ECONOMICS BULLETIN

Income Inequality and Marriage

Kwang Woo Park
Minnesota State University, Mankato

Myeong Hwan Kim
State University of New York at New Paltz

Soung Chan Lee
Plymouth State University

Abstract

This study examines the extent to which changes in household formation exacerbated income inequality in the United States during the last two generations. Using a time-varying parameter model, the impact on how marriage decisions, changes in human capital, and fertility choices influence inequality are estimated. The estimation results show that marital sorting evolves over time and positively and increasingly affects the degree of income inequality and intergenerational human capital transmission induces path-dependent income distribution dynamics. This suggests that intrahousehold choices explain a substantial proportion of income distribution dynamics.

Citation: Park, Kwang Woo, Myeong Hwan Kim, and Soung Chan Lee, (2007) "Income Inequality and Marriage." *Economics Bulletin*, Vol. 15, No. 20 pp. 1-12
Submitted: August 28, 2007. **Accepted:** October 9, 2007.
URL: http://economicsbulletin.vanderbilt.edu/2007/volume15/EB-07O10035A.pdf

'Likes' tend to marry each other, when measured by intelligence, education, race, family background, height, and many other variables.

Gary Becker, Economic Analysis and Human Behavior, 1979, p.7.

1. Introduction

The increasing trend of income inequality over the last few decades has been a major concern of economists and policy makers. In the United States (US) a substantial body of literature has emerged examining the increased dispersion in the distributions of wages, incomes, and wealth.[1]

Since the largest component of income for most families derives from their earnings, much analysis has focused upon the increase in earnings inequality which is based on the difference of human capital. By focusing on the evolution of human capital, many recent studies have examined the role of household formation on income inequality (Fernández and Rogerson, 1998, 2001; Kremer and Chen, 2000; Fernández, et al., 2001). Marriage or household formation plays an important role not only in shaping income inequality, but also in representing one of the primary institutions by which income distribution dynamics take place. As both Becker and Tomes (1979) and Loury (1981) point out, the evolution of families across time play a central role through human capital investments on how parents affect their children's income earnings potential. Intergenerational human capital transmission induces path-dependent income distribution dynamics. As a result, when human capital is transmitted through mate selection, marital sorting can have significant consequences for income inequality. In addition, as long as families with less human capital decide to have more children and invest less in education, the path-dependent human capital transmission associated with larger fertility differentials can exacerbate the extent of income inequality.[2]

This study examines the role of assortative mating, fertility differentials and intergenerational mobility over the past two decades in order to explain the observed rise of income inequality for married couples in the United States. The study uses a time-varying parameter model to investigate the interactions between household formation and household income inequality. This is accomplished by using the Panel Study of Income Dynamics (PSID) data from 1968 to 1993. The degree of marital sorting, fertility differentials and intergenerational mobility are examined to capture the underlying trend in US income inequality.

2. Literature Review

This research is related to several literatures. There is a rapidly growing literature related to the intergenerational transmission of inequality in models with marriage matching (Kremer, 1997; Francesconi, 1995; Fernández and Rogerson, 1998, 2001; Fernández, et al., 2001, 2005). The majority of these studies examine the relationship

[1] For a literature review, see Katz and Autor (1999).
[2] For fertility differentials, see Kremer and Chen (2000).

between the degree of marital sorting and household income inequality. They are concerned with whether an exogenous increase in the degree of marital sorting can lead to a quantitatively significant increase in inequality. Specifically, Kremer (1997) argues that the quantitative effects of even a very large increase in sorting are likely to be very small, as far as the distribution of income is concerned. Instead, Kremer concludes that sorting has somewhat more significant effects on intergenerational mobility rather than on inequality. Contrary to Kremer's (1997) finding that marital sorting has an insignificant effect on inequality, Fernández and Rogerson (2001) find that increased marital sorting will significantly increase income inequality. In line with this strong positive relationship between sorting and inequality, Fernández, et al. (2001, 2005) endogenize the role of sorting on inequality in their model and show that the economy can converge to either a steady state with a high degree of marital sorting and high inequality or to a low-sorting and low-inequality steady state. Zak and Park (2002) point out that marital sorting evolves over time and is a main factor to engender the income distribution dynamics through modeling and simulating a mate selection theory.

On fertility differentials and the income distribution, there is a small literature relevant to this study. Lam (1986) analyzes the effects of fertility differentials on Lorenz curves and shows that the empirical relationship between fertility differentials and inequality is ambiguous. However, more recent studies find otherwise. Kremer and Chen (2000) point out that greater inequality tends to be associated with larger fertility differentials within a country. Fernández, et al. (2001) show that a greater degree of sorting leads to greater skill premia through greater fertility differentials. Greenwood, et. al. (2003) confirm this positive association between fertility differentials and income inequality in their model of marriage, the quantity and quality of children. Greenwood, et. al. (2003) explains that the poorest of the society like single mothers tend to have more children. As a result, single mothers' income that is small to begin with must be spread over the larger number of children. Increasingly greater portion of children in the society receive little investment in human capital and grow to earn less income. Income inequality widens over time.

In the wake of a pioneering work of Becker and Tomes (1979) on income and intergenerational mobility, studies have found empirical evidence that intergenerational mobility is positively correlated with income inequality (Becker and Tomes, 1986; Erikson and Goldthorpe, 1991; Ozdural, 1993; Bjorklund and Jantti, 1997). Maoz and Moav (1999) provide theoretical explanation for this positive relationship between intergenerational mobility and inequality in analyzing the role of mobility in economic growth. More recently, though, Davies, et al. (2005) point out possible differences in the relationship between in the short and long run. In modeling the role of private and public education on long-term growth, they find "In steady states, more mobile societies have less inequality; but in the short run, higher mobility may result from an increase in inequality."

There is also a body of descriptive and empirical literature that is related to this study. As reviewed by Lam (1988), the general consensus is that there is positive assortative mating across spouses. For example, Fransconi (1995) shows that positive marital sorting has increased over time and the husband-wife correlation of education in families with high-income men have increased faster than in families of lower-income men in the US between 1976 and 1992. Similarly, Schwartz and Mare (2005) report that educational homogamy increased in the United States from 1960 to 2003. Mare (1991) documents the correlations between spouses' schooling in the US since 1930s and shows that the correlation between the final educational attainments of spouses increases as average ages of leaving school have increased. Dahan and Gaviria (2001) report a positive relationship between inequality and marital sorting for Latin American countries.

In short, there have been a number of studies that have looked at marital sorting, fertility differentials and intergenerational mobility. This study draws upon these factors to help formulate its theory and model. In particular, compared to the previous studies, this empirical study assumes a time-varying states between these variables (marital sorting, fertility differentials and intergenerational mobility) and the trend of income inequality, and focuses on the dynamic effects of these factors on the degree of income inequality.

3. The Empirical Model

In order to see the time-varying extent to which changes in household formation have exacerbated income inequality over the last few decades in the US, the empirical analysis uses a time-varying parameter model. The empirical model below estimates the impact of marriage decisions (marital sorting), changes in human capital from parents to children (intergenerational mobility), and fertility choices (fertility differentials) on income inequality. The approach to the estimation of time-varying coefficients is based on the Kalman filter technique. The Kalman filter is ideal because it provides insight into how a rational economic agent would revise his estimates of the coefficients when new information is available in a world of uncertainty.[3] As such, the Kalman filter makes it possible to trace the dynamics of the regression coefficients on the extent to which the explanatory variables explain the variation of the degree of income inequality.

The Kalman filter is a special case of the general state-space model that is composed of the measurement equation that describes the relationship between observed state variables and unobserved state variables, and the transition equation that describes the dynamics of the state variables. The transition equation has the form of a first-order difference equation in the state vector. Consider the following measurement equation of the state-space model

$$G_t = x_t \beta_t + \varepsilon_t, \qquad t = 1, 2, ..., T, \ \varepsilon_t \sim i,i,d.N(0, R) \tag{1}$$

where G_t is the degree of income inequality at time t and time-varying parameter vectors, and the β_t s are unobserved state variables that explain the variation of the degree of income inequality. The model consists of three unobserved state variables: the degree of marital sorting, fertility differentials, and the intergenerational correlations in education as a measure of intergenerational mobility. ε_t is the stochastic error term. The transition equations that describe the evolution of the time-varying state vector and the

[3] In addition, the Kalman filter can capture the uncertainty about the unobserved current state through the changing conditional variance of the dependent variable.

family environment states assume the following simple form of a first-order difference equation in the state vector.

$$\beta_t = \mu + F\beta_{t-1} + v_t, \quad t = 1, 2, ..., T, \; v_t \sim i,i,d.N(0,Q) \tag{2}$$
$$E(\varepsilon_t v_t^{'}) = 0 \tag{3}$$

The Kalman filter estimates the unobserved state variables β_t through recursive procedure using the Maximum Likelihood Estimation (MLE) method which is based on predicting and updating. The maximized log likelihood function is represented by

$$\ln L = \frac{1}{2}\sum_{t-1}^{n}\ln(2\pi f_{t|t-1}) - \frac{1}{2}\sum_{t-1}^{n}\eta_{t|t-1}^{'} f_{t|t-1}^{t-1}\eta_{t|t-1} \tag{4}$$

where $\eta_{t|t-1}$ is the prediction error and $f_{t|t-1}$ is the conditional variance of the prediction error. The prediction error is the difference between the actual value, y_t and the fitted value of y_t given information up to $t-1$, $y_{t|t-1}$. Thus, we have

$$\eta_{t|t-1} = y_t - y_{t|t-1} \tag{5}$$

and the conditional variance of the prediction error is calculated as

$$f_{t|t-1} = E[\eta_{t|t-1}^2] \tag{6}$$

In the time-varying parameter model above, uncertainty about current regression coefficients, β_t s, result in changing conditional variance of the degree of income inequality.

The variance of the conditional forecast error in the Kalman filter is given by

$$f_{t|t-1} = Y_{t|t-1}P_{t|t-1}Y_{t|t-1}^{'} + \sigma_\varepsilon^2 \tag{7}$$

where $P_{t|t-1}$ is the covariance matrix of P_t, which represents the degree of uncertainty associated with an inference on β_t conditional on information up to time $t-1$. Since the Kalman filter estimates the entire series in a Bayesian fashion when new information is available in a world of uncertainty, it brings the uncertainty about the future states as well as the uncertainty about the current states into the model.[4]

4. Data

[4] The Kalman filter shows how rational economic agents would combine past information and new information to form a new expectation (Kim and Nelson, 1989).

The data used for this study comes from the 2000 release of the Panel Study of Income Dynamics (PSID), a longitudinal survey conducted annually since 1968. Detailed information on the education and earnings of the household head and spouse are collected every survey year. People with any post-graduate education were classified as having 18 years of schooling. First of all, the data are included from 1968 to 1993 if two conditions are met: if both husband and wife are present; and if education variables are available for both spouses. Both conditions have to be met in order to measure the degree of assortative mating. In addition, the data are included if the wife is between 35 to 54 years old to avoid undersampling couples who are planning to have more children and who get separated with their children over age 25. For the degree of household income inequality, taxable household income is examined and the Gini index is calculated. The Figure 1 shows the actual Gini coefficients in the US and the Gini coefficient of the PSID respondents during the sample period. The Figure 1 clearly shows an increasing trend of the Gini coefficients since 1968. The Gini coefficients from the sample PSID data increased about 23% between 1968 and 1993, and the actual Gini of the US increased about 42% over the same period of time. More specifically, the PSID Gini index seems structurally different between the period before 1978 and the period after 1978.

The number of years of education is used to describe the degree of marital sorting and fertility differentials. The degree of marital sorting variable is measured by the correlation coefficient between the husband's schooling years and the wife's schooling years. Similarly to Kremer and Chen (2000), the fertility differential variable is calculated by the difference in the average fertility rates between the bottom 10% of the less educated households and the top 10% of the highly educated households. For describing intergeneration mobility, the correlation coefficient between the parents' years of education and children's years of education is used.

Table 1 above shows summary statistics and trends of the degree of marital sorting, *MS*, fertility differentials, *FD* and intergenerational mobility of education, *IM*. The degree of marital sorting and the intergenerational mobility in education has an increasing trend, but the fertility differentials in the late 1980's are less than zero, which means that the income effect was a dominant factor for determining the number of children.

5. Empirical Results

In the first test, the classical Ordinary Least Squares (OLS) method was used to see the model specification on the degree of income inequality. The results are presented in Table 2. Except for the coefficient of fertility differentials, the regression coefficients are statistically significant. The first column in the Table 2 shows that the estimated coefficient for the degree of marital sorting, 0.987, is fairly high and highly significant. This means that the elasticity of the degree of marital sorting to the degree of income inequality around the mean is about 1.71. The coefficient of determination shows that a single variable, specifically, degree of marital sorting in couples' education, explains about 52% of the variation in the degree of income inequality. The second column presents the regression result based on the fertility differentials. Contrary to the theory, the effect of fertility differentials on income inequality has a different direction than theoretically predicted. One possibility for this unexpected result is that the fertility differentials in the PSID data, in particular, doesn't have enough variation to explain the income inequality and the income effect outweighs the substitution effects during the late of 1980's. The third column presents the regression results based on the intergenerational correlation in education.

The estimated coefficient, 0.535, is substantial and highly significant. Among the three explanatory variables, the intergenerational correlation in education explains the variation of income inequality most highly. When the degree of marital sorting and the intergenerational correlation in education are combined (see the fourth column), the overall fitness of the regression model increase to 70%. The final column of Table 2 presents the regression results when marital sorting, fertility differentials and intergenerational correlation in education are considered simultaneously. In this case, those three explanatory variables explain about 82% of the variation in income inequality.

Even though most of the estimated coefficients are significant and in the right direction, the OLS estimates are based on a fixed-coefficient model and thus provide only averages for the variable coefficients for the whole sample period. In order to see the dynamic effects of the explanatory variables, it is therefore desirable to examine how the estimated coefficients vary over time as the degree of income inequality changes over the sample period.

Figures 4 present plots of the time-varying regression coefficients generated using the Kalman filter method. As can be seen in these Figures, the time-varying coefficients on the marital sorting and on the intergenerational correlation in education have clear increasing trends since the mid of 1970's. For the time-varying coefficient on the degree of marital sorting, it starts from a low level of 0.04 and stays more or less at the same level through 1979 and then rises to 0.35. This means that a one-unit increase in the correlation coefficients of couple's education leads to a substantial increase, approximately over one third of the whole range in the degree of income inequality. The time-varying coefficient on the intergenerational mobility in education also has a similar effect on the degree of income inequality. It increases from -0.01 to 0.27. This suggests that the increasing trend of income inequality in the last two decades in the US is driven mainly by the increasing trend of marital sorting which is combined with intergenerational mobility of education. For the time-varying coefficient on fertility differential, it moves around zero and the effects are reversed around 1984. Focusing on the time-path of the coefficient of marital sorting for the period between 1980 and 1991, the assortative marriage decisions appear to increasingly affect the degree of income inequality.

6. Conclusion

A time-varying parameter model was proposed to estimate the dynamics of the degree of income inequality, and the Kalman filter technique was applied to estimate the model. The estimation results show that marital sorting evolves over time and positively and increasingly affects the degree of income inequality and that intergenerational human capital transmission induces path-dependent income distribution dynamics. Even though consideration was given to the effect of fertility differentials, the test results suggest that the effect is insignificant and negligible.

Table 1: Basic Descriptive Statistics

Variables	1968	1976	1984	1992	Mean	Variance
MS	0.545	0.520	0.527	0.640	0.550	0.400
FD	0.252	0.330	-0.534	0.237	0.018	0.931
IM	0.244	0.454	0.520	0.626	0.466	0.244

Note: *MS*: Degree of Marital Sorting; *FD*: Fertility Differentials; *IM*: Intergenerational Mobility of Education.

Table 2: Simple Regression Results

Variables	(1)	(2)	(3)	(4)	(5)
Constant	-0.079	0.461	0.214	0.032	0.088
	(0.107)	(0.011)	(0.039)	(0.092)	(0.075)
MS	0.987			0.460	0.493
	(0.193)			(0.213)	(0.170)
FD		-0.119			-0.069
		(0.024)			(0.018)
GM			0.535	0.383	0.221
			(0.083)	(0.105)	(0.094)
R^2	0.52	0.50	0.63	0.70	0.82

Note: The dependent variable in the five regression equations is the PSID Gini. The numbers in parenthesis represent the standard errors. Except for some of the constant terms, the others are all significant at a 95% confidence level.

Figre 1: The US actual Gini and the PSID Gini

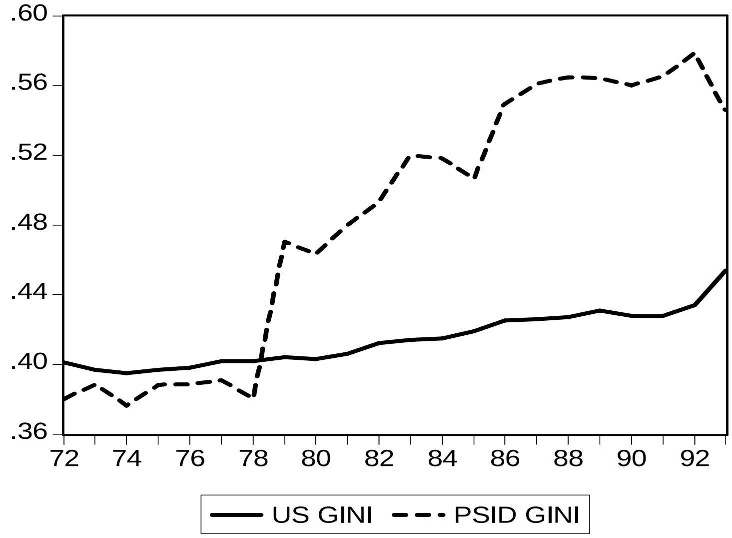


Figure 2: Time Varying Coefficient of Marital Sorting

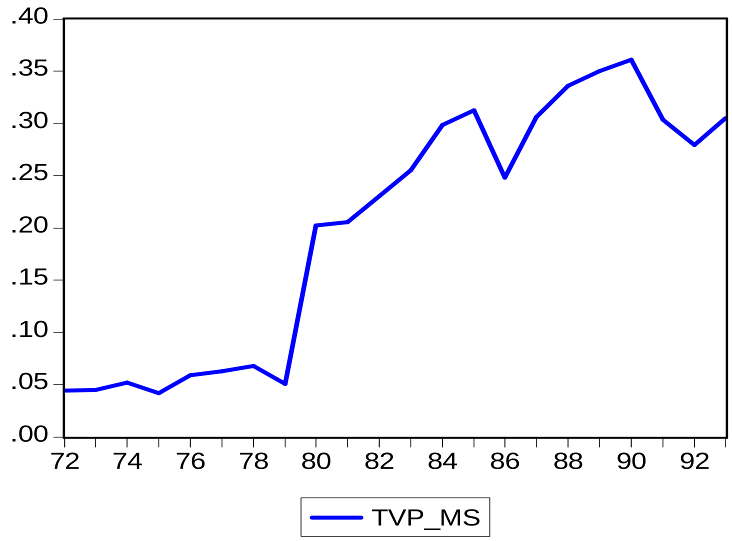


Figure 3: Time Varying Coefficient of Fertility Differentials

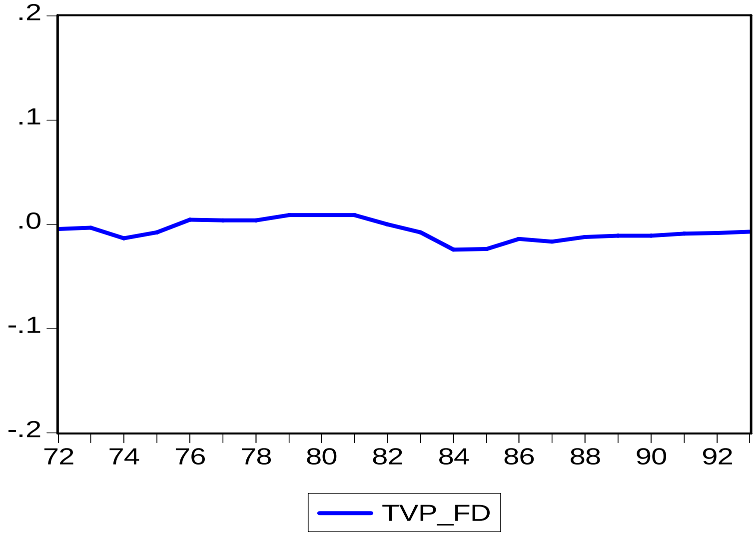
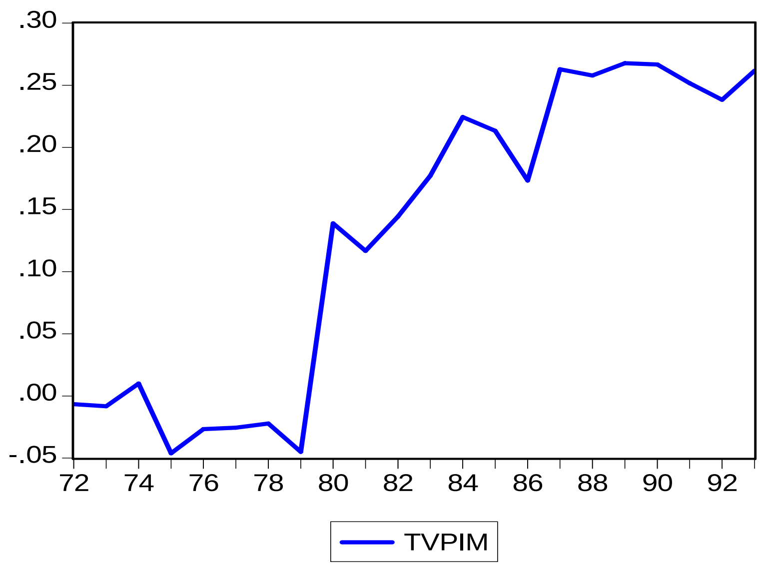


Figure 4: Time Varying Coefficient of Intergenerational Correlation



References

Becker, G. S. and Tomes, N. (1979) "An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility" *Journal of Political Economy* **87**(6), 1153-89

Becker, G. S. and Tomes, N. (1986) "Human Capital and the Rise and Fall of Families" *Journal of Labor Economics* **4**(3), S1-39.

Becker, G. S. (1979) "Economic Analysis and Human Behavior, in *Sociological Economics* by L. Levy-Garboua, Eds., Sage: Beverly Hills, CA.

Bjorklund, A. and Jantti, M. (1997) "Intergenerational Income Mobility in Sweden compared to the United States" *American Economic Review* **87**, 1009-18.

Dahan, M. and Gaviria, A. (2001) "Sibling Correlations and Intergenerational Mobility in Latin America" *Economic Development and Cultural Change* **49**(3), 537-554

Davies, J. B., Zhang, J. and Zeng, J. (2005) "Intergenerational Mobility under Private vs. Public Education" *Scandinavian Journal of Economics* **107**(3), 399–417

Erikson, R. and Goldthrope, J. H. (1991) *The Constant Flux: A Study of Class Mobility in Indurtrial Societies*, Clarendon Press: Oxford.

Fernández, R. and Rogerson, R. (1998) "Public Education and Income Distribution: A Dynamic Quantitative Evaluation of Education-Finance Reform" *American Economic Review* **88**(4), 813-33.

Fernández, R. and Rogerson, R. (2001) "Sorting and Long-Run Inequality" *Quarterly Journal of Economics* **116**, 1305-41

Fernández, R., Guner, N. and Knowles, J. (2001) "Love and Money: A Theoretical and Empirical Analysis of Household Sorting and Inequality" NBER Working Papers 8580.

Fernández, R., Nezih G. and Knowles, J. (2005) "Love and Money: A Theoretical and Empirical Analysis of Household Sorting and Inequality" *The Quarterly Journal of Economics* **120**(1), 273-344.

Francesconi, M. (1995) "Husbands and Wives: Family Income Inequality and Assortative Mating in the United States" ESRC Working Papers 95-21, Research Centre on Micro-social Change.

Greenwood, J., Guner, N. and Knowles, J. A. (2003) "More on Marriage, Fertility and the Distribution of Income" *International Economic Review* **44**(3), 827-862.

Katz, L. and Autor, D. (1999) "Changes in the Wage Structure and Earnings Inequality" in *Handbook of Labor Economics* by O. Ashenfelter and D. Card, Eds., North Holland, Volume 3A.

Kim, C. J. and Nelson, C. (1989) "The Time Varying Parameter Model for Modeling Changing Conditional Variance: The Case of the Lucas Hypothesis" *Journal of Business and Economic Statistics* **7**(4), 433-440.

Kremer, M. and Chen, D. (2000) "Income Distribution Dynamics with Endogenous Fertility" NBER Working Papers 7530.

Kremer, M. 1997) "How Much Does Sorting Increase Inequality?" *Quarterly Journal of Economics* **112**(1), 115-39.

Lam, D. (1986) "The Dynamics of Population Growth, Differential Fertility, and Inequality" *American Economic Review* **76**(5), 1103-1116.

Lam, D. (1988) “Marriage Markets and Assortative Mating with Household Public Goods: Theoretical Results and Empirical Implications” *Journal of Human resources* **23**, 462-487.

Loury, G. C, (1981) “Intergenerational Transfers and the Distribution of Earnings” *Econometrica* 49(4), 843-67,

Maoz, Y. D. and Moav, O. (1999) “Intergenerational Mobility and the Process of Development” *Economic Journal* **109**(458), 677–697.

Mare, R. (1991) “Five Decades of Educational Assortative Mating” *American Journal of Sociology* **56**, 15-32.

Ozdural, S. (1993) “Intergenerational Mobility: A Comparative Study between Turkey and the United States” *Economics Letters* **43**, 221-30.

Schwartz, C. R. and Mare, R. D., (2005) “Trends in Educational Assortative Marriage from 1940 to 2003” *Demography* **42**, 621-46.

Zak, P. J. and Park, K. 2002, Population Genetics and Economic Growth” *Journal of Bioeconomics* **4**(1), 1-38