Job Displacement, Remarriage, and Marital Sorting*

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Abstract

We investigate how job displacement affects whom men match with on the marriage market and study implications for marriage market matching theory. Leveraging quasi-experimental variation from Danish establishment closures, we show that displaced men on average match with higher earning women, relative to an untreated control group. We show that in conventional marriage market search and matching models this finding is challenging to square with the widely documented positive correlation between matched partners' incomes. To reconcile our findings with theory, we develop a multidimensional frictional marriage market model. We propose a specification in which sorting on income is negative, yet a positive correlation between matched partners' incomes can arise spuriously, driven by unobserved characteristics. To highlight the policy relevance of our results, we simulate the impact of tax reforms on marital sorting and income inequality. We constrast simulation results from a one-dimensional marriage market model with our multidimensional framework.

Keywords: Marriage Market, Sorting, Search and Matching, Job Displacement

JEL classification: D10, J12, J63, J65

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1 Introduction

Sorting in the marriage market contributes to economic inequality. This idea, which goes back to Becker (1973), has motivated an extensive body of literature that studies the link between marital sorting and income inequality. In particular it has been investigated how marital sorting shapes the evolution of income inequality over time, and how marital sorting interacts with policy changes.[1] A wide range of these studies document a positive empirical association between spousal characteristics (such as income, education, and physical attractiveness).[2] However, much less is known about the drivers behind this positive association: What part of marital sorting is driven by observed versus unobserved characteristics? To what extent do exogenous shocks to individual characteristics affect whom a person marries? What is implied for the link between marital sorting and income inequality?

We aim to provide answers to these questions by estimating the effects of exogenous job displacements on whom displaced workers marry (or are in a committed relationship with). We then use our empirical results to derive implications for marriage market matching theory.

In the empirical part of our paper we leverage quasi-experimental variation from establishment closures in Denmark. In a difference-in-differences design we compare over 75,000 displaced male workers to a a non-displaced control group. We study the evolution of relationship status and spouse's (or cohabiting partner's) characteristics, including income, age, and education, in the treatment group relative to the control group. Our estimation results document that displaced men have a persistently increased separation risk. Relative to the control group, the treatment group has a 1.5 percentage points higher probability to experience a separation over the 10 years following the displacement. Two thirds of the separated men remain single after 10 years. The remaining third of men remarry or cohabit with new partners. We further document displaced men on average match with higher earning new partners relative to the control group. This effect is driven by wages. For the new partner's hours worked, the displacement effect is small and insignificant, ruling out changes in intra-household specialization as a driving force. In robustness checks we show that our results are not driven by displaced men moving to firms or cities in which women on average have higher incomes. Based on a back of the envelope calculation we further argue that it is unlikely that our results are driven by equilibrium effects that establishment closures may exert on local marriage markets.

We show that in one-dimensional marriage market search and matching models (see, e.g., Shimer

[1] See,.e.g., Breen and Salazar (2011); Breen and Andersen (2012); Greenwood, Guner, Kocharkov and Santos (2015); Eika, Mogstad and Zafar (2019)

[2] See, e.g., Oreffice and Quintana-Domeque (2010); Chiappori, Oreffice and Quintana-Domeque (2012); Dupuy and Galichon (2014); Chiappori, Costa-Dias and Meghir (2020)). In Denmark, the country we study, the correlation of income levels in the cross section of married and cohabiting couples was 0.2 between 1980 and 2013.

and Smith (2000)) our empirical findings are challenging to square with the widely documented positive correlation between matched partners' labor incomes. Intuitively, in one-dimensional models complementarities in partners' earnings potential govern both, the association between matched partners' incomes in the cross-section, as well as the impact of exogenous shocks to individual characteristics (e.g., job displacement).

To reconcile theory with our empirical results we build on the Shimer and Smith (2000) framework and develop a multidimensional extension. In our proposed specification sorting on income (ceteris paribus) is negative, implying that agents who experience negative income shocks tend to match with higher earning partners. At the same time a positive cross-sectional correlation between matched partners' incomes can arise spuriously, driven by other individual characteristics.

Models of household decision-making with endogenous marriage/divorce and two-sided heterogeneity typically follow one of two modeling paradigms regarding marriage market matching. One group of papers allows for search frictions and assumes a parametric matching function (e.g. Greenwood, Guner, Kocharkov and Santos, 2016; Goussé, Jacquemet and Robin, 2017; Holzner and Schulz, 2019). The other group assumes frictionless matching in the spirit of Choo and Siow (2006) (e.g. Choo, 2015; Gayle and Shephard, 2019). In both cases, observed PAM correlations can be treated as estimation targets such that the estimated model mimics the empirical allocation of heterogeneous types in the cross section of couples. The driving force of sorting in these models is typically the parametric form of the household production function, for instance (log-)supermodularity in education or income (following Shimer and Smith, 2000).

The main contribution of our paper is best understood in relation to the literature about time trends in assortative mating in the marriage market and inequality (e.g. Greenwood et al., 2015; Eika et al., 2019; Chiappori et al., 2020). The existing literature is mainly concerned with the measurement and implications of rising PAM. We complement this literature by taking a step back and studying the origins of PAM using quasi-experimental variation in income. Our results suggest that income sorting of married couples actually reflects NAM. We argue that the observed positive income correlation in the cross section of couples can be explained by multidimensional marriage market matching.

Our findings are also of interest for the broader structural literature that studies matching patterns and their implications (e.g. Greenwood et al., 2016; Goussé et al., 2017; Chiappori, Costa-Dias and Meghir, 2018; Holzner and Schulz, 2019; Ciscato, 2020; Pilossoph and Wee, 2020). To match the observed allocation in the marriage market, the models typically employed in this literature necessitate a parameterization of the household production function. We are able to disentangle matching on income from matching on other variables, which is helpful for the modeling of home production and marital surplus. However, the evidence in favor of income-based NAM we present also poses a challenge. In the light of our findings, it appears difficult to allow for income-based NAM at the household level and match the positive income correlation in the cross section at the same time, at least for one-dimensional models of marriage market matching.

Our paper joins a relatively small literature that studies marriage matching patterns using (quasi-)experimental variation. Kaufmann, Messner and Solis (2015) use a regression-discontinuity approach to study educational sorting. They find that own education has a significant positive effect on the partner's education and income. Anderberg, Bagger, Bhaskar and Willson (2020) find that raising the school-leaving age in the UK in 1972 affected partner choices both in terms of (unobserved) ability and qualification. Adda, Pinotti and Tura (2020) and Schulz and Siuda (2020) use the Choo and Siow (2006) framework to study the marriage market impact of the eastern expansion of the European Union and a German labor market reform, respectively. Both papers find significant reform effects on the surplus and stability of interethnic marriages. Fisman, Iyengar, Kamenica and Simonson (2006) conducted speed-dating experiments to generate random variation in the number and characteristics of potential partners. In line with our findings, they find significant differences in the role that various heterogeneous partner characteristics (ambition, intelligence, race, physical attractiveness, income) play for matching decisions and also highlight important differences between men and women in this regard, while we restrict our attention to men.

Finally, our paper is related to the vast literature on the effects of mass layoffs (plant closures), which goes back to Jacobson, LaLonde and Sullivan (1993). Various outcomes of displaced workers have been studied. A few examples are earnings losses (Davis and von Wachter, 2011), wage and employment fluctuations (Schmieder and von Wachter, 2010), consumption (Browning and Crossley, 2008), health (Browning, Moller Dano and Heinesen, 2006; Browning and Heinesen, 2012), and more recently negative spillovers effects on the regional economy (Gathmann, Helm and Schönberg, 2018) and access to credit (Braxton, Herkenhoff and Phillips, 2020).

Autor, Dorn and Hanson (2019), following Autor, Dorn and Hanson (2013), use variation in Chinese import competition to identify gender-specific labor demand shocks across the U.S. economy. Closely related to our empirical analysis, these authors study effects on the marriage market prospects of young men. They also find negative effects on marriage rates and report an increased prevalence of single-headed households exposed to poverty risk. Relative to their paper, ours shifts the focus to new partner characteristics upon remarriage and assortative matching, which has additional implications for inequality.

The remainder of our paper is structured as follows: in section 2, we introduce the marriage market matching model with one-dimensional heterogeneity and derive predictions regarding the implications of job displacement for marital sorting. Section 3 describes our data sources and empirical strategy. In section 4, we present our empirical results and show that they are in disagreement with the predictions of the one-dimensional sorting model. We explore multi-dimensional sorting as a possible avenue to reconcile theory and data in section 5. Section 6 concludes.

2 Conceptual Framework

We introduce a theoretical framework that draws on established matching models of the marriage market. Within this framework we discuss the relationship between sorting patterns and the impact of job loss on marriage market matching. Our benchmark framework draws on the frictional marriage market model introduced by Shimer and Smith (2000).[3] We study a frictional environment as these models provide a natural link to our empirical setup.[4] While the arguments we conduct are specific to frictional matching, we hypothesize similar arguments apply in widely used frictionless matching models.[5]

2.1 Setup

We derive our results for (two-sided) matching markets, in which women of type $q_f \in [\underline{q}, \overline{q}]$ match with men of type $q_m \in [\underline{q}, \overline{q}]$ in continuous time discounted at rate r. Search is random, i.e., at rate λ_f a single woman meets men randomly drawn from the distribution of single men, G_m, and vice-versa. We assume meeting rates are proportional to the mass of singles, $\lambda_f = \alpha \int dG_m(q_m)$ and $\lambda_m = \alpha \int dG_f(q_f)$. Upon meeting agents observe each others type and each decide whether to accept and form a match or reject and continue searching.[6] We consider settings in which utility is transferable within couples. A matched couple of type (q_f, q_m) enjoys flow marital surplus, $f(q_f, q_m)$, which is distributed between the matched agents. The marital surplus thus equals the sum of the matched partners' individual utilities. As we shall show in our empirical analysis in sections 3-4 show that experiencing persistent income losses affect who men match with. We thus link the described matching framework to our empirical analysis by interpreting agents' types, q_f and q_m, as labor income (or more precisely as long-run earnings potential).

[3] Versions of the Shimer and Smith (2000) model have been applied, e.g., in Goussé et al. (2017), Ciscato (2020), and Holzner and Schulz (2019).

[4] In our data we observe that finding a new partner on average takes several years, consistent with frictional matching.

[5] Frictionless marriage market matching models are used, e.g., in Choo and Siow (2006), Iyigun and Walsh (2007), Chiappori, Salanié and Weiss (2017), Chiappori et al. (2018), Ashraf, Bau, Nunn and Voena (2020), Ciscato, Galichon and Goussé (2020), Gayle and Shephard (2019), Adda et al. (2020), and Pilossoph and Wee (2020).

[6] In equilibrium the meeting rate is proportional to the respective measure of singles.

2.2 Matching and Separations

The described framework entails that upon meeting couples match if the marital surplus is positive, $f(q_f, q_m) \geq 0$. In this case the marital surplus can be distributed between the matched agents such that both agents benefit relative to remaining single. If a type q_f woman and a type q_m man match upon meeting (i.e. if $f(q_f, q_m) \geq 0$) write $q_f \in \mathcal{M}(q_m)$, i.e. $\mathcal{M}(q_m)$ denotes the matching set of q_m type men. Note that as matching is symmetric, $q_f \in \mathcal{M}(q_m)$ is equivalent to $q_m \in \mathcal{M}(q_f)$.

We assume exogenous separations occur at rate δ. Upon separating both partners enter the population of singles and search for a new partner. Later in our analysis we assume that job loss permanently alters men's types within existing matches, e.g., from q_m to $\tilde{q}_m$. In this case the couple (q_f, q_m) separates endogenously after the man's job loss if $f(q_f, \tilde{q}_m) < 0$.

2.3 Equilibrium and Sorting

Shimer and Smith (2000) prove the existence of steady state equilibria which satisfy 1.) *individually optimal behavior:* every agent maximizes her expected payoff, taking all other agents' strategies as given, and 2.) *steady state:* match creation equals match destruction for each agent type (i.e., for all q_f and all q_m).[7]

Furthermore Shimer and Smith (2000) provide the following definition of PAM and NAM in this environment and derive conditions under which PAM or NAM obtains in equilibrium.

Definition 1. *Consider $q'_f < q''_f$, $q'_m < q''_m$.*

There is PAM if:

$$\left.\begin{matrix} q''_f \in \mathcal{M}(q'_m) \\ q'_f \in \mathcal{M}(q''_m) \end{matrix}\right\} \Rightarrow \begin{cases} q'_f \in \mathcal{M}(q'_m) \\ q''_f \in \mathcal{M}(q''_m) \end{cases}$$

There is NAM if:

$$\left.\begin{matrix} q'_f \in \mathcal{M}(q'_m) \\ q''_f \in \mathcal{M}(q''_m) \end{matrix}\right\} \Rightarrow \begin{cases} q''_f \in \mathcal{M}(q'_m) \\ q'_f \in \mathcal{M}(q''_m) \end{cases}$$

The following relationships between sorting and partner type correlations hold:

$$\text{PAM} \Rightarrow Corr(q_f, q_m) > 0, \tag{1}$$

[7] Shimer and Smith (2000) additionally posit that agents accept any matches with weakly positive marital surplus, but show in Shimer and Smith (1997), that this assumption is not required.

$$\text{NAM} \Rightarrow Corr(q_f, q_m) < 0. \tag{2}$$

Using these relationships we can directly conclude from the observed correlation between matched partners incomes which sorting patterns our data are consistent with. As is shown in section 3 our data exhibit a positive cross-sectional correlation between matched partners' labor incomes: i.e., by (1) and (2) our data are consistent with PAM, and inconsistent with NAM.

2.4 Job Loss and Marriage Market Matching

We show that in the described framework sorting patterns (PAM or NAM) fully determine how a reduction in labor income (q_m) affects whom men match with.

Formally, we assume that job loss leads to a permanent reduction in labor income by $d > 0$. If a type q_m men is displaced he is thus permanently assigned the new type $\tilde{q}_m = q_m - d$. Now consider a treatment group ($D_m = 1$) and a control group ($D_m = 0$) of men, observed at two points in time $t = 0$ and $t = \tau > 0$. Suppose all men in the treatment group are displaced between period zero and τ while men in the control group are not (i.e., $\tilde{q}_{m\tau} = q_{m0} - d$ for the treated and $\tilde{q}_{m\tau} = q_{m0}$ for the control group). Denote by S_m a dummy that indicates a separation, and by R_m a dummy that indicates a switch to a new partner between $t = 0$ and $t = \tau > 0$.

We show that the following relationships between sorting and the sign of the treatment effect hold:

Proposition 1. *(1) Under PAM displaced men who switch to a new partner on average match with partners of weakly lower type than non-displaced men. (2) Under NAM displaced men who switch to a new partner on average match with partners of weakly higher type than non-displaced men:*

$$PAM \Rightarrow \mathbb{E}[q_{f\tau} - q_{f0}|S_m = 1, R_m = 1, D_m = 1] \leq \mathbb{E}[q_{f\tau} - q_{f0}|S_m = 1, R_m = 1, D_m = 0], \tag{3}$$

$$NAM \Rightarrow \mathbb{E}[q_{f\tau} - q_{f0}|S_m = 1, R_m = 1, D_m = 1] \geq \mathbb{E}[q_{f\tau} - q_{f0}|S_m = 1, R_m = 1, D_m = 0]. \tag{4}$$

In sections 3 - 4 we provide quasi-experimental evidence showing that displaced men tend to switch to higher earning women relative to a control group of non-displaced men, refuting the consequent in (3), but consistent with the consequent in (4). Proposition 1 thus establishes that our quasi-experimental evidence is inconsistent with PAM, within the introduced matching framework.

In sum the quasi-experimental evidence we present in sections 3 - Section 4 is thus inconsistent with PAM, while the positive correlation between matched partners' labor incomes is inconsistent with NAM (by 2). This constellation presents a puzzle to widely used matching models which either exhibit PAM or NAM.

3 Empirical Strategy

Our empirical strategy compares roughly 63,000 workers who lose their job as part of establishment closures to a control group of workers who have similar observable characteristics, but who were not laid off as part of an establishment closure during our sample period. The following subsections describe how we identify establishment closures in our data, our definition of treatment and control group, and the regression specification of our research design.

3.1 Data

Our empirical analysis is based on Danish register data, which includes the universe of men and women living in Denmark between 1980 and 2007. The data consist of information from tax and social security records and include variables about employment, different income measures, occupation, work hours as well as marital status and children. Individuals can be linked to their partners and children. Moreover, the data allow us to identify unmarried cohabiting couples. Statistics Denmark defines cohabiting couples as two opposite-sex individuals with and without joint children who share the same address, exhibit an age difference of less than 15 years, have no family relationship, and do not share their accommodation with other adults (see also Datta Gupta and Larsen, 2007). The data further contain information on the establishments individuals work at, in particular establishment size and the year of the closure of the establishment.

3.2 Establishment Closures

To identify establishment closures in our data we consider establishments in our data that stop operating, i.e., completely shed their workforce. To define the *closure year* we consider the last three years of establishment operation and pick the first among these years with a workforce reduction by 10% or more. In our main analysis we exclude establishments with less than 5 employees in the last period prior to the closure year. These criteria broadly follow the definition of establishment closure in Browning and Heinesen (2012).

3.3 Treatment and Control Group

Based on our definition of establishment closure we define treatment and control groups.

Treatment group. Our treatment group consists of men employed at closing establishments in the closure year. To focus on men who are strongly attached to the labor force, we only include men with at least three years of tenure at the closing establishment and who are of age 25–45 in the closure year. The time window we consider extends from five years prior to ten years after establishment closure, i.e., at this point in time the laid off men are 35–55 years old.

Drawing the Control Group, Exact Matching. We rely on matched sampling to obtain a control group of men who resemble our treatment group in terms of observable characteristics, but who were not laid off as part of an establishment closure during our sample period.

More precisely, we draw our control group from all men in our data with tenure of at least three years at establishments which did not close during our observation period. We perform exact matching to ensure similarity between treatment and control group in terms of observables. Our exact matching approach discretizes continuous matching variables into bins and then exactly matches each displaced individual with a control individual on the discretized attributes. As argued by Iacus, King and Porro (2012), this method has favorable statistical properties in small samples, as well as the appeal of being straightforward to interpret.

Matching variables. The variables that we perform our exact matching algorithm on are marital status (single, cohabiting, married, divorced), (exact) age, calendar year, occupation (6 categories), industry (9 groups), establishment size quintiles, and tenure quintiles. We match treatment and control group with respect to each of these variables three years before establishment closure.

3.4 Regression Specification

To study how job displacement affects marriage market matching, we estimate the following regression specification, using a set of different outcome variables for Y_{it} (see section 4):

$$Y_{it} = \sum_{\tau=-3}^{10} \alpha_\tau \mathbf{1}\{t=\tau\} + \sum_{\tau=-3}^{10} D_i \beta_\tau \mathbf{1}\{t=\tau\} + e_{it}, \tag{5}$$

where i is an individual index and t is time relative to the year of displacement. D_i is a dummy variable indicating whether an individual is in the treatment group and e_{it} is the residual error term. The coefficients of interest are β_τ, which correspond to the effect of the displacement on the treatment group relative to the control group in the year of displacement and subsequent years. The key assumption to identify β_τ is that the trend in Y_{it} would have been parallel across treatment and control group in the absence of job displacement.

4 Empirical Results

Our main empirical results show that men who are displaced from their job have a higher propensity to separate from their married or cohabiting partner, and re-match with higher earning women relative to a non-displaced control group. We show that this effect is not driven by endogenous labor supply choices.

As robustness checks we investigate whether laid off men switch to firms or move to regions with higher earning women, and can rule out either.

There are two potential margins contributing to our empirical results. A behavioral response: displaced men adjust their search behavior on the marriage market, and endogenous selection: those men who separate and re-match after being laid off have characteristics that make switching to a higher earning woman more likely. In section 5 we use our empirical results to draw conclusions for matching theory. Our conclusions hold irrespectively of which of the above margins drives our results.

4.1 Employment and Labor Income

We begin our analysis by estimating the impact of the displacement on employment and earnings in our sample. These results are important to show that the displacement indeed has an adverse impact on workers' long-run labor market outcomes, which is necessary to interpret displacement as an income shock.

Figure 1 shows the result for estimating equation 5. The outcome variables are an indicator variable for employment and total labor income, where non-employment is coded as zero. The figure shows that job displacement has a negative impact on labor income that builds up to around -13,000 DKK in the first four years after displacement and persists at around -7,000 DKK ten years after displacement. The remaining graphs illustrate the underlying mechanisms behind this effect. The displacement reduces the probability of employment. The employment rate recovers only 10 years after the displacement. In addition, there is a persistent negative effect on the wage of the worker, which could for example result from falling of the career ladder and having to switch to a less attractive job. Finally, the displacement also reduces work hours.

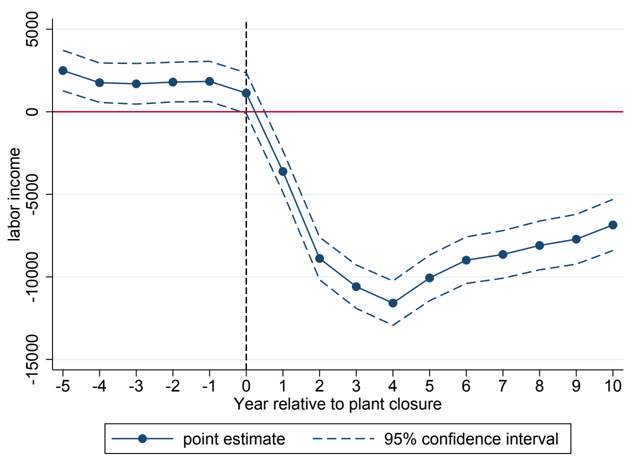
4.2 Relationship Status

In Figure 5, we show the impact of the displacement on workers' relationship status. In these specifications, the dependent variable is an indicator for whether the individual has separated from their initial partner, lives as a single, and lives with a new partner. The estimates show that the displaced group is up to 1.2 percentage points more likely to have experienced a separation 10 years after displacement. The other two figures show how this breaks down into individuals who find a new partner and those who are single at each given point in time.[8] Roughly two thirds of the separations result in an increase in singlehood, whereas one third leads to a cohabiting

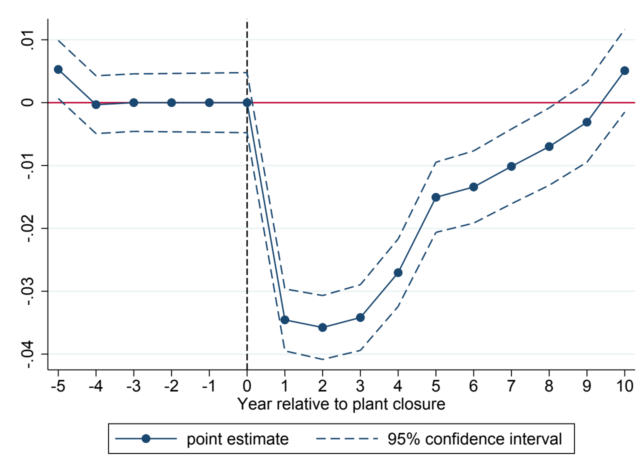
[8] Note that we define singles as those who are currently not in a cohabiting relationship with a partner. This can include individuals in an early-stage relationship who do not live with their partner yet. In that sense, our estimate is an upper bound for singlehood which includes non-cohabiting relationships.

Figure 1: Labor Market Effects of Job Displacement

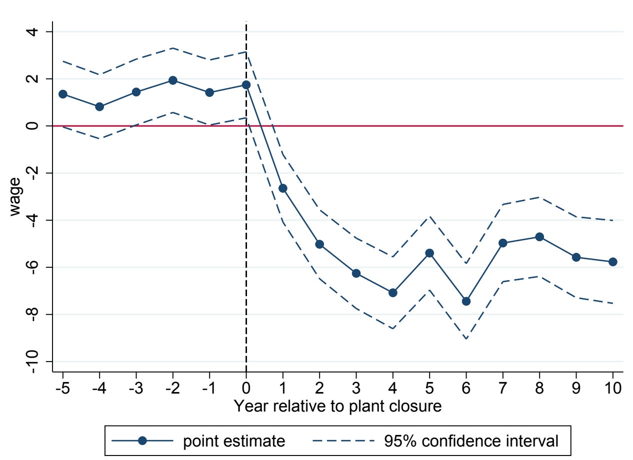
(a) Labor Income (in DKK)



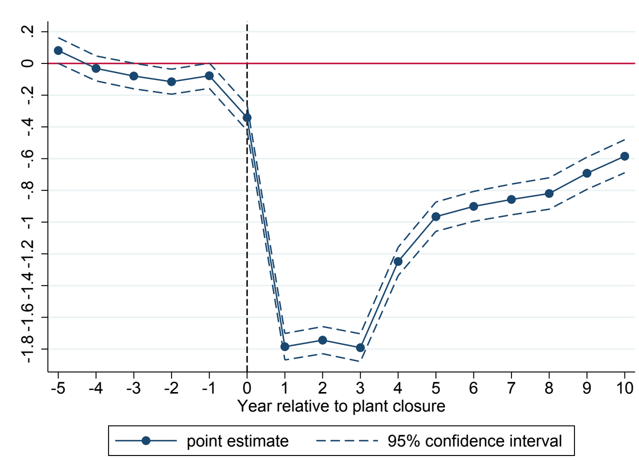
(b) Employed



(c) Hourly Wage (in DKK)



(d) Work Hours



Notes: The figure shows the effect of establishment closure on different labor market outcomes. Point estimates measure the impact of experiencing establishment closure on labor income (in DKK), employment, hourly wages (in DKK), and weekly work hours (including zeros for non-employed). The estimates correspond to estimates of β_τ from equation (5). All estimates are based on a sample of men who experienced an establishment closure between 1980-2007, and the same number of control individuals selected by exact matching. The sample selection criteria and matching algorithm are described in subsection 3.3.

relationship with a new partner. The effect of job loss on separations has also been documented by Eliason (2012) using Swedish data.

4.3 Partner Income

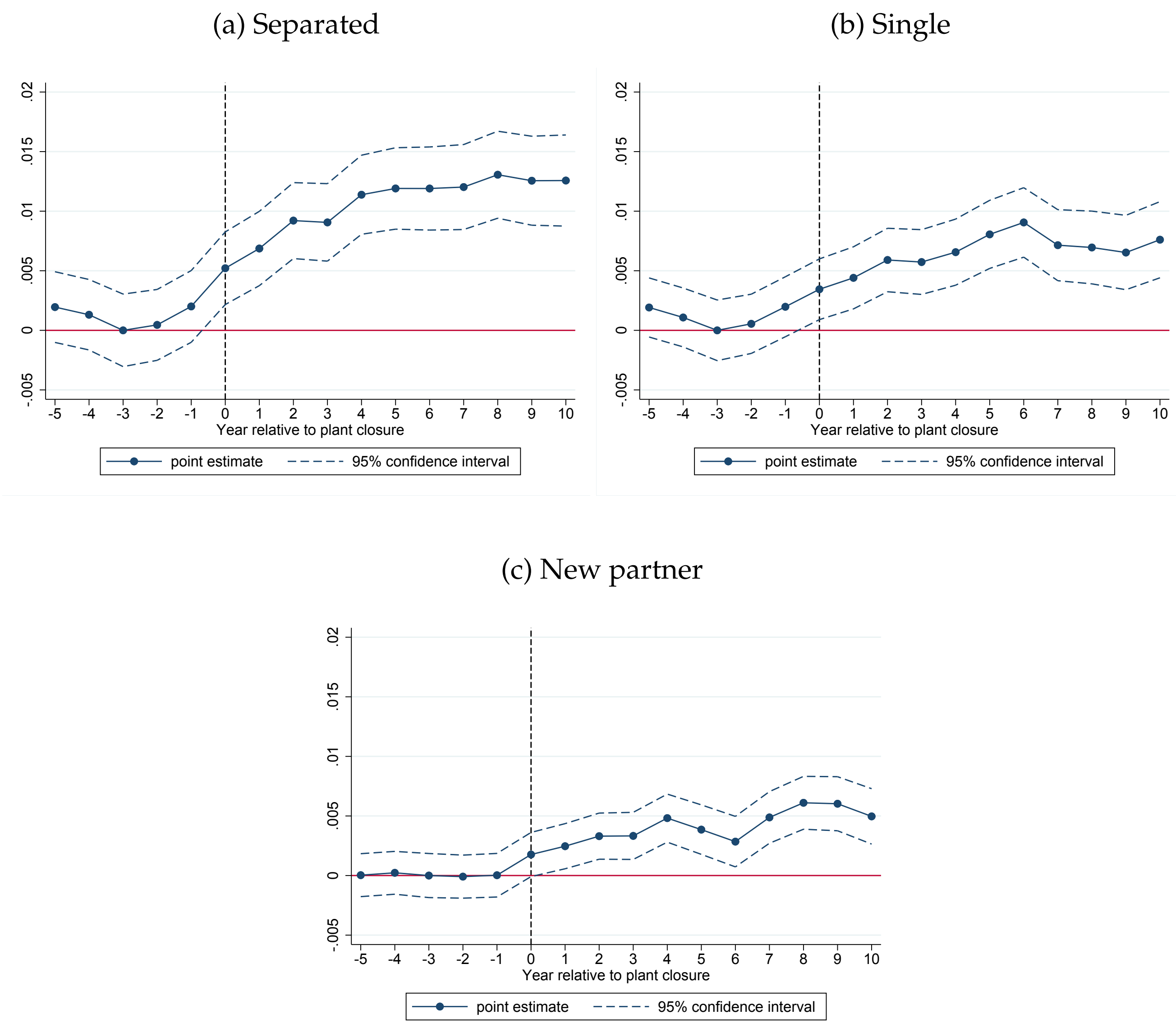
In Figure 3, we turn to the main focus of our paper, the effect of the displacement on the characteristics of the new partner. To determine the impact of the displacement on the income of the new partner, we estimate equation 5 with an indicator variable for whether the income of the new partner is at least 5% higher than the income the old partner has in the same period: Recall that R_{it} is an indicator for whether the individual is currently in a relationship, and that changes in partner characteristics are only defined conditional on $R_{it} = 1$.

Figure 3 shows how the probability of living with a new partner with either higher, the same, or lower income as the previous partner evolve after the displacement.[9] The figure reveals that most of the difference in partner switching is driven by a higher propensity of the displaced group to switch to a partner with a *higher* income. In this case, the estimated coefficients are positive significant at the 5% level at all post-displacement event times. For switching to a partner with the same income, the coefficients are smaller and not always statistically significant. Finally, for switching to lower income partners, there is almost no difference between treatment and control group. The coefficients are almost always close to 0 and insignificant.

In table 1, we summarize these estimates in a single coefficient. We pool all post-displacement event times and regress partner income on a constant and a dummy for the displacement group. The highly significant coefficient on the displaced dummy is 7806.9, capturing that displaced men on average switch to a partner with higher earnings. To investigate the drivers behind the increase in partner earnings, we also conducted the regression separately for hours and wages of the new partner. The table shows that the increase in partner income is primarily driven by wages. For hours, the displacement effect is small and insignificant. Note that this result rules out changes in intra-household specialization as a driver of the increase in partner income. In principle, it could be that the (new) partners of displaced men increase their work hours somewhat in order to make up for the displacement. However, our finding of no significant change in hours is evidence against such a channel.

[9] Note that the three dummy variables which are used as outcomes here are the interaction of (1) having a new partner and (2) the income of the new partner. As a result, the sum of the three dummies would be equal to an indicator variable for having found a new partner.

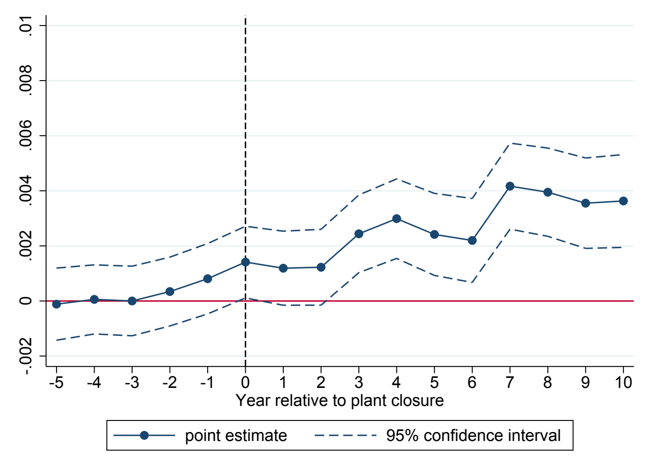
Figure 2: Impact of Job Displacement on Relationship Status



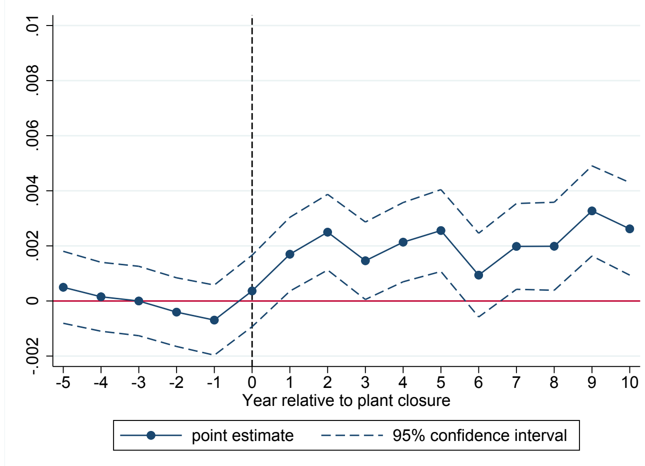
Notes: The figure shows the effect of establishment closure on different measures of relationship status. Point estimates measure the impact of experiencing establishment closure on the probability to be (a) separated from the initial partner (defined as the partner at $\tau = -3$), (b) single (i.e., *not* married *and not* cohabiting) or (c) matched (i.e., married or cohabiting) with a new partner who is distinct from the initial partner. The estimates correspond to estimates of β_τ in equation (5). All estimates are based on a sample of men who experienced an establishment closure between 1980-2007, and the same number of control individuals selected by exact matching. The sample selection criteria and matching algorithm are described in subsection 3.3.

Figure 3: Impact of Job Displacement on New Partner's Labor Income, Relative to Initial Partner

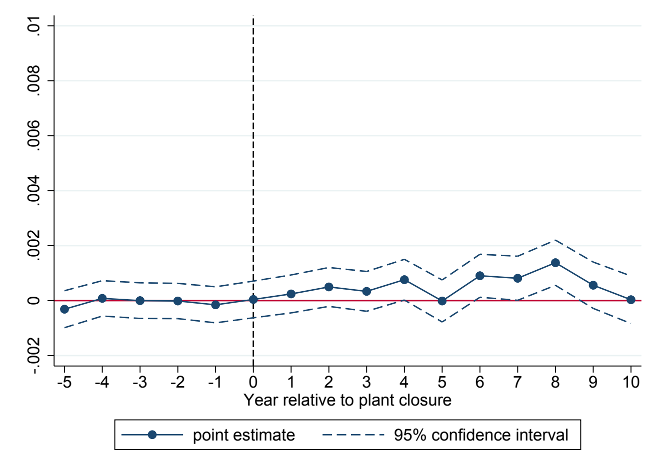
(a) New partner income higher by $> 5\%$



(b) New partner within a $\pm 5\%$ range



(c) New partner income lower by $> 5\%$



Notes: The figure shows the effect of establishment closure on the probability to be matched with a new partner (distinct from the initial partner, defined as the partner at $\tau = -3$) whose labor income is (a) higher by $> 5\%$, (b) within a $\pm 5\%$ range of, or (c) lower by $> 5\%$ initial partner's earnings, where the initial partner's and new partner's earnings are compared in the time periods (event time τ). The estimates correspond to estimates of β_τ from equation (5). All estimates are based on a sample of men who experienced an establishment closure between 1980-2007, and the same number of control individuals selected by exact matching. The sample selection criteria and matching algorithm are described in subsection 3.3.

Table 1: Treatment Effects, Conditional on Re-matching with a New Partner

	(1) Income	(2) Wage	(3) Hours
Treatment	3185.2*	4.073***	0.139
	(2.47)	(3.49)	(0.79)
Constant	-1639.1	-8.429***	0.291*
	(-1.77)	(-10.03)	(2.31)
N	65046	62753	49930

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The table reports the results of regressions of differences in labor income, wages and work hours between new partner and initial partner (defined as the partner at event time $\tau = -3$) on a constant and an indicator variable that equals 1 for individuals in the treatment group and 0 for control group individuals. t-statistics are reported in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4.4 Robustness

Finally, we rule out a number of alternative explanations for our findings which are unrelated to the channels highlighted by the theoretical model.

Moves Across Local Marriage Markets. First, we look at the role of geographical moves. Figure 4 how the displacement affects the propensity to move by estimating our previous specification with an indicator variable for whether the individual has moved to a different region. The figure shows that the impact of displacement on the likelihood of having moved to a different municipality is significantly positive and stabilizes at 1.5 p.p. 3 years after displacement.

Since the figure shows that displaced workers adjust their mobility behavior, it is also important to check whether the regions they move to differ from the choices of the control group. For example, if displaced workers were, for whatever reasons, moving to regions in which women on average earn more than in their previous region, this would partially explain why they find a better partner after their displacement. However, it turns out that there is hardly any difference between the regional earnings of women between the treatment and control group. The difference is very small and not statistically different from zero.

A related issue is that the new regions might differ in the sex ratio. In regions in which there are many women relative to men, it would also be easier to find a better partner than previously. To exclude this explanation, we also ran an event study with the sex ratio of the region as an dependent variable. To capture common age differences between spouses, we construct age-specific sex ratios which compute the ratio of women relative to men in a 10-year window around the individuals own age.[10] As with the regional earnings, however, there is no difference in the regional sex ratio between treatment and control group after displacement.

Marriage Market Equilibrium Effects of Establishment Closures. A potential challenge to identification is that establishment closures might exert equilibrium effects on the marriage market. Our previous empirical analysis rests on the assumption that establishment closures affect displaced men directly, but do not change the overall composition of the pool of singles on the marriage market. We provide a back of the envelope calculation to demonstrate that we can reasonably expect such equilibrium effects to be small: The workforce of the average closing establishment in our sample is 270 workers. The raw rate at which displaced workers separate from their partners in the 10 years following establishment closure is 0.2. The average inflow of singles into the marriage market over 10 years in the aftermath of an establishment closure hence is approximately $0.2 \times 270 = 54$. This amounts to an influx of 1.4% relative to the average number of singles living in the municipality where the establishment closes (which is 3897).[11] We view this number as a conservative approximation, given the long time horizon (10 years) we consider and given that we look at the number of singles in the municipality of the closing establishment, arguably a lower bound for the size of the local marriage market.

5 Reconciling Theory and Data: Multidimensional Matching

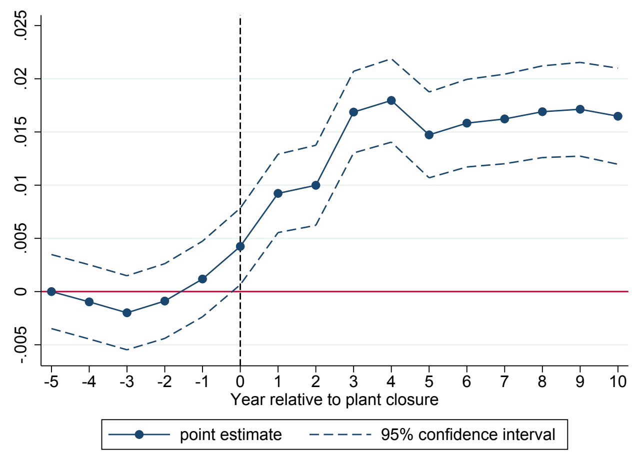
We extend the framework described in section 2 to multidimensional settings. We derive a relationship between sorting patterns and matching sets in the multidimensional case and provide conditions under which our empirical facts that challenge the one-dimensional framework are reconciled with theory, i.e., under which the model is consistent with: 1. men switching to higher earning partners upon job loss, in line with our quasi-experimental evidence, as well as with 2. the positive correlation between matched partners' incomes observed in the data.

[10] For example, for a 40 year old worker, the age-region-specific sex ratio is the ratio between the number of single women between 35 and 45.

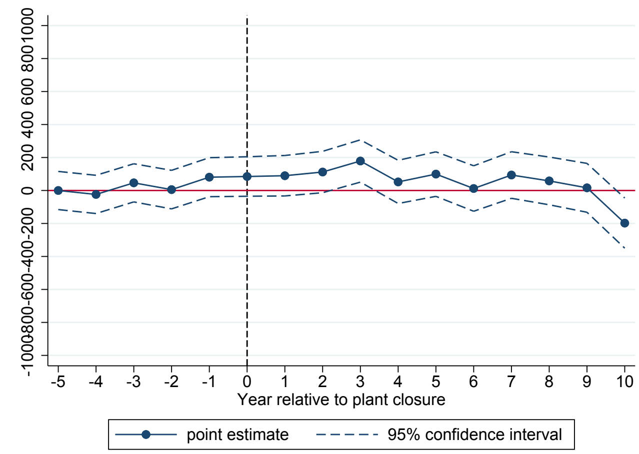
[11] We arrive at a similarly small number (0.89%) if we use the median instead of the mean establishment size and number of singles in the municipality.

Figure 4: Do Displaced Men Move to Municipalities that Differ in Terms of Single Women's Labor Income or Sex-ratio?

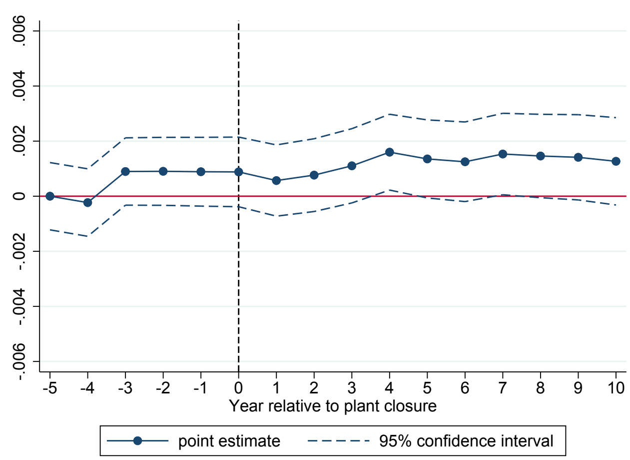
(a) Fraction Moved



(b) Single Women's Average Labor Income, Difference to Initial Municipality



(c) Sex Ratio, Difference to Initial Municipality



Notes: The figure shows the effect of establishment closure on (a) the probability of moving to a different municipality, (b) the difference between single women's average labor income in the municipality an individual lives in to the average single women's labor income in the municipality where the individual lived in $\tau = -3$, and (c) the difference between the sex ratio ($\frac{\#women}{\#men}$) in the municipality an individual lives in to the average sex ratio in the municipality where the individual lived in $\tau = -3$. The estimates correspond to estimates of β_τ in equation (5). All estimates are based on a sample of men who experienced an establishment closure between 1980-2007, and the same number of control individuals selected by exact matching. The sample selection criteria and matching algorithm are described in subsection 3.3.

5.1 Multidimensional Setup

The model fundamentals, the timing and the search protocol are identical to the one-dimensional case presented in section 2. We extend the framework by allowing for n-dimenstional male and female types summarized in vectors, v_f and v_m. Upon meeting, model agents take into account all dimensions of v_f and v_m, in deciding whether to accept or reject a potential partner. A matched couple of type (v_f, v_m) enjoys flow marital surplus $f(v_f, v_m)$. Analogous to the one-dimensional case a match is formed if a type v_f woman and type v_m men and $f(v_f, v_m) \geq 0$.

5.2 Multidimensional Sorting

We extend the defintion of PAM and NAM presented in section 2 to capture sorting in multidimensional settings. Denote by $\mathcal{M}(v_m)$ the matching set of men of type v_m. In the following it will be useful to occasionally denote v_f as (v_{fi}, v_f^{-i}), where v_{fi} denotes the i-th component and v_f^{-i} denotes all but the i-th components of vector v_f. We define positive/negative assortative mating in dimension (i, j) (write PAM (i,j) and NAM (i,j), respectively) as follows.

Definition 2. *Consider $v'_{fi} < v''_{fi}$, $v'_{mj} < v''_{mj}$.*

There is PAM (i,j) if:

$$\left.\begin{matrix} (v''_{fi}, v_f^{-i}) \in \mathcal{M}(v'_{mj}, v_m^{-j}) \\ (v'_{fi}, v_f^{-i}) \in \mathcal{M}(v''_{mj}, v_m^{-j}) \end{matrix}\right\} \Rightarrow \begin{cases} (v'_{fi}, v_f^{-i}) \in \mathcal{M}(v'_{mj}, v_m^{-j}) \\ (v''_{fi}, v_f^{-i}) \in \mathcal{M}(v''_{mj}, v_m^{-j}) \end{cases}$$

There is NAM (i,j) if:

$$\left.\begin{matrix} (v''_{fi}, v_f^{-i}) \in \mathcal{M}(v'_{mj}, v_m^{-j}) \\ (v'_{fi}, v_f^{-i}) \in \mathcal{M}(v''_{mj}, v_m^{-j}) \end{matrix}\right\} \Rightarrow \begin{cases} (v'_{fi}, v_f^{-i}) \in \mathcal{M}(v'_{mj}, v_m^{-j}) \\ (v''_{fi}, v_f^{-i}) \in \mathcal{M}(v''_{mj}, v_m^{-j}) \end{cases}$$

To obtain similar results on the relationship of sorting and matching sets as in the one-dimensional case we furthermore need to make an assumption that ensures for given v_f and v_m^{-i} matching sets are non-empty (and likewise for given v_m and v_f^{-i}).

Assumption 1. *For all v_f, v_m^{-i} there is a v_{mi}, such that $(v_{mi}, v_m^{-i}) \in \mathcal{M}(v_m)$. For all v_m, v_f^{-i} there is a v_{fi}, such that $(v_{fi}, v_f^{-i}) \in \mathcal{M}(v_m)$.*

Intuitively, under assumption 1 even a man who is unfavorable in all but the i-th dimension is able to match with women of any type v_f if he is favorable enough in dimension i (and analogously for women).

5.3 Two-Dimensional Matching

In the following we focus on a two-dimensional specification, the simplest case of a multi-dimensional model in which theory can be reconciled with our quasi-experimental evidence. Consider female and male types, $v_f = (q_f, x_f)$ and $v_m = (q_m, x_m)$, where q_f and q_m are female and male labor income. We interpret the second dimension, x_f (and x_m), as "general attractiveness" which is observable by the model agents, but which is unobservable to us, the researchers. The relationship between sorting and matching sets in the two-dimensional case is established in the following proposition.

Proposition 2. *Under assumption 1, and given PAM (1,1) or NAM (1,1), then* $(q_f, x_f) \in \mathcal{M}(q_m, x_m)$ *if and only if* $q_f \in [a(q_m, x_m, x_f), b(q_m, x_m, x_f)]$, *where* a *and* b *are*

(i) increasing in q_m *under PAM (1,1),*

(ii) decreasing in q_m *under NAM (1,1).*

Conditional on general attractiveness, matching sets are increasing in income under PAM (1,1) and decreasing in income under NAM (1,1,). This result allows us to explore how sorting on income affects matching after job loss.

5.4 Job Loss and Two-Dimensional Matching

Analogous to the one-dimensional case, we model job loss as a permanent reduction to labor income. Formally if a (q_m, x_m) man loses his job, his labor income is reduced to $\tilde{q}_m = q_m - d < q_m$. As in section 2, we denote by $D_m = 1$ a treatment group of men who lose their job between period $t = 0$ and $\tau > 0$ and by $D_m = 0$, a control group of men who are not displaced from their jobs.

The following proposition establishes that whether sorting on income (i.e. in dimension (1,1)) is positive or negative, determines whether men who are displaced from their jobs (on average) switch to weakly lower earning or weakly higher earning female partners.

Proposition 3. *Under PAM (1,1) displaced men who switch to a new partner on average match with partners of weakly lower income relative to non-displaced men who switch to a new partner. Under NAM (1,1) displaced men who switch to a new partner on average match with partners with weakly higher income relative to non-displaced men who switch to a new partner:*

$$\text{PAM (1,1)} \Rightarrow \mathbb{E}[q_{f\tau} - q_{f0} | S_m = 1, R_m = 1, D_m = 1] \leq \mathbb{E}[q_{f\tau} - q_{f0} | S_m = 1, R_m = 1, D_m = 0],$$
$$\text{NAM (1,1)} \Rightarrow \mathbb{E}[q_{f\tau} - q_{f0} | S_m = 1, R_m = 1, D_m = 1] \geq \mathbb{E}[q_{f\tau} - q_{f0} | S_m = 1, R_m = 1, D_m = 0].$$

This link between sorting on income and marriage market matching established resembles the relationship in the one-dimensional framework established in Proposition 1. Adding a second dimension to the model does not substantially alter this relationship. In the two-dimensional framework our quasi-experimental evidence thus is consistent with negative sorting on income (NAM (1,1)) and inconsistent with positive sorting on income (PAM (1,1)), similar to our result in the one-dimensional case.

5.5 Cross-Sectional Correlations under Two-Dimensional Matching

We provide conditions under which two-dimensional matching is consistent with a positive correlation between matched partners' labor incomes. In particular we show that partners' incomes can be positively correlated even if sorting on income is negative, consistently with our empirical findings. We show that in this case the positive correlation between matched partners' labor incomes arises spuriously and is driven by (unobserved) general attractiveness.

Formally, we provide conditions under which, looking at matched couples, the conditional expectation of female labor income, conditional on male labor income, $\mathbb{E}[q_f|q_m]$, is increasing (decresing) q_m, implying a positive (negative) correlation between q_f and q_m.

To this end we decompose the effect of increasing male labor income on $\mathbb{E}[q_f|q_m]$ into a direct effect (DE), capturing the impact of ceteris paribus increasing q_m, holding x_m constant, and an indirect effect (IE), that captures the association between q_m and x_m in the population of men. We then sign DE and IE under conditions on sorting on income and general attractiveness, and on the association between income and attractiveness and income, q_m and x_m. Note that assuming $Corr(q_m, x_m) > 0$ (or < 0) is not sufficient. Instead we assume $G(x_m|q_m)$ is increasing (decreasing), a stronger condition on the association of male income and general attractiveness that implies $Corr(q_m, x_m) > 0$ ($Corr(q_m, x_m) < 0$).

Proposition 4. *Consider the following decomposition for $q''_m > q'_m$*

$$\begin{aligned}\mathbb{E}[q_f|q''_m] - \mathbb{E}[q_f|q'_m] \quad &= \quad \underbrace{\int \mathbb{E}[q_f|q''_m, x_m] - \mathbb{E}[q_f|q'_m, x_m] dG(x_m|q''_m)}_{:=\textbf{DE (Direct effect)}} \\ &+ \quad \underbrace{\int \mathbb{E}[q_f|q'_m, x_m] dG(x_m|q''_m) - \int \mathbb{E}[q_f|q'_m, x_m] dG(x_m|q'_m)}_{:=\textbf{IE (Indirect effect)}}.\end{aligned}$$

In a bidimensional steady state matching equilibrium the following implications hold:

$$PAM(1,1) \quad \Rightarrow \quad DE \geq 0,$$

$$
\begin{aligned}
NAM(1,1) &\Rightarrow \textit{DE} \leq 0, \\
PAM(1,2) \textit{ and } G(x_m|q_m) \textit{ is increasing in } q_m &\Rightarrow \textit{IE} \geq 0, \\
NAM(1,2) \textit{ and } G(x_m|q_m) \textit{ is increasing in } q_m &\Rightarrow \textit{IE} \leq 0, \\
PAM(1,2) \textit{ and } G(x_m|q_m) \textit{ is decreasing in } q_m &\Rightarrow \textit{IE} \leq 0, \\
NAM(1,2) \textit{ and } G(x_m|q_m) \textit{ is decreasing in } q_m &\Rightarrow \textit{IE} \geq 0.
\end{aligned}
$$

By proposition 4 the two-dimensional model is consistent with our quasi-experimental evidence, showing that men on average switch to higher earning women upon job loss, as well as with the positive correlation between matched partners incomes. In particular the model is consistent with our empirical evidence if sorting on income is negative and cross-sorting between income and attractiveness is positive (negative) and the association of income and attractiveness is positive (negative). In these cases matched partners' incomes are correlated does not reflect a causal relationship, i.e., this correlation arises spuriously. The the impact of ceteris paribus changing q_m on marriage market matching is captured by DE, while IE captures the spurious association of matched partners' labor income that is driven by (unobserved) attractiveness.

6 Policy Simulations

TBA

7 Conclusion

In this paper, we have investigated the impact of job displacement on the remarriage outcomes of workers. Leveraging quasi-experimental variation from establishment closures in Denmark, we find that workers who experience a displacement shock are more likely to separate from their current partner and on average find a new partner with *higher* earnings than their previous partner, relative to an untreated control group. This finding is hard to reconcile with a large class of matching models which generate positive assortative matching on income in the cross-section. These view marriage as matching on a single attribute (income) and predict that the effect of shocks to earnings should be the same as the effect of initial earnings differences in the beginning of life. As a way of reconciling theory and data, we propose multidimensional matching, in which there is a second attribute, which we call "general attractiveness" and which is positively correlated with income. If there is positive assortative matching on general attractiveness, this can generate a positive correlation between the incomes of partners even if matching on income (conditional on general attractiveness) exhibits negative assortative matching.

These findings suggest caution in interpreting the positive correlation between partners' earnings as evidence of causal positive assortative mating on earnings. Through the lens of our multidimensional model, the underlying matching patterns on earnings are in fact negatively assortative, while unobserved variables lead to a positive earnings correlation. Whether marriage market matching is positively assortative on income has important implications for a range of policy questions, particularly those related to redistribution and the tax and benefit system. If matching is positively assortative on income, one would expect policies which reduce inequality, such as the tax and transfer system, to indirectly reduce PAM, which would result in an additional reduction of inequality. Under NAM, the marriage market impact of such policies would *amplify* inequality, which would mitigate the intended effect of reducing inequality.

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A Derivations and Proofs

Proof of proposition 1: We prove the implication for PAM. The result for NAM follows by analogous steps.

We use that under PAM matching sets are intervals with bounds that are weakly increasing in agent type. E.g., a man of type q_m matches with women of type $q_f \in [a(q_m), a(q_m)]$ with a, b weakly increasing in q_m.[12] It follows that

$$\mathbb{E}[q_f|q_m] = \mathbb{E}[q_f|a(q_m) \leq q_f \leq b(q_m)] \tag{6}$$

with a, b weakly increasing in q_m.

We start by considering the control group. In the control group all separations are exogenous, i.e., occur independent of agent types. We thus have

$$\mathbb{E}[q_{ft}|S_m = 1, D_m = 0] = \mathbb{E}[q_{ft}|D_m = 0]. \tag{7}$$

By the law of iterated expectations

$$\mathbb{E}[q_{ft}|D_m = 0] = \mathbb{E}[\mathbb{E}[q_{ft}|q_{mt}, D_m = 0]D_m = 0]. \tag{8}$$

In the control a given men's type does not change between the initial match in period $t = 0$ and the new match that we observe in τ. We thus have

$$\mathbb{E}[q_{f\tau}|q_{m\tau}, D_m = 0] = \mathbb{E}[q_{f\tau}|q_{m0}, D_m = 0] \tag{9}$$

and by stationarity of the distribution of single women, G_f, and (6):

$$\mathbb{E}[q_{f\tau}|q_{m0}, D_m = 0] = \mathbb{E}[q_{f0}|q_{m0}, D_m = 0] = \mathbb{E}[q_{f0}|a(q_{m0}) \leq q_{f0} \leq b(q_{m0}), D_m = 0] \tag{10}$$

By (7) - (10) it follows that

$$\mathbb{E}[q_{f\tau}|S_m = 1, D_m = 0] - \mathbb{E}[q_{f0}|S_m = 1, D_m = 0] = 0. \tag{11}$$

Next, we consider the treatment group. We start with $\mathbb{E}[q_{f0}|S_m = 1, D_m = 1]$. By the law of iterated expectations

$$\mathbb{E}[q_{f0}|S_m = 1, D_m = 1] = \mathbb{E}[\mathbb{E}[q_{f0}|q_{m0}, S_m = 1, D_m = 1]S_m = 1, D_m = 1]$$

For the treatment group, as both exogenous and endogenous separations occur, conditioning on $S_m = 1$ is not innocuous. More precisely, endogenous separations occur for couples who have matched in $t = 0$, but who would not match after the men loses his job. These are couples for which $q_{f0} \in [a(q_{m0}), b(q_{m0})]$ and $q_{f0} \notin [a(q_{m0} - d), b(q_{m0} - d)]$ or equivalently $q_{f0} \in [b(q_{m0} - d), b(q_{m0})]$ (as a, b are weakly increasing under PAM).

[12] This is proved by Shimer and Smith (2000). Under NAM the same holds with a, b weakly decreasing.

Note that the probability of an exogenous separation between time $t = 0$ and $t = \tau$ is $1 - e^{-\delta\tau}$. The probability of an endogenous separation, conditional on having matched in $t = 0$ is

$$\frac{G_f(b(q_{m0})) - G_f(\max\{b(q_{m0} - d), a(q_{m0})\})}{G_f(b(q_{m0})) - G_f(a(q_{m0}))}.$$

$\mathbb{E}[q_{f0}|q_{m0}, S_m = 1, D_m = 1]$ is a weighted sum of the expectation of q_{f0} conditional on exogenous and endogenous separation, respectively:

$$\begin{aligned}
\mathbb{E}[q_{f0}|q_{m0}, S_m = 1, D_m = 1] \quad = \quad & \frac{1}{1 - e^{-\delta\tau} + e^{-\delta\tau}\frac{G_f(b(q_{m0})) - G_f(\max\{b(q_{m0}-d), a(q_{m0})\})}{G_f(b(q_{m0})) - G_f(a(q_{m0}))}} \\
& \Bigg[(1 - e^{-\delta\tau})\mathbb{E}[q_{f0}|a(q_{m0}) \leq q_{f0} \leq b(q_{m0})] \\
& + e^{-\delta\tau}\frac{G_f(b(q_{m0})) - G_f(\max\{b(q_{m0} - d), a(q_{m0})\})}{G_f(b(q_{m0})) - G_f(a(q_{m0}))} \\
& \mathbb{E}[q_{f0}|\max\{b(q_{m0} - d), a(q_{m0})\} \leq q_{f0} \leq b(q_{m0})] \Bigg]. \qquad (12)
\end{aligned}$$

Now consider $\mathbb{E}[q_{f\tau}|S_m = 1, D_m = 1]$. By the law of iterated expectations

$$\mathbb{E}[q_{f\tau}|S_m = 1, D_m = 1] = \mathbb{E}[\mathbb{E}[q_{f\tau}|q_{m\tau}, S_m = 1, D_m = 1]|S_m = 1, D_m = 1]$$

As the control group is laid off between $t = 0$ and $t = \tau$ we have $q_{m\tau} = q_{m0} - d$. Moreover note that conditional on a man's type that he separated is independent from the type of is next partner, and thus

$$\begin{aligned}
\mathbb{E}[q_{f\tau}|q_{m\tau}, S_m = 1, D_m = 1] &= \mathbb{E}[q_{f\tau}|q_{m0} - d, D_m = 1] \\
&= \mathbb{E}[q_{f\tau}|a(q_{m0} - d) \leq q_{f\tau} \leq b(q_{m0} - d)].
\end{aligned}$$

Note that in general for a random variable X, and $b \leq b'$, $a \leq a'$:

$$\mathbb{E}[X|a \leq X \leq b] \leq \mathbb{E}[X|a' \leq X \leq b']. \qquad (13)$$

By (13)

$$\mathbb{E}[q_{f0}|a(q_{m0}) \leq q_{f\tau} \leq b(q_{m0})] \leq \mathbb{E}[q_{f\tau}|\max\{b(q_{m0} - d), a(q_{m0})\} \leq q_{f\tau} \leq b(q_{m0})], \qquad (14)$$

and thus

$$\begin{aligned}
\mathbb{E}[q_{f0}|q_{m0}, S_m = 1, D_m = 1] &\geq \mathbb{E}[q_{f0}|a(q_{m0}) \leq q_{f\tau} \leq b(q_{m0})] \\
&\geq \mathbb{E}[q_{f0}|a(q_{m0} - d) \leq q_{f\tau} \leq b(q_{m0} - d)] \\
&= \mathbb{E}[q_{f\tau}|q_{m0}, S_m = 1, D_m = 1].
\end{aligned}$$

We thus have established

$$\mathbb{E}[q_{f0}|q_{m0}, S_m = 1, D_m = 1] - \mathbb{E}[q_{f\tau}|q_{m0}, S_m = 1, D_m = 1] \geq 0.$$

Together with (11) we get

$$\mathbb{E}[q_{f\tau} - q_{f0}|S_m = 1, D_m = 1] - \mathbb{E}[q_{f\tau} - q_{f0}|S_m = 1, D_m = 0] \geq 0.$$

□

Proof of proposition 2: Define $\mathcal{M}_{(1,1)}(q_m, x_m, x_f) := \{q_f : (q_f, x_f) \in \mathcal{M}(q_m, x_m)\}$. We proceed by first proving that $\mathcal{M}_{(1,1)}$ is a convex set and then show that its bounds are weakly increasing under PAM(1,1).

1. $\mathcal{M}_{(1,1)}(q_m, x_m, x_f)$ is convex:

Consider $q'_f < q''_f < q'''_f$, with q'_f and q'''_f in $\mathcal{M}_{(1,1)}(q_m, x_m, x_f)$, i.e.,

$$(q'_f, x_f) \in \mathcal{M}(q_m, x_m), \tag{15}$$
$$(q'''_f, x_f) \in \mathcal{M}(q_m, x_m). \tag{16}$$

Consider $\mathcal{M}(q_f, x_f)$, by (A1) this set is nonempty and by (A2) there is a $\hat{q}_m$ such that $(\hat{q}_m, x_m) \in \mathcal{M}(q''_f, x_f)$. Equivalently

$$(q''_f, x_f) \in \mathcal{M}(\hat{q}_m, x_m). \tag{17}$$

If $\hat{q}_m = q_m$, (17) entails convexity of $\mathcal{M}_{(1,1)}$. Suppose $\hat{q}_m < q_m$ then PAM(1,1) together with (15) and (17) implies $(q''_f, x_f) \in \mathcal{M}(q_m, x_m)$. If $\hat{q}_m > q_m$ the same follows from PAM(1,1), together with (16) and (17). We thus have shown $\mathcal{M}_{(1,1)}(q_m, x_m, x_f)$ is convex. Note that given q_m, x_m, x_f, $\mathcal{M}_{(1,1)}(q_m, x_m, x_f)$ is thus described by interval bounds $a(q_m, x_m, x_f)$, $b(q_m, x_m, x_f)$.

2. $a(q_m, x_m, x_f)$ and $b(q_m, x_m, x_f)$ are weakly increasing in q_m under $PAM(1,1)$:

b is weakly increasing in q_m: If not, $b(q'_m, x_m, x_f) > b(q''_m, x_m, x_f)$ for some $q'_m < q''_m$. As matching sets are closed $b(q'_m, x_m, x_f) \in \mathcal{M}(q'_m, x_m, x_f)$ and $b(q''_m, x_m, x_f) \in \mathcal{M}(q''_m, x_m, x_f)$. Equivalently $(b(q'_m, x_m, x_f), x_f) \in \mathcal{M}(q'_m, x_m)$ and $(b(q''_m, x_m, x_f), x_f) \in \mathcal{M}(q''_m, x_{mx})$. By PAM(1,1) this constellation implies $(b(q'_m, x_m, x_f), x_f) \in \mathcal{M}(q''_m, x_m)$. Equivalently, $b(q'_m, x_m, x_f) \in \mathcal{M}_{(1,1)}(q''_m, x_m, x_f)$, in contradiction with $b(q''_m, x_m, x_f)$ being the upper bound of $\mathcal{M}_{(1,1)}(q''_m, x_m, x_f)$.

That a is weakly increasing in q_m follows by similar steps that yield, $a(q''_m, x_m, x_f) \in \mathcal{M}_{(1,1)}(q'_m, x_m, x_f)$, in contradiction with $a(q'_m, x_m, x_f)$ being the lower bound of $\mathcal{M}_{(1,1)}(q'_m, x_m, x_f)$.

The proof that $a(q_m, x_m, x_f)$ and $b(q_m, x_m, x_f)$ are weakly decreasing in q_m under $NAM(1,1)$ proceeds analogously.

Proof of proposition 3: We prove the implication for PAM(1,1). The result for NAM(1,1) follows by analogous steps.

From proposition 2 it follows that

$$\mathbb{E}[q_f|q_m, x_m] = \mathbb{E}[q_f|a(q_m, x_m, x_f) \leq q_f \leq b(q_m, x_m, x_f)] \tag{18}$$

with a, b weakly increasing in q_m. Note that the expectation in is taken over the joint distribution $G(q_f, x_f)$.

Consider the control group first. By analogous steps as in the proof of proposition 1 it follows that

$$\mathbb{E}[q_{f\tau}|q_{m0}, D_m = 0] = \mathbb{E}[q_{f0}|q_{m0}, D_m = 0] = \mathbb{E}[q_{f0}|a(q_{m0}, x_{m0}, x_{f0}) \leq q_{f0} \leq b(q_{m0}, x_{m0}, x_{f0}), D_m = 0],$$

and

$$\mathbb{E}[q_{f\tau}|S_m = 1, D_m = 0] - \mathbb{E}[q_{f0}|S_m = 1, D_m = 0] = 0. \tag{19}$$

Next, we consider the treatment group. By the law of iterated expectations

$$\mathbb{E}[q_{f0}|S_m = 1, D_m = 1] = \mathbb{E}[\mathbb{E}[q_{f0}|q_{m0}, x_{m0}, S_m = 1, D_m = 1]S_m = 1, D_m = 1]$$

The treatment group in $t = 0$ matches given their types (q_{m0}, x_{m0}) while in later periods $t > 0$ (after layoff) matches that are formed given their new types $(q_{m0} - d, x_{m0})$. For the treatment group endogenous separations occur for couples, where $q_{f0} \in [a(q_{m0}, x_{m0}, x_{f0}), b(q_{m0}, x_{m0}, x_{f0}))]$ and $q_{f0} \notin [a(q_{m0}-d, x_{m0}, x_{f0}), b(q_{m0}-d, x_{m0}, x_{f0}))]$, or equivalently $q_{f0} \notin [b(q_{m0}-d, x_{m0}, x_{f0}), b(q_{m0}, x_{m0}, x_{f0}))]$.

The probability of endogenous separation, conditional on (q_{m0}, x_{m0}, x_{f0}) thus is

$$\frac{G(b(q_{m0}, x_{m0}, x_{f0})) - G(\max\{b(q_{m0} - d, x_{m0}, x_{f0}), a(q_{m0}, x_{m0}, x_{f0}))\})}{G(b(q_{m0}, x_{m0}, x_{f0})) - G(a(q_{m0}, x_{m0}, x_{f0}))}$$

and we get for the separation probability, conditional on (q_{m0}, x_{m0})

$$\begin{aligned}
&P(S_m = 1|q_{m0}, x_{m0}, D_m = 0) = 1 - e^{-\delta\tau} \\
&+e^{-\delta\tau} \int \frac{G(b(q_{m0}, x_{m0}, x_{f0})) - G(\max\{b(q_{m0} - d, x_{m0}, x_{f0}), a(q_{m0}, x_{m0}, x_{f0}))\})}{G(b(q_{m0}, x_{m0}, x_{f0})) - G(a(q_{m0}, x_{m0}, x_{f0}))} dG(x_{f0}).
\end{aligned}$$

$\mathbb{E}[q_{f0}|q_{m0}, S_m = 1, D_m = 1]$ is a weighted sum of the expectation of q_{f0} conditional on exogenous and endogenous separation, respectively:

$$\begin{aligned}
&\mathbb{E}[q_{f0}|q_{m0}, x_{m0}, S_m = 1, D_m = 1] = \\
&\frac{1}{P(S_m = 1|q_{m0}, x_{m0}, D_m = 0)} \Bigg[(1 - e^{-\delta\tau}) \int \mathbb{E}[q_{f0}|a(q_{m0}, x_{m0}, x_{f0}) \leq q_{f0} \leq b(q_{m0}, x_{m0}, x_{f0})] dG(x_{f0}) \\
&+e^{-\delta\tau} \int \frac{G(b(q_{m0}, x_{m0}, x_{f0})) - G(\max\{b(q_{m0} - d, x_{m0}, x_{f0}), a(q_{m0}, x_{m0}, x_{f0}))\})}{G(b(q_{m0}, x_{m0}, x_{f0})) - G(a(q_{m0}, x_{m0}, x_{f0}))} dG(x_{f0})
\end{aligned}$$

$$\int \mathbb{E}[q_{f0}|\max\{b(q_{m0}-d,x_{m0},x_{f0}),a(q_{m0},x_{m0},x_{f0}))\} \leq q_{f0} \leq b(q_{m0},x_{m0},x_{f0})]dG(x_{f0})\Bigg]. \quad (20)$$

Using that for a random variable X, and $b \leq b'$, $a \leq a'$

$$\mathbb{E}[X|a \leq X \leq b] \leq \mathbb{E}[X|a' \leq X \leq b'], \quad (21)$$

it follows from (20) that

$$\mathbb{E}[q_{f0}|q_{m0},x_{m0},S_m=1,D_m=1] \quad \geq \quad \int \mathbb{E}[q_{f0}|a(q_{m0},x_{m0},x_{f0}) \leq q_{f0} \leq b(q_{m0},x_{m0},x_{f0})]dG(x_{f0}) \quad (22)$$

Moreover conditional on male type, (q_{m0},x_{m0}), separation is independent of the type of the new partner, $q_{f\tau}$, and hence

$$\begin{aligned}
\mathbb{E}[q_{f\tau}|q_{m\tau},x_{m\tau},S_m=1,D_m=1] &= \mathbb{E}[q_{f\tau}|q_{m\tau},x_{m\tau},D_m=1] \\
&= \int \mathbb{E}[q_{f\tau}|a(q_{m0}-d,x_{m0},x_{\tau}) \leq q_{f0} \leq b(q_{m0}-d,x_{m0},x_{f\tau})]dG(x_{f\tau})
\end{aligned}$$

From (22) and applying (21) we thus get

$$\mathbb{E}[q_{f\tau}|q_{m\tau},x_{m\tau},S_m=1,D_m=1] \leq \mathbb{E}[q_{f0}|q_{m0},x_{m0},S_m=1,D_m=1]$$

and hence

$$\mathbb{E}[q_{f\tau}-q_{f0}|S_m=1,D_m=1] = \mathbb{E}[\mathbb{E}[q_{f\tau}-q_{f0}|q_{m0},x_{m0},S_m=1,D_m=1]|S_m=1,D_m=1] \leq 0$$

Together with (19) we have established that

$$\mathbb{E}[q_{f\tau}-q_{f0}|S_m=1,D_m=1] \leq \mathbb{E}[q_{f\tau}-q_{f0}|S_m=1,D_m=0].$$

□

Proof of proposition 4: We first show that PAM (1,1) implies $DE \geq 0$, while NAM (1,1) implies $DE \leq 0$. Using Proposition 2 it follows that

$$E[q_f|q_m,x_m] = \int E[q_f|a(q_m,x_m,x_f) \leq q_f \leq b(q_m,x_m,x_f),x_f]dG(x_f) \quad (23)$$

with a,b weakly increasing (weakly decreasing) in q_m under PAM (1,1) (NAM (1,1)). As the expectation of a truncated random variable is weakly increasing in the truncation bounds, $E[q_f|a(q_m,x_m,x_f) \leq q_f \leq b(q_m,x_m,x_f),x_f]$ and therefore $E[q_f|q_m,x_m]$ and DE are weakly increasing (weakly decreasing) in q_m under PAM (1,1) (NAM (1,1)).

Next, we establish that monotonicity of $G(x_m|q_m)$ in q_m together with PAM (1,2) or NAM (1,2) determines the sign of IE. In the following we prove that $IE \leq 0$ under PAM (1,2) and if

$G(x_m|q_m)$ is weakly increasing in q_m. The other relationships follow analogously.

Given that $G(x_m|q_m)$ is weakly increasing in q_m, $G(x_m|q''_m)$ first order stochastically dominates $G(x_m|q'_m)$ implying that for any increasing function h

$$\int h(x_m)dG(x_m|q''_m) \geq \int h(x_m)dG(x_m|q'_m). \tag{24}$$

By (23) and since under PAM (1,2) a, b are weakly increasing in x_m,

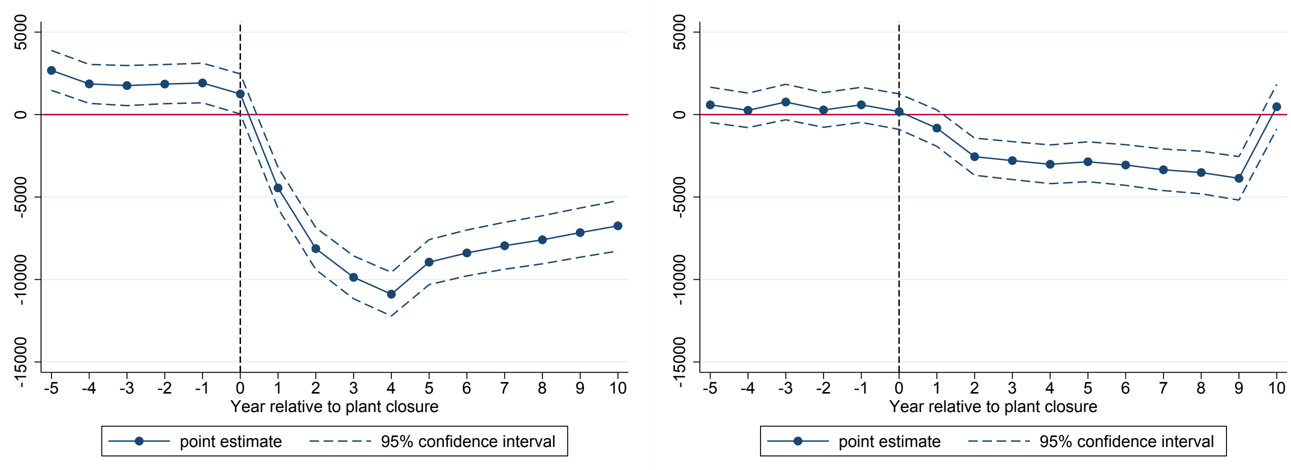
$E[q_f|q_m, x_m]$ is increasing in x_m. By (24) we thus have $IE \leq 0$.

□

B Additional Figures

Figure 5: Income Loss around Displacement: Robustness

Including UI benefits | Disposable Income



Notes: The graph shows the event study for labor income for two alternative definitions. In the first panel, we add UI benefits to gross labor income. In the second panel, we use a variable which contains disposable income, taking into account all sources of income as well as the full tax and transfer system.