CHANGE AT HOME, IN THE LABOR MARKET, AND ON THE JOB

Edited by Solomon W. Polachek, Konstantinos Tatsiramos

I Z A Institute of Labor Economics
Initiated by Deutsche Post Foundation

RESEARCH IN LABOR ECONOMICS

VOLUME 48

CHANGE AT HOME, IN THE LABOR MARKET, AND ON THE JOB

RESEARCH IN LABOR ECONOMICS

Series Editor: Solomon W. Polachek

IZA Co-Editor: Konstantinos Tatsiramos

Recent Volumes:

Volume 34: Informal Employment in Emerging and Transition Economies
Edited by Hartmut Lehmann and Konstantinos Tatsiramos

Volume 35: 35th Anniversary Retrospective
Edited by Solomon W. Polachek and Konstantinos Tatsiramos

Volume 36: Research in Labor Economics
Edited by Solomon W. Polachek and Konstantinos Tatsiramos

Volume 37: Labor Market Issues in China
Edited by Corrado Giulietti, Konstantinos Tatsiramos and Klaus F. Zimmermann

Volume 38: New Analyses in Worker Well-Being
Edited by Solomon W. Polachek and Konstantinos Tatsiramos

Volume 39: Safety Nets and Benefit Dependence
Edited by Stéphane Carcillo, Herwig Immervoll, Stephen P. Jenkins, Sebastian Königs and Konstantinos Tatsiramos

Volume 40: Factors Affecting Worker Well-Being: The Impact of Change in the Labor Market
Edited by Solomon W. Polachek and Konstantinos Tatsiramos

Volume 41: Gender Convergence in the Labor Market
Edited by Solomon W. Polachek, Konstantinos Tatsiramos and Klaus F. Zimmermann

Volume 42: Gender and the Labor Market
Edited by Solomon W. Polachek, Konstantinos Tatsiramos and Klaus F. Zimmermann

Volume 43: Inequality: Causes and Consequences
Edited by Lorenzo Cappellari, Solomon W. Polachek and Konstantinos Tatsiramos

Volume 44: Income Inequality Around the World
Edited by Lorenzo Cappellari, Solomon W. Polachek and Konstantinos Tatsiramos

Volume 45: Skill Mismatch in Labor Markets
Edited by Solomon W. Polachek, Konstantinos Pouliakas, Giovanni Russo and Konstantinos Tatsiramos

Volume 46: Transitions Through the Labor Market: Work, Occupation, Earnings and Retirement
Edited by Solomon W. Polachek and Konstantinos Tatsiramos

Volume 47: Health and Labor Markets
Edited by Solomon W. Polachek and Konstantinos Tatsiramos

This page intentionally left blank

RESEARCH IN LABOR ECONOMICS VOLUME 48

CHANGE AT HOME, IN THE LABOR MARKET, AND ON THE JOB

EDITED BY

SOLOMON W. POLACHEK
State University of New York at Binghamton, USA and IZA, Germany

KONSTANTINOS TATSIRAMOS
University of Luxembourg, LISER, Luxembourg and IZA, Germany

United Kingdom – North America – Japan
India – Malaysia – China

Emerald Publishing Limited
Howard House, Wagon Lane, Bingley BD16 1WA, UK

First edition 2021

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-83909-933-5 (Print)
ISBN: 978-1-83909-932-8 (Online)
ISBN: 978-1-83909-934-2 (Epub)

ISSN: 0147-9121 (Series)

Awarded in recognition of Emerald's production department's adherence to quality systems and processes when preparing scholarly journals for print

INVESTOR IN PEOPLE

CONTENTS

LIST OF CONTRIBUTORS

Carolina Castagnetti	University of Pavia, Italy
Robert W. Fairlie	University of California, Santa Cruz, USA
Frank M. Fossen	University of Nevada, Reno, USA
Pablo Adrian Garlati-Bertoldi	Pontificia Universidad Javeriana de Bogotá, Colombia
Nicolas Gerber	University of Bonn, Germany
Rania Gihleb	University of Pittsburg, USA
Xin Jin	University of South Florida, USA
Kevin Lang	Boston University and NBER, USA
Judith Liu	University of Melbourne, Australia
Luisa Rosti	University of Pavia, Italy
Tekalign Gutu Sakketa	University of Bonn, Germany
Marina Töpfer	University of Erlangen-Nürnberg, Germany
Masao Yamaguchi	Aichi Prefectural University, Japan

This page intentionally left blank

EDITORIAL ADVISORY BOARD

This page intentionally left blank

PREFACE

Research in Labor Economics is a series that publishes new labor economics research. Articles apply economic theory and econometrics to policy-relevant topics often with an international focal point. This volume contains eight articles. Seven deal with demographic and labor market change, and one deals with wage differences essentially at a point in time. Of the seven, two analyze changes in family-related matters and have implications regarding labor supply; two examine legislative changes, one of which has implications on teenage employment, and the other on informal business formation; one looks at potential productivity changes on farms in a developing country and has implications for remaining on the family farm or going to work; one models wage growth and shows why wages sometimes fall as one remains in a job longer; and finally one investigates new enterprise formation over time. As you will see, published articles in *Research in Labor Economics* focus on important issues and maintain the highest levels of scholarship. They are indexed in EconLit, Google Scholar, RePEc, and SCOPUS. Readers who have prepared manuscripts that meet these stringent standards are encouraged to submit them via the IZA website (http://rle.iza.org).

Perhaps the biggest change in the labor market over the last 150 years is the continual increase in women's labor force participation. In part, this change is demographically based. Fertility rates declined, women's years of school increased, and of late, cohabitation rates grew, and the age of first marriage rose. Related to these trends is the division of labor in the home, and hence husbands' and wives' characteristics: who marries whom, and why. It is now somewhat known husbands and wives are getting closer in age implying a diminished marital age gap (See RLE, Volume 41). However, in the first article Rania Gihleb and Kevin Lang note economists and sociologists have mixed messages regarding educational trends. Economists have argued in favor of assortative mating whereas sociologists in favor of homogamy, but according to Gihleb and Lang the two are different, and it is not clear that either is prevalent in the data. Thus they distinguish between the two concepts. According to them, positive assortative mating refers to a situation in which the average education of one spouse is increasing in the education of the other. Homogamy instead refers to a situation in which likes marry likes, that is, those with the same level of education marry each other so that, for example, college students marry college students, and high school students marry high school students. Based on these definitions they utilize the Current Population Surveys and the decennial census along with the American Community Survey to examine changes in marital sorting and homogamy by education. They conclude that there is no compelling evidence of an increase.

Indeed, when they separate college graduates from those with a more advanced degree, homogamy appears to have declined. Similarly, over the last 50 years, they find no evidence that assortative mating changed substantially.

One impetus for change in the family dynamic and subsequent labor supply, say from one cohort to another, might occur when labor market institutions are altered early in a new cohort's career. In the next article Judith Liu examines change in the medical profession. Doctors are mostly male and are known to work long hours. In 1950, 6% of physicians were women. In 1970 this increased to 23%, and then to 36% in 2015. Concomitantly hours worked declined. To become a physician in the US, one must complete 3–7 years of residency training after college and medical school, and then obtain a medical license to practice medicine. In the early days, residency requirements did not explicitly reference resident hours. Instead, documents dictating residency requirements concentrated on the learning environment and required intense training often entailing long hours and periodic 24-hour shifts. In 2003 the Accreditation Council for Graduate Medical Education (ACGME) implemented a dramatic reduction in residency hours. This entailed a maximum of 80 hours worked per week, averaged over a month, a 24-hour limit on continuous duty, 1 day per week free of all medically related duties, and a 10-hour rest period between duty periods or work shifts. Liu uses monthly data from the 1989–2017 Current Population Surveys to identify the effects of a reduction in early career hours, due to the change in work-hour regulations, on long-term physician labor supply. She employs a difference-in-differences model with cohort and year fixed effects as well as a changes-in-changes (CIC) approach. She finds, as a result of the reform, the mean resident hours per week decrease by 10.03 for males and 6.87 for females. Further, these negative effects are stronger when moving toward the upper tail of the distribution for both male and female physicians, thus yielding a greater impact among those with the longest hours. For women, increases in the probability of marriage and increases in the number of children are the family dynamic mechanisms by which these labor supply changes occurred.

As countries develop the proportion of the economy devoted to agriculture falls. In 1900, 41% of the US workforce was employed in agriculture. In 2012 the proportion in agriculture dwindled to 1.5%. Yet today, the percent is still significant in many developing countries, for example, 72.7% in Ethiopia. Many farms in developing countries are family-run. Yet increasingly, in these countries, who remains in agriculture and who gets a job for pay outside the family farm is an important question. It is especially significant for women and youth. Whether one leaves the family farm is related to one's potential wage, as well as one's value at home on the family farm, namely one's opportunity costs. As such, leaving the family farm should be related to one's productivity on the farm. The higher the productivity the less likely a family member will leave, and the lower the productivity the greater the likelihood. In the next article Tekalign Gutu Sakketa and Nicolas Gerber employ a sample of about 500 households spanning two time periods in a select number of Ethiopian districts to determine who among Ethiopian 13–34-year-old men and women leave the family farm to join the formal labor market. Their innovation is to incorporate male and female

"shadow" wages along with family income both estimated from a household farm production function. They obtain labor supply equations containing gender and age cross-elasticity parameters. The paper finds an upward sloping labor supply function for males, a backward bending labor supply function for females, and significant cross-substitution effects.

Changes in a country's policy have real effects, sometimes immediate, sometimes not so immediate. The impact of the minimum wage has been extensively studied in many countries, but not in Japan. The handful of studies there mostly use aggregate employment data and find negative employment effects for young workers, but virtually no studies utilize employment and work hours data based on an establishment survey. The next article by Masao Yamaguchi is an exception. Based on annual 2008–2010 Japanese minimum wage changes that vary by prefecture, he identifies minimum wage effects on employment, average hourly wages, work hours, full-time equivalent employment (FTE), total wage costs, average tenure, separations and new hiring at the establishment level. He utilizes panel data gleaned from the Basic Survey on Wage Structure (BSWS) which covers the whole of Japan and thus does not focus on narrow geographic locations as did analyses in many other countries. Identification is established by minimum wage variations across establishments in 47 prefectures from 2008 to 2010. Further, he focuses on accommodation, eating and drinking services, and food takeout and delivery services, the sectors typically employing workers at the minimum wage. The paper finds a positive but statistically insignificant effect on employment and significant increases in wage costs for establishments, which may be caused by the larger decrease in the separation than in the new hiring of part-time workers.

One problem with many policy evaluation studies is their failure to distinguish long-term from short-term effects. One innovation in the next article is to distinguish between short-term from long-term changes. It examines theoretically and empirically the impact of tax reform on relative employment in the informal (compared to the formal) sector of the Colombian labor market. In Colombia, high payroll taxes lead to informality. However, in 2012 Colombia significantly reduced payroll taxes, thereby decreasing the employers' relative cost of hiring formal workers. In the next article, Pablo Adrian Garlati-Bertoldi evaluates this reform's impact on informal employees, both theoretically and empirically. He utilizes a difference-in-differences (DID) approach using two data sets. The first is composed of many repeated cross-sections covering years 2008–2016. The second is a panel dataset that covers the years 2010, 2013, and 2016. However, because of alternative changes that occurred at the same time as the treatment of interest, Garlati-Bertoldi utilizes his DID estimates to calibrate a static general equilibrium model. The model is then used to study potential combinations of enforcement and taxes. The results show that the reform is associated with reductions in informality with small short-term effects and large long-term effects.

It is well known that wages increase over one's working life. But this wage premium means older workers earn more than younger ones. Whereas the human capital, as well as deferred compensation models, explain this phenomenon, it is

also possible that younger workers feel discriminated against because of their wage deficiency. At least in Italy, this is the case. However, disentangling discrimination from other explanations is difficult. In the next article, Carolina Castagnetti, Luisa Rosti, and Marina Töpfer apply a machine-learning approach using a least absolute shrinkage operator (LASSO) estimator and control for sample selection to decompose estimates of the conditional average pay gap between 18–34- and 35–64-year-old individuals using 2005–2016 Italian Institute for Development of Vocational Training of Workers data. The raw data indicate that young male employees earn on average 24% less than older ones, whereas young women earn 17% less. However, the average pay gap is reduced to 2% when using their approach. As such, Castagnetti et al. conclude age discrimination in pay is only perceived but not actual in Italy either for men or women.

Whereas wages rise over the life cycle, within a job the earnings-tenure gradient is sometimes flat or even decreasing. One reason is promotion. The very able highly productive workers simply advance to a new job, and those remaining are of poorer quality. As such, a number of studies argue promotion to be critical to wage growth. However, none focus on wage growth of the nonpromoted. In the next article, Xin Jin devises a human capital model whereby asymmetric learning results in a rising then falling wage when a worker fails to be promoted. Initially wages rise as the worker acquires human capital but the negative signal from nonpromotion leads to a decline. Jin tests the model's predictions using the personnel records from a large US firm from 1970 to 1988. He finds a hump-shaped wage-job-tenure profile for workers who stay at the same job level thus supporting his model's contention.

Conceptually it is hard to distinguish working for oneself and working for someone else. Both constitute work. Both have to do with making money and getting paid, but both are intrinsically different. Working for oneself defines entrepreneurship, taking on risk and responsibility, potentially building a business. Working for someone else defines employment, taking on less risk, but potentially moving up the occupational ladder. One can move from employment to entrepreneurship, but there are a number of unanswered questions about this phenomenon, most notably who starts a business, and when. For example, current studies show positive, negative, and zero relationships between unemployment and entrepreneurship. Whereas the literature defines two types of entrepreneurship: opportunity and necessity, currently they are not defined well enough to yield convincing empirical evidence. In the final article, Robert W. Fairlie and Frank M. Fossen propose sufficiently viable definitions of opportunity and necessity entrepreneurship to enable them to validate their definitions by exploring their consistency empirically. Individuals who are initially unemployed before starting businesses are defined as "necessity" entrepreneurs, and individuals who are wage/salary workers, enrolled in school or college, or are not actively seeking a job are defined as "opportunity" entrepreneurs. Necessity entrepreneurship is countercyclical, whereas opportunity entrepreneurship is procyclical. Fairlie and Fossen measure necessity and opportunity entrepreneurship by utilizing large, nationally representative, widely used data for the United States and Germany. Using these definitions, they find that roughly 80%

of entrepreneurship is of the opportunity versus necessity variety in the United States, and roughly 90% in Germany. In the process, they find that opportunity versus necessity entrepreneurship is positively associated with the creation of more growth-oriented businesses.

For insightful editorial advice, we thank Heather Antecol, Arturo Anton, German Blanco, Petri Böckerman, Mario Bossler, Mark L. Bryan, Alex Bryson, Brantly Callaway, Luis David Chanci-Arango, Ritam Chaurey, Márton Csillag, David Cuberes, Joseph R. Cummins, Janet Currie, Thomas DeLeire, Evangelos M. Falaris, Jiani Gao, Leila Salarpour Goodarzi, Laszlo Goerke, Tal Gross, Michael Grossman, Italo Gutierrez, Antti Kauhanen, Alexander Kritikos, Laure Latruffe, Hartmut Lehmann, Pierre-Carl Michaud, Sophie Mitra, Leonardo Fabio Morales, William Pouliot, Suraj Prasad, Shakil Quayes, Thomas Rawski, Daniel Rees, Christopher Ruhm, Martin Salm, Jacques Silber, Rishabh Sinha, Fabian Slominczyk, Marlon Tracey, Peter van der Zwan, Van Quang Tran, Johan Vilkström, Madeline Zavodny, Mariana Zerpa, Nicolas R. Ziebarth, Xing Zhou, and Xu Zhang.

Solomon W. Polachek
Konstantinos Tatsiramos
Editors

This page intentionally left blank

EDUCATIONAL HOMOGAMY AND ASSORTATIVE MATING HAVE NOT INCREASED*

Rania Gihleb and Kevin Lang

ABSTRACT

Some economists have argued that assortative mating between men and women has increased over the last several decades. Sociologists have argued that educational homogamy has increased. The two are conceptually distinct but often confused. We clarify the relation between the two and, using both the Current Population Surveys and the decennial Censuses/American Community Survey, show that neither conclusion is correct. Both are sensitive to how educational categories are chosen. The former is based on the use of inappropriate statistical techniques.

Keywords: Assortative mating; education; marriage; homogamy; measurement; inequality

1. INTRODUCTION

We reexamine the evidence regarding changes in positive assortative mating by education and educational homogamy. Positive assortative mating refers to a situation in which the average education of one spouse is increasing in the education of the other. Following sociologists, we define homogamy as a situation in which likes marry likes. The degree of educational homogamy therefore refers to the extent to which men and women with the same level of education

*This paper is a revision of a chapter in my (Rania Gihleb) PhD dissertation, which I completed at Boston University in 2014.

Change at Home, in the Labor Market, and On the Job
Research in Labor Economics, Volume 48, 1–26

ISSN: 0147-9121/doi:10.1108/S0147-912120200000048001

tend to marry each other. As we discuss later, economists have not been entirely consistent in distinguishing between homogamy and assortative mating. Some authors have relied on changes in measures of homogamy to capture changes in assortative mating. Importantly, as discussed in the conceptual framework section, changes in either homogamy or assortative mating need not reflect changes in homophily, which is the utility the individual derives from matching with a spouse who is similar.[1]

Using standard reduced form techniques, economists have argued that, over the last several decades, the United States has seen increased positive assortative mating by education (Greenwood, Guner, Kocharkov, & Santos 2014). In contrast, more structural approaches in economics such as Chiappori, Salanié, and Weiss (2017), Chade and Eeckhout (2013), and Siow (2015) have found little evidence for increased positive assortative mating. Sociologists have reached the similar but distinct conclusion that there has been an increase in educational homogamy (Mare, 1991, 2008; Schwartz & Mare, 2005).[2] Siow also finds some support for increased educational homogamy.

In this paper, we reexamine changes in marital sorting and homogamy by education using standard measures and conclude that there is no compelling evidence of an increase. Conclusions about changes in homogamy are sensitive to how educational groups are defined. In essence, if all college graduates are grouped together, homogamy increased. If we separate college graduates from those with a more advanced degree as is common in the wage structure literature (Acemoglu & Autor, 2011), then, if anything, homogamy appears to have declined.[3]

The difficulty with the assortative mating literature is, in part, due to the sensitivity of the result to the choice of categories, but it is also, to a greater degree, statistical. The ideal statistic for addressing the degree of assortative mating would be a rank-order correlation coefficient that works well when there are a large number of ties, as there are in the education distribution. Unfortunately, none exists. However, if we use either a standard Pearson correlation coefficient or standard rank-order statistics that correct for ties, we find no increase in the correlation between husband's and wife's education regardless of whether we use 5, 6, or 12 categories of education. Only if we use a rank-order correlation coefficient that does not correct for ties and five categories do we reach the conclusion that the correlation has increased. We also show that, because the relative variances of husbands' and wives' education have changed,

[1]We note that Chiappori et al. (2017) do find evidence of an increased desire for assortative mating, which we term homophily, although in their model this shows up as a differential increase in the return to matching with a more educated spouse.

[2]For an interesting paper about assortative mating by degree program, see Bicakova and Jurajda (2016).

[3]The finding that the choice of groupings is important is consistent with Eika et al. (2014) who find that changes in the pattern of assortative mating *within education groups* differ across levels of education, but see our later discussion of the metric they use to measure these changes.

examining the change in the coefficient from a regression of wife's education on husband's education (or vice versa) is not informative.[4]

Because our analysis is simple and merely statistical, we are able, in some ways, to provide a broader overview of changes in assortative mating and homogamy that complements the work of Chiappori, Salanie, and Weiss and of Siow. We use both the Current Population Surveys and the decennial Censuses and American Community Surveys. We examine the evolution of educational homogamy both within and between cohorts and, depending on the question, examine changes over a period of up to 50 years.

These findings cast light on our theories of marriage and the division of labor within marriage. In Becker (1974; 1981), likes marry likes when the characteristic is complementary but not when it is substitutable. Education is likely to be complementary in consumption. But when women are not in the labor force, they are substitutes: high-skill men should marry low-skill women who then specialize in home production. Which of these two forces should dominate is unclear. But as women increasingly entered the labor force and fertility declined (Polachek, Zhang, & Zhou, 2015), the importance of complementarity should have increased because specialization in home versus market production should have decreased, a point made somewhat differently by Stevenson and Wolfers (2007). Moreover, a decline in specialization in home production by women may have contributed to their increased investment in marketable human capital.[5] Therefore, we would expect either educational homogamy or assortative mating or both to increase in the light of the growth in women's labor force participation.

In addition, Fernandez, Guner, and Knowles (2005) suggest a feedback mechanism between income inequality across education groups and assortative marriage in which "…[an] increase in inequality increases sorting by making skilled workers less willing to form households with unskilled workers …." However, Cornelson and Siow (2016) find that earnings inequality and education do not have a major effect on assortative mating.

Sociologists view the prevalence of homogamy based on education as indicative of the social distance between groups. If social interactions between individuals with different education backgrounds decline, there will be fewer marriages between such individuals and hence increased educational homogamy. Similarly, if such interactions involve more friction, we will also see more homogamy.

2. CONCEPTUAL BACKGROUND

The purpose of the section is primarily pedagogical. We believe the results in this section are known but underappreciated, at least by those who, like us, are

[4]With controls this statement depends on conditional variances.

[5]There was also a dramatic change in what women studied, which may have been both a cause and an effect of the change in labor force participation. Unfortunately, we cannot address homogamy with respect to field of study, but we note that the challenges presented by changing distributions would undoubtedly be exacerbated in this case.

not steeped in the theoretical literature. Therefore, we have eschewed the more standard section title, "*Theory*." We examine the relation among homophily, which we interpret as a property of tastes or the utility function, and homogamy and assortative mating, which are the equilibrium outcomes of a process that pairs mates. We refer anyone interested in a more thorough examination of the literature to excellent reviews by Chade, Eeckhout, and Smith (2017) and Browning, Chiappori, and Weiss (2014).

To see the relation among the concepts and how they related to the marriage market, consider two groups of equal mass, which we will call X and Y (although the reader may wish to think of them as XX and XY) or x and y when referring to a group member. For the moment, we will assume that each individual i is endowed with a fixed amount of some characteristic z_i.

For simplicity, we will assume that the distribution of z within each group is uniformly distributed:

$$z_i|g \sim U(0, z_g^*), g = x, y \tag{1}$$

with $z_y^* > z_x^*$.

Let us now consider equilibrium matching in a case of strong homophily. Individuals may match with exactly one individual from the other group, or they may choose to remain unmatched. The utility of an individual is given by

$$U_i = \begin{array}{ll} V - (z_i - z_j)^2 & \text{if matched} \\ 0 & \text{otherwise} \end{array} \tag{2}$$

where j denotes i's mate, so that individual i's utility is maximized and equal to V when matched with a partner with the same z.

Note that there is no money in the example. In technical terms, utility is strictly not transferable.[6] Each individual prefers to match with someone with the same level of z but will not be able to do so.[7] A proportion $(z_y^* - z_x^*)/z_y^*$ of Y individuals will clearly not be able to match with an X with the same characteristic because no such X exists. And the same proportion of Xs at each level of z is "surplus" matches. These surplus individuals will be sorted negatively so that within any match

$$z_y = z_y^* - \frac{z_y^* - z_x^*}{z_x^*} z_x \text{ if } V > z_y^{*2}. \tag{3}$$

It may seem surprising that an X with $z = 0$ matches with a Y with $z = z_y^*$. After all, the former strictly prefers to match with a Y with z_x^* and values doing so

[6]Similar issues arise if there is some ability to transfer utility within marriage but the parties cannot make binding commitments prior to marriage (see Lundberg and Pollak (2008)).
[7]This violates the condition in Legros and Newman (2010) for positive assortative mating even under strict nontransferable utility.

more than does the excess X with $z = z_x^*$ who actually makes that match.[8] But the Y with z_x^* strictly prefers the latter match, and there is no mechanism that allows the unfortunate excess X with z = 0 to convince him otherwise.[9] Note that we have abstracted from the search process. To consider costly search would take us too far afield, require us to choose a search technology, and be far more technical than is commensurate with our goal for this section. In general, we would expect types on the long side of their market to consider searching in proximate markets on which they are on the short side. Arcidiacono, Beauchamp, and McElroy (2016) provide one specification of such a model.

How does this equilibrium relate to our concepts of homogamy and assortative mating? If we define a homogamous match as one in which both spouses have exactly the same education, the proportion of homogamous matches is given by z_x^*/z_y^*. If we measure assortative mating by the correlation between z_x and z_y, it will be positive if and only if $2z_x^* > z_y^*$. In this very special case then, positive assortative mating corresponds to the case where more than half of matches are homogamous.

It is tempting to draw conclusions about homophily from the degree of homogamy or assortative mating. However, our final point in this section is a simple one: *the matching pattern depends on the matching technology as well as tastes.* Let us modify our example somewhat. Assume that each individual is endowed with some amount of money, m, measured in units of some private good and that utility is linear in the private good. Then utility is transferable, provided m is sufficiently large, and therefore matching will be efficient so that

$$z_y = \frac{z_y^*}{z_x^*} z_x, \tag{4}$$

and there will be a set of transfers of the private good between matched individuals that will support the equilibrium.[10,11]

At the same time, while we have presented the two cases as differing with respect to the transferability of utility, they can also be interpreted as differing in the importance of homophily. As individuals put more weight on being matched with someone similar, the ability of transfers to overcome their preferences diminishes. An increase in homophily could reduce assortative mating, making it even more difficult to ascribe changes in the matching pattern to changes in homophily. Therefore, in the remainder of this paper, we focus only on changes in homogamy and assortative mating without trying to draw conclusions about homophily.

---

[8]Interestingly Siow (2015) finds evidence for such a pattern but only at the extremes of the education distribution.

[9]One can think of this in terms of the deferred acceptance algorithm which leads to a stable matching equilibrium (Roth & Sotomayor, 1990).

[10]Legros and Newman (2007) provide more general conditions which allow for nontransferable, but not strictly nontransferable, utility.

[11]That efficiency requires strictly positive assortative mating is readily verified.

3. MEASURING CHANGES IN HOMOGAMY

Now consider the question of whether homogamy is greater with or without transferable utility in the example. Here we show our second simple point: *our conclusions about whether homogamy has increased or decreased can be very sensitive to our definition of "similar."* In the example without transferable utility, a fraction z_x^*/z_y^* of matches are exact in the sense that $z_x - z_y = 0$. With transferable utility, the set of matches with this characteristic has measure zero. On the other hand, with transferable utility there is more homogamy in the sense that

$$z_y - z_x \leq z_y^* - z_x^*. \tag{5}$$

In contrast, the maximum gap without transferable utility is much larger. In practice, social scientists who have measured homogamy by education have defined homogamous marriages as those in which the educations of the partners lie in the same interval (e.g., less than high school, high school, more than high school). The argument goes through with some changes; which setting has more homogamy depends on the choice of categories. In the empirical work below, we show that estimates of whether and how homogamy has changed are, indeed, sensitive to how we define education categories.

Finally, we note that *measured homogamy can be sensitive to shifts in the underlying distributions of the characteristics.* In either of our two cases, there is perfect homogamy if $z_x^* = z_y^*$ but homogamy is less than perfect otherwise. Thus again, we can observe a shift in homogamy with no change in the underlying utility functions or matching technology.

We will discuss below technical issues associated with measuring assortative mating in real data. However, in the examples here, it is relatively straightforward. In the case where utility is not transferable, the correlation, however measured, between z_x and z_y is imperfect while it is perfect with transferable utility. Still, it is important to recognize that, at least in the case of nontransferable or imperfectly transferable utility, the degree of assortative mating can depend on the distributions of z.

One of the most widely used measures of assortative mating compares the proportion of same education matches with the proportion that would be observed if men and women matched randomly. Thus, for each possible combination of wife's and husband's education, Eika, Mogstad, and Zafar (2014) calculate the ratio

$$s_{ij} = \frac{P(ED_w = i \cap ED_h = j)}{P(ED_w = i) * P(ED_h = j)}. \tag{6}$$

They then aggregate this by taking a weighted average of s_{ij}, that is a weighted average of the measure along the diagonal, which we denote by s^*.

Note, however, that this is a measure of homogamy, not assortative mating. Along the lines discussed in the conceptual framework, if every woman marries

a man with exactly one year less education, mating is perfectly assortative. But $s^* = 0$ because it is a measure of homogamy.

Similarly suppose that both men and women are equally divided among high school dropouts, high school graduates, and college graduates. Suppose further that college graduates of one sex all marry high school dropouts of the other and that all high school graduates marry high school graduates. We have perfect negative assortative mating. However, for the middle category, s equals 3 while for the other two diagonal categories, it equals 0. If we weight by the expected population sizes under random matching, we get $s^* = 1$. Eika et al. would incorrectly conclude that there was neither positive nor negative assortative mating.[12]

We choose not to use s^* as our measure of homogamy because it can be quite sensitive to changes in the distribution of education. To take an extreme and admittedly unrealistic case, suppose that a fraction p of men are high school graduates and the rest are high school dropouts. The fraction of women who are high school graduates is also p, but, in contrast with men, the rest are college graduates. Homophily is extremely strong and utility is not transferable so that all high school graduates marry other high school graduates and dropouts and college graduates are left to marry each other. In this case, $s^* = p/p^2$ or $1/p$. [13] As the proportion of high school graduates goes to 0, this measure of homogamy goes to infinity. We would find it misleading at best to conclude that homogamy was extremely high because the very small number of high school graduates married each other.

Similarly, consider the same example except that the proportions of men and women high school graduates are p and γp with $\gamma > 1$ so that some female high school graduates have to marry high school dropouts. Then $s^* = 1/(\gamma p)$. It is not self-evident that we should conclude that homogamy has decreased. As, regardless of γ, homogamy is at its maximum, we are inclined to view γ as not affecting the degree of homogamy.

Finally, suppose that in both sexes, we have a fraction p of high school graduates and $1 - p$ of college graduates. Increases in p shift s_{ii} in different directions. If, for example, p decreased from 0.75 to 0.5, s would go from 1.33 to 2 among high school graduates and from 4 to 2 among college graduates. Because random matching with $p = 0.5$ implies that the proportion of matches in which both spouses are college graduates should be 0.25, maintaining an s of 4 among college graduates would require that all of the matches consist of two college-graduate spouses. As we will see, this is the type of change that drives Eika et al.'s conclusion that homogamy (which they term assortative mating) has decreased among college graduates.

One might object that our examples rely on very high rates of homogamy. If the trends we were considering involved low rates of homogamy, and we were asking whether homogamy increased or decreased somewhat from this low rate,

[12]To be fair to these authors, their 2017 revision addressed a number of the measures of assortative mating we discuss later and in the 2016 NBER working paper version of this paper (Gihleb and Lang, 2016).

[13]Under random matching, the fraction of homogamous high school/high school matches is p^2. The actual number of homogamous matches is p and thus $s_{ii} = 1/p$. As this is the only possible homogamous match, it should have weight 1.

we might be inclined to agree that this is a cause for concern. However, we will see that levels of homogamy are, at least from our perspective, relatively high, and, moreover, they are sufficiently high that in some cases maintaining a constant s_{ii} in the presence of shifts in the education distribution would require the proportion of homogamous marriages within an education group to exceed 100%. As a result, we measure homogamy simply by the proportion of homogamous marriages while noting changes in the potential for homogamous marriages based on the education distribution.

4. MEASURING CHANGES IN ASSORTATIVE MATING

Many economists are less interested in why matching might have changed than in whether it has changed as increased assortative mating might increase family income inequality.[14]

In the previous section, we assumed that the underlying trait was uniformly distributed for both *X*s and *Y*s. As a consequence, with perfect assortative matching, the correlation between the partners' educations was also perfect. In reality, of course, there is no reason to expect the education distributions to be drawn from the same family. Moreover, education tends to be very lumpy.

Although economists tend to use correlation measures such as the Pearson correlation coefficient (r) or its square (R^2), it is more natural to use measures based on rank. Assortative matching is perfect if the individual with the highest value of z in the X group is matched with the individual with the highest z among the *Y*s, the second highest in each group are matched, and so on. Nothing in this description depends on being able to write z_{iy} as a linear function of z_{ix}.

It may therefore be more appropriate to use a correlation measure designed for ordered data and that does not rely on the interval properties of the data. The Spearman rank-order correlation coefficient asks precisely how closely two variables are correlated when they are rescaled by their rank. This metric is the most natural one for us to use because it corresponds strongly to the idea of correlation of ranks. Unfortunately, it does not perform particularly well in the presence of ties, of which there are many in the data.[15]

Kendall's τ (sometimes called τ_a) asks, when comparing any two observations, whether both variables are ranked the same way. In other words, if the husband

[14]Eika et al. (2014) and Hryshko, Juhn, and McCue (2017) find that assortative mating does not have a sizable effect on family income inequality.

[15]A simple example may help to illustrate why this is a problem. Suppose that 40 percent of women and 60 percent of men have high school diplomas and that the remainder have college degrees. The female high school graduates all marry male high school graduates and male college graduates all marry female college graduates. The excess female college graduates marry the excess male high school graduates. Mating is thus maximally assortative. The male high school graduates are all assigned rank 0.3 (the mean of 0–0.6) and the females high school graduates are all assigned rank 0.2. Similarly, male and female college graduates are assigned ranks 0.8 and 0.7. The Spearman rank correlation is only 0.67.