correlation, others do not. A preliminary data analysis is deemed to add little value given the discussions in Section 2 above.

Despite the fact that the countries under study are reasonably homogenous, country-specific effects deserve some attention. Allowing for such effects in the panel data would enable us to account for cross-country characteristics, such as geographical, political factors or culture (Islam 1995). On the other hand, ignoring these effects may produce totally misleading results (Fields 2001: Chapter 3). There exist different approaches to handling these effects in panel data modelling. Among them are random effects or error components, fixed effects or dummy variables as well as the first-differencing approaches. Taking first differencing is impossible for countries with only one observation. One could drop these countries from the study but this is certainly not recommended. Given the acute scarcity of data on inequality and existence of alternatives, every effort should be made to preserve degrees of freedom. Error components (random effects) approach assumes independence of GDP and the unknown country effects, an assumption hardly justifiable. Recently, mixed fixed and random coefficient (MFR) models of Hsiao (1989) are being applied (see Nair-Reichert and Weinhold 2001). However, there is no clear evidence showing the superiority of MFR approach over the others.

In this paper, we choose to follow Barro (2000:28) to adopt the simple but popular dummy variable approach while acknowledging the incidental parameters problem addressed by Hsiao, Pesaran and Tahmiscioglu (2002) and others. Given the number of functional forms under scrutiny, estimations are accomplished in two stages. In the first stage, heterogeneity is not considered. This is partly due to the fact that incorporating dummy variables into the nonlinear models could be difficult. The first round estimation results are tabulated in Table 2. Focusing on the conventional linear models (columns 2-5), it was surprising to find that they performed reasonably well—surprising in the sense that our initial intention to include them was largely for comparison purpose. In particular, the loglinear and reciprocal models both produced R^2s close to 0.4. And all parameters are found to be significantly different from zero except the linear term in the reciprocal model. This is rather encouraging as Fields (2001:39) states that, in cross-country studies, the R^2 is usually low, typically on the order of 0.2 or less. Among the linear models, the loglinear specification (column 4) turns out to be the best, followed by the reciprocal specification (column 5). The loglinear model has the highest R^2, lowest SSE and the highest loglikelihood value. In contrast, the linear model with no constant performed appallingly.

Table 1: Data description

Country	Year	No. obs.	Gini range	Time pattern	GDP range	Time pattern
Armenia	90, 92-7	7	26.9-62.14	Inv-U	686.56-1540.77	Inc-U
Azerbaijan	88-90, 96-7	5	27.5-44.96	U	377.68-1367.31	\
Belarus	88-90,92-7	9	23.14-33.59	R-C	1952.2-3117.37	R-C
Bulgaria	80-97	18	20.69-37.15	U	1317.21-1895.41	R-C
Croatia	97-8	2	24.62-26.8	/	3918.83-4080.9	/
Czech Rep.	90-7	8	18.85-28.14	U	4651.07-5288.01	U
Estonia	81,86,88-9,92-8	11	25.1-39.57	R-C	3063.27-4806.91	R-C
Georgia	95-7	3	51.86-58.71	Inv-U	350.78-428.36	/
Hungary	62,67,70,72,74 76-8,80,82,84,86-98	24	20.42-31.62	R-C	1891.63-5017.51	R-C
Kazakhstan	88-90,96	4	28.9-35.4	U	1285.43-2235.26	\
Kyrgyz Rep.	86,88-90,92-7	10	25.9-43.1	R-C	724.37-1492.03	R-C
Latvia	81,86,88-98	13	24.0-34.9	R-C	1900.46-3730.79	R-C
Lithuania	88-90,92,94-7	8	24.4-36.99	R-C	1676.78-2985.86	R-C
Macedonia	90-7	8	23.41-27.93	R-C	1268.58-1537.12	\
Moldavia	89,90,92-5,97	7	25.8-46.63	R-C	685.77-1817.17	\
Mongolia	95	1	33.2		420.55	
Poland	90-7	8	25.49-34.2	R-C	2414.04-3241.79	R-C
Romania	89-97	9	22.9-31.2	U	1238.39-1627.32	Inc-U
Russian	81,86,88-92,94-8	12	23.5-38.2	R-C	2133.6-3796.26	Inv-U
Slovak Rep.	88-97	10	18-24.83	U	3081.98-4148.07	R-C
Slovenia	90-7	8	23.8-29.64	/	8330.74-10217.58	U
Turkmenistan	88-90,98	4	25.5-40.8	U	845.61-2148.35	\
Ukraine	88-97	10	21.8-36.79	R-C	844.5-2118.87	\
Uzbekistan	88-90	3	25.7-31.5	U	980.59-983.86	/
Total obs.		202				

Source: Based on WIID (UNU/WIDER 2002).

It seems that in order to impose the theoretically sound restriction of Ram (1995), models other than the linear specification must be employed. Our results do not necessarily reject the restriction. Rather it may imply that the linear form is inadequate for addressing the problem raised by Ram (1995). By the same token, the significance of the constant term in the linear model does not mean that inequality as indicated by Gini should be as high as 40 percent when per capita GDP is zero for every sample point. It can be said that the constant term essentially captures the deterministic or non-stochastic component of the dependent variable Gini, which is not explained by the linear model. Put differently, the constant estimate here may signify the ignorance of our understanding about that part of the Gini.

Table 2: Estimation results without country dummies

Independent	Linear Model				Exponential and				Exponential
Variable or	Linear	Linear	Loglinear	Reciprocal	Linear	Linear	Loglinear	Reciprocal	only
Parameter	a=0	a • 0			a=0	a • 0			
GDP	0.146	-0.06		0.002	0.09	-0.134		-0.051	
t-raio	19.21	-8.324		0.51	20.44	-5.58		-0.73	
GDP^2	-0.014	0.005			-0.007	0.009			
t-raio	-11.33	6.45			-10.66	4.89			
Ln GDP			-0.115				-0.125		
t-raio			-9.97				-6.51		
$(\text{Ln GDP})^2$			0.036				0.033		
t-raio			5.26				3.21		
1/GDP				0.108				0.037	
t-raio				8.66				0.53	
b1					2.553	-0.654	-0.089	-0.11	0.56
t-raio					8.09	-3.46	-0.78	-0.8	11.96
b2					1.15	1.28	1.184	0.567	0.335
t-raio					24.98	6.49	1.82	1.82	17.04
Constant		0.404	0.347	0.228		0.726	0.373	0.378	
t-raio		31.41	52.54	15.16		10.01	11.41	2.65	
R^2	-3.18	0.3	0.39	0.38					
Adjusted R^2	-3.2	0.29	0.39	0.38					
SSE	5.21	0.87	0.75	0.77					
Loglikelihood value	82.84	263.09	277.93	276.18	263.55	281.31	278.27	277.29	165.33
Sample size	202	202	202	202	202	202	202	202	202

Source: Calculated by the author.

Among the nonlinear models (columns 6-10), the original form suggested in Ram (column 10) is clearly a failure; it has the lowest loglikelihood value than all models presented in Table 2 except the conventional linear model with no constant (column 2). The exponential-linear (with constant) combination has the largest loglikelihood value (column 7). However, the model predicts a Gini of 73 percent when all GDP is zero, a clear indication of its inadequacy despite its statistical superiority. Rejection of this model coupled with the significance of the constant term imply that the exponential-linear (no constant) combination is deficient in describing our data. That leaves us with two choices: the exponential-loglinear combination (column 8) and exponential-reciprocal combination (column 9). Note that, apart from the constant term, the former has two significant parameters and the latter has none. Therefore, the nonlinear reciprocal model has little power in describing or explaining the growth-inequality relationship.

Based on the discussions of the preceding two paragraphs, two preferred models can be selected from the first stage of estimation (models without country dummies): the loglinear specification among the linear models and the exponential-loglinear combination among the nonlinear ones. In choosing a most preferred model from Table 2, attention must be paid to both statistical and non-statistical considerations. Using the generalized likelihood ratio test, the nonlinear version is rejected at the 5 percent significance level in favour of the conventional loglinear form. It is interesting to note the closeness of parameter estimates by these two models (of course, parameters in the exponential function must be left aside). By the same test, the nonlinear reciprocal model would be rejected in favour of the conventional reciprocal equation.

In summary, all the nonlinear models are rejected, indicating the adequacy of conventional linear models in analysing inequality-gorwth relationships in transition economies as a whole or individually. Among the linear models, the loglinear form performs better and this is our most preferred model from the first round of estimation.

In Figure 1, we plot GDP against the predicted Gini values given by various models. It is clear that both preferred models (conventional loglinear and exponential-loglinear) confirm a similar half U pattern (panel A of Figure 1). A rising tail is more evident based on the former—the most preferred model among models without country dummies. To assess the sensitivity of modelling results to functional forms, we also plot the predicted values by the other models in panels B-D of Figure 1. Panel B indicates that the exponential-only model portrays quite nicely a Kuznets curve, so does the conventional linear model without a constant term. Interestingly, both of these models are suggested by Ram (1995) and were used by Ram to substantiate existance of Kuznets curve. These are deceptive as demonstrated by our modelling results. The diverse shapes of the curves in Figure 1 indicate the importance of model specification. It is worth reiterating that the rejection of the nonlinear models cannot be taken in a general sense. These nonlinear models could be valid for other data sets. In other words, the selection of functional form is essentially an empirical question.

It must be remembered that all the above models are estimated without country dummies, whose inclusion is bound to improve the R^2 for the conventional linear models and the loglikelihood values for all models. More importantly, Fields (2001:41-2) demonstrates the need to estimate fixed-effect models and shows how non-incorporation of such effects could turn a statistically significant U into a spurious inverted U. This finding was also present in Ravallion (1995), Deininger and Squire (1998), Schultz (1998) and Bruno, Ravallion and Squire (1998). Having decided not to incorporate dummies in the nonlinear models (the nonlinear models are all rejected anyhow), it is now necessary to proceed to the second stage of modelling where we estimate the linear models with fixed effects and come up with a finally preferred model.

Figure 1: Kuznets curves: based on various models

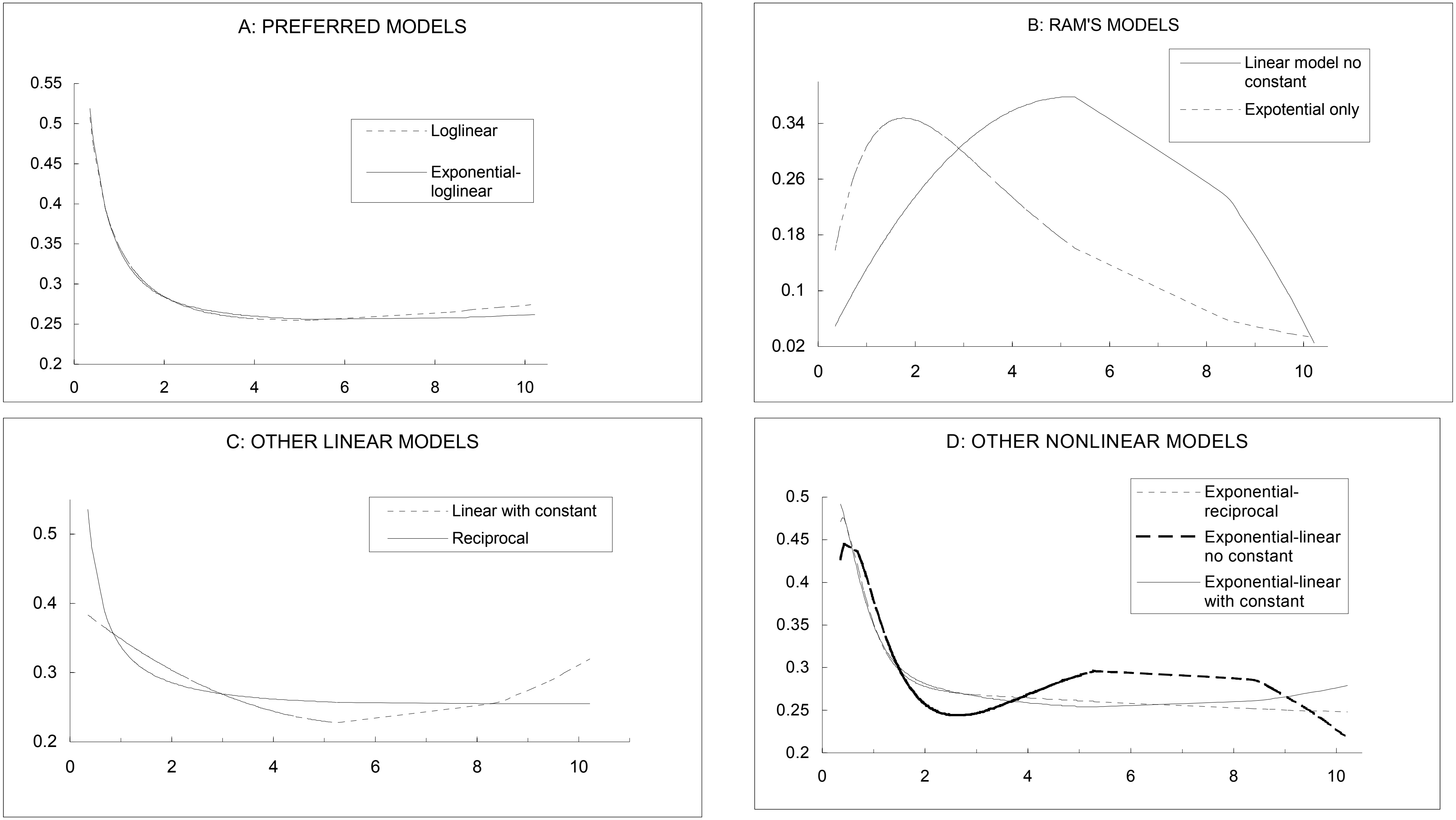

Table 3: Estimation results with fixed effects and transition dummies

	Fixed Effects				Allow for Transition Dummy			
Independent Variable	Linear a=0	Linear a • 0	Loglinear	Reciprocal	Linear a=0	Linear a • 0	Loglinear	Reciprocal
GDP	0.138	-0.103		-0.017	0.111	-0.084		-0.011
t-ratio	7.68	-7.9		-2.18	7.53	-6.81		-1.62
GDP2	-0.018	0.01			-0.013	0.008		
t-ratio	-5.42	5.01			-4.9	4.52		
Ln GDP			-0.12				-0.099	
t-ratio			-9.48				-8.26	
(Ln GDP)2			0.018				0.018	
t-ratio			1.66				1.81	
1/GDP				0.087				0.074
t-ratio				6.09				5.65
Constant		0.475	0.36	0.279		0.417		
t-ratio		24.59	27.21	10.06		20.8		
Transition Dummy					0.135	0.051	0.049	0.05
t-ratio					9.86	6.08	5.95	6.07
R^2	-0.62	0.63	0.66	0.65	-0.05	0.69	0.71	0.71
Adjusted R^2	-0.79	0.59	0.62	0.61	-0.17	0.65	0.68	0.67
SSE	2.02	0.46	0.43	0.44	1.31	0.386	0.36	0.36
Loglikelihood value	178.63	326.89	334.96	332.62	222.04	345.77	353.07	351.4
Sample size	202	202	202	202	202	202	202	202

Source: Calculated by the author.

In the second stage of modelling, we first consider the country fixed effects and then examine stability of the Kuznets curve. The latter is needed because there are compelling reasons to expect different Kuznets curves for the pretransition and the transition periods. Results of fixed-effects models are presented in Table 3 (columns 2-5). Following convention, estimates associated with country dummies are not reported. A pair-wise comparison indicates that except the linear term in the reciprocal model, all other estimates maintain the same signs as their counterparts in Table 2. Essentially, this means that the Kuznets curves implied by the models are not sensitive to the country dummies—a finding contrary to that of Fields (2001). However, the goodness of fit increased quite substantially with the addition of the dummies. Thus, the fixed effects model can explain a large percentage of cross-country variation in income equality. Judging by the loglikelihood value and R^2, the loglinear form is still the best among the models in columns 2-5 of Table 3. Simple Chi-square tests confirm the validity of the fixed effects under any model specification. The small sample F-tests also favour the dummy variable models.

Having confirmed the validity of fixed effects, attention is now turned to the stability of the growth-inequality curve. For this purpose we follow Barro (2000) by incorporating transition dummies into the fixed effects models. Although different countries entered transition at slightly different times (Blanchard 1997), the difference is negligible and a bit fuzzy (Blanchard 1997:2). Therefore, we define 1990s as the transition period. The estimation results (not presented, but available upon request) indicate that none of the (transition) slope dummies are significant but all (transition) intercept dummies are significant. These results imply that apart from a parallel shift, the growth-inequality relationship is stable as far as its shape is concerned.

Given the above, we drop the (transition) slope dummies from the model specifications and re-estimate the fixed effects models with the intercept dummy only. The estimation results are presented in columns 6-9 of Table 3. Consistent with a priori expectations, the coefficients for the intercept dummies are all positive and significant in all models. Further, simple F-tests help to draw the conclusion that the fixed effects models with intercept dummies are preferred to those without these dummies. Nevertheless, if one compares the estimated values between columns 2-5 and 6-9, it is quite clear that there is no change in the signs of the estimates and changes in magnitudes are small. However, there is a general decline in the t-ratios once the intercept dummy is added. This signals some econometric problems with the models without the dummy—likely heteroscedasticity over time. It is easy to identify that the loglinear specification with fixed effects and intercept dummy is the finally preferred model. In this model, the linear term is negative and the quadratic term is positive, thus a U rather than inverted U is found. To obtain a net relationship between GDP and inequality, predicted value of Gini after filtering out the estimated effects of the control dummies are plotted against log (GDP). See Barro (2000:25). The plot confirms an incomplete U pattern, once again (the shape looks more like a linear rather than U curve because of the use of log (GDP) as the horizontal axis). See Figure 2.

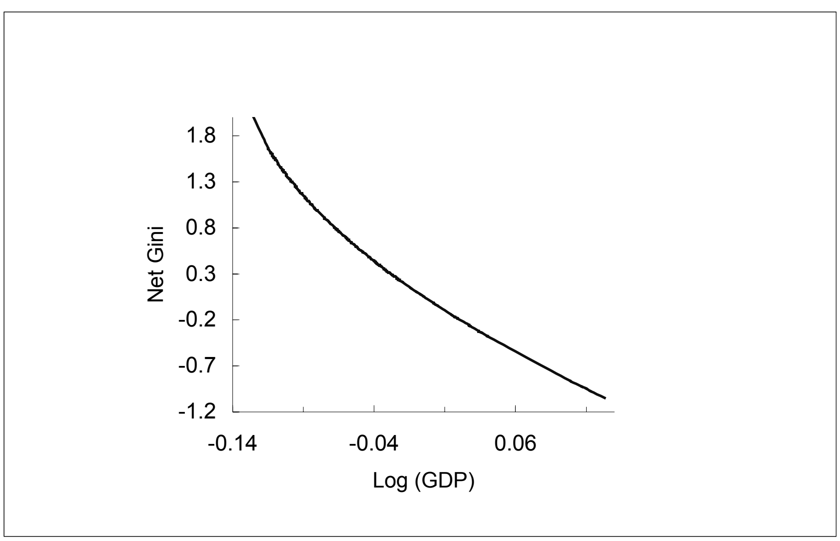

Figure 2: Kuznets curve

Our findings are not consistent with Fields (2001) and those quoted by Fields. In this paper, models with and without fixed effects and with and without transition dummies all point to an incomplete but *significant* U pattern. In contrast, the general conclusion of Fields (2001) is that there does not exist any relationship between inequality and growth. It is possible that the pattern discovered in this paper is unique to transition economies and cannot be generalized. Even if this is the case, our findings raise doubts on conclusions of any study based partially or fully on data from the transition economies where such a unique pattern is not duly taken into consideration.

Our findings refute the models and findings of Dahan and Tsiddon (1998) and others who tend to generalize an inverted U Kuznets curve for transition economies as a whole. Their models and analytical frameworks must be flawed given the stylised facts (see Table 1) and findings from the present cross-country study. Of course, one may speculate that the Kuznets curve may resurface once these countries enter the post-transition growth. But, then, they are no longer transition economies any more and many features of the analytical approaches in Dahan and Tsiddon (1998) and others are likely to change. Our results also indicate that inequality increase after transition is only a temporary phenomena and can be taken as the cost of transition. Since the increases are found not to be part of the regularities found elsewhere, policy measures, if deemed necessary, can be instituted to address the income distribution problem by the transition governments.

5. Concluding remarks

In the 1980s, the transition economies faced the choice of equality of poverty or inequality of prosperity. Economic transition while leading to rising inequality has not brought about prosperity in the countries under consideration. One has to ask: is this the price that must be paid? Is this going to be a temporary phenomenon? This study points to rising inequality not being part of the inevitable Kuznets curve, nor a part of the empirical regularity found by Barro (2000). The implication is clear: policy initiatives would be effective and in fact urgently needed—urgent in the sense that if there is a turning point in sight, it looks like to be a rising one. In this aspect, our finding, somehow surprisingly, is in line with the theoretical prediction of Ferreira (1999).

Rejection of the nonlinear models must be viewed in the particular context of transition economies. Elsewhere, there are arguments which point to double or multiple turning points (see Ikemoto and Uehara 2000, and Atkinson 1999). The proposed nonlinear models may well find applicability in a different context. An alternative to the nonlinear specification is to add even higher orders of polynomials (List and Gallet 1999). Such a practice is likely to be problematic as multicollinearity could become too severe to enable identification of significant parameters. This may explain why only the cubic term is significant in their study.

Future work is needed to explore the theoretical constraint proposed by Ram (1995) if one wishes to continue to use the conventional linear model. More work is also needed for developing economically sensible nonlinear models. What this paper did is simply to combine existing models without much theoretical construct. This may have contributed to the poor performance of nonlinear models in this paper. Another direction for future study is to explore the causes of changing inequality—be it structural change, technical progress, trade and globalization or some other factors.

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