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Firm Relocations, Commuting and Relationship Stability

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Abstract

In this paper, we study the impact of firm relocations on commuting distance and the probability of married couples and cohabiting couples with children separating. We use Swedish register data for 2010-2016 and select employees of relocating firms with one workplace and more than 10 employees. Focusing on this sample allows us to use plausibly exogenous variation in the commuting distance arising from the relocation. We extend the literature on the effect of commuting on relationship stability by reducing the possibility for unobserved time-variant factors to bias our estimates. While previous literature has focused on the difference between short- and long-distance commuting, we focus on changes in the commuting distance that are externally induced by firm management. We find a small but statistically significant negative effect of increased firm relocation distance on family stability. A 10 km change in commuting distance leads to a 0.09 percentage point higher probability of separation if the commuter remains with the firm for the next 5 years.[1]

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JEL codes: J32, J61, R23, R41.

1 Introduction

Commuting times of workers in Europe have been slowly but steadily increasing in the last decade.[2] Policymakers and firms sometimes weigh the costs and benefits of expanding labor markets and increasing average commuting distances. The cost-benefit analyses of commuting often consider the economic and environmental effects of commuting. Fewer studies consider the social impacts of commuting. In particular, commuting time may influence the quality of partnerships. Time spent traveling could decrease time spent with family members and contributing to household chores, which may increase stress. Ultimately, the commuting situation could become unbearable and lead to separation. However, wage compensation and increased employability may also result from a longer commute and thus the total impact of commuting on relationship stability is an empirical question. Currently, evidence about the impact of commuting time on relationship stability is scarce.

Commuting distance is a job characteristic that is usually known to the job seeker when he chooses to accept the job. We can understand commuting distance as a joint equilibrium outcome on a job market and a housing market. Therefore, we are not usually able to model commuting distance as randomly allocated.

If a firm moves to a new location, however, this relocation might not be expected by an employee. The particular circumstances of any employee should not influence the relocation decision in large firms. A change in commuting distance could be considered

2. According to Numbeo, which provides traffic rankings since 2012 at https://www.numbeo.com/traffic/rankings_by_country.jsp, and calculations by KH, among 27 countries included in the 2012 and 2018 index, the population weighted average of commuting time increased from 35.5 minutes one way in 2012 to 36.6 minutes in 2018. Further information about the methodology is available at numbeo.com.

a random shock to both the commuting distance and job quality.

In this paper, we focus on employees of single-site firms with more than 10 employees in 2010 or 2011. First, we examine the properties of relocating firms and check that they are similar to non-relocating firms in baseline characteristics. We then estimate the impact of relocation-induced commuting distance changes on family stability outcomes. Our main results point to a small but significant effect of an increase in the commuting distance on the probability of separation.[3]

Subsequently, we consider other sources of variation in the commuting distance: job change and residential move. We find that change in commuting distance related to job change is weakly and statistically non-significantly associated with separation whether the original firm relocated or remained stationary. Residence moves during firm relocation do not have a significant association with separation. Residence moves away from a stationary firm were associated with significantly lower separation probability. Moving while working in a stationary firm seems to be the most endogenous choice, as a decision to invest in a common good of a new house can be reasonably expected to depend on partnership expectations.

2 Literature review

This study is related to several strands of literature. We follow the family stability literature in uncovering how social and economic factors influence separation and divorce. Theoretical works provide frameworks for empirical studies, including observational studies about the association of long-distance commuting and family stability. Next, we build on the firm relocation literature methodologically by examining the impact of relocations on socioeconomic outcomes. Further, it is useful to compare our results with firm closure studies that have also considered family stability an outcome.

3. Sample size does not allow us to consider the potentially assymetrical impact of commuting distance.

2.1 Theories of marital stability

Kley (2015) identifies several theories of marital stability, which she uses to support her empirical model. In particular, there is social exchange theory (Kelley and Thibaut 1978) and microeconomic theory of divorce (Becker, Landes, and Michael 1977). These theories are not mutually exclusive and often suggest similar predictions.

According to social exchange theory, marital stability is influenced by unfolding social exchange processes within and outside of the couple. This theory was applied early by Levinger (1965), who recognizes attractions, barriers to leaving, and the presence of attractive alternatives to the relationship.

In the context of our study, long-distance commuting potentially changes the relationship value for one or both partners by reducing the time the couple spends together and by changing bargaining power distribution within the couple. Long-distance commuting could influence attractive alternatives to the partnership both ways. On the one hand, less time to socialize outside of family and work may decrease the perceived alternatives to the relationship. On the other hand, as Kley (2015) mentions, the commuter may likely have friends at work that are not shared with the less mobile partner and can increase alternatives to the relationship.

According to the microeconomic theory of divorce, the value of staying in a partnership is central to family stability. The partnership value depends on partner match, division of labor within the household, and investment in couple-specific capital. The partner match is related to the labor division within the couple. While Becker argued that the negative correlation of wage-earning powers should increase couple stability, newer empirical studies contest this theory. For example, Kley (2015) finds that while labor participation of women in Western Germany is associated with the probability of separation, it is not significantly associated in Eastern Germany. The partner match is improved by homogeneity in complementary factors such as age and education level. The couple-specific capital includes shared homeownership and children. These assets

may stabilize relationships because they lose value at separation. However, the value of couple-specific capital may be reduced during long-distance commuting as the more mobile partner has less time to use it, and the less mobile partner may need to do more chores. Kley (2015) finds that women, in particular, may be affected by long commutes as they are responsible for the bulk of household chores.

2.2 Association of long-distance commuting with family stability

This paper is also related to the literature about the effects of long-distance commuting. In particular, several recent studies analyze the association of long-distance commuting with family stability (Sandow 2014; Kley 2015; Kley and Feldhaus 2017). Research has also been conducted on perceptions of partnership quality (Viry, Widmer, and Kaufmann (2010)).

Sandow (2014) uses the Swedish National Register and event history analysis with discrete-time logistic regression to examine whether long-distance commuting predicts couple separation. The study finds that the association differs according to gender and the duration of long-distance commuting. Couples who commute longer than 5 years seem to either selectively survive or to have become accustomed to the commuting lifestyle. The register data did not include either travel time or travel mode, and it was not possible to control for specific motivations for long-distance commuting. In this study, we estimate commuting time to see if the results from commuting distance generalize for commuting time. Sandow (2014) did not provide a causal interpretation of the data as the commuting behavior may be endogenous to individual time-changing factors associated with relationship stability. In this paper, we address this limitation by using firm relocations as a source of variation in commuting distance.

Kley and Feldhaus (2017) and Kley (2015) use German survey data. Kley and Feldhaus (2017) study long-distance commuting using the nationally representative sample Panel Analysis of Intimate Relationships and Family Dynamics (pairfam) with 2,500 couples

and monthly data over 3 years. Pairfam data allows one to control for an annual measure of marital quality and commuting for up to 2 residences. Furthermore, pairfam includes the timing of breakups and changes of residence and employment in months.[4] The authors find that long-distance commuting of women longer than 1 hour predicts lower family stability except for women living in the suburbs. These associations persist even after controlling for breakup predictors frequently found in the literature, such as social position of the partners, barriers to leaving the partnership, partnership quality and labor division within the household. Kley (2015) studies the effect of commuting time on relationships. She uses monthly data from a three-year-long study on 890 inhabitants of two comparable German cities and tests hypotheses based on social exchange and economic theories of marital stability. The author controls for theoretically important predictors of marital stability, including indicators of the partner match (age at start of marriage, homogamy in education levels, division of labor within the household, couple-specific capital, and barriers to leaving the relationship. While these predictors are theoretically important, they are likely interrelated, which could make the interpretation of the findings difficult. The study finds higher and significant associations of long-distance commutes of women for Eastern Germany and lower association for women of Western Germany. The author explains this difference by different social acceptance of the paid work of mothers.[5] In Western Germany, the paid work of women predicts the separation of couples, while long-distance commuting has a smaller and less significant association with family stability.

Using the British Household Panel Study dataset, Nisic and Kley (2019) study long distance commuting and define long distance as longer than 1 hour. They also consider moves longer than 50 km. The authors first describe the social structure of mobile couples and then focus on satisfaction with their social life. They find that women are

4. For more information about pairfam, see Huinink et al. (2011).

5. The social acceptance of female paid work is consistent with labor participation data: In 2005, 72% women in Eastern Germany participated in the labor market in contrast to 65% of women in Western Germany. (Source: Federal Statistical Office Germany.)

affected by mobility more than men. They find a negative association of long commuting and satisfaction with social life for women who move because of their partner's career prospects.

Viry, Widmer, and Kaufmann (2010) view daily long-distance commuting as one of the cases of mobility. Their survey data includes a reason for commuting and information about other kinds of mobility (weekend commuting, long-distance relationships). They find that the effect of commuting can be mediated by the life course, the process by which one becomes mobile, social status, and national context (such as family policy regime, residential amenities such as daycare and after school programs, and quality of transportation systems).

For a comparison of main studies, see Table 1.

Table 1: Commuting longer than 30 km and family stability

Odds ratios of separation	Women	Men	Country
Annual:			
Sandow (2014) commuter	0.98–1.02	1.02–1.05 *	Sweden
Sandow (2014) 1-4 years	1.00–1.04	1.02–1.06 *	Sweden
Sandow (2014) 5+ years	0.90–0.96	1.00–1.05 *	Sweden
Monthly:			
Kley (2015)	3.33**	0.33	Germany
Kley and Feldhaus (2017)	1.97**	1.04	Germany

We have included a range of estimates depending on reported specifications.
Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Sources: Sandow (2014), Kley (2015), and Kley and Feldhaus (2017)
Time frames: 3 years Kley (2015) and Kley and Feldhaus (2017), 5-10 years Sandow (2014).
Reference groups: non-commuting workers Sandow (2014) and Kley and Feldhaus (2017), non-working Kley (2015).

2.3 Firm relocations

This study is methodically inspired by the literature about firm relocations. The closest paper to our study is Mulalic, Van Ommeren, and Pilegaard (2014), who investigate wage compensation of workers at relocating firms. They estimate the causal effect of

firm relocation using data from the register of companies in Denmark. The study finds that workers are compensated for the increase in commuting distance in the long term, while the short term wage compensation is small. The authors deal with endogeneity in commuting distance by including worker fixed effects and firm fixed effects in the empirical model. They then estimate their models in terms of first differences and consider both the short- and long-term

2.4 Firm closures

When we consider the effect of single-site firm relocation on the social life of the firm's employees, one obvious comparison is with firm closures. In both cases, a given job bundle ceases to exist. The difference is that in the case of firm relocations, a similar job bundle appears at a different spatial location. The employee of a relocating firm thus has, ceteris paribus, a better position in terms of employment opportunities. Therefore, firm closures should impact family stability more strongly than firm relocations.

Rege, Telle, and Votruba (2007) use data from Statistics Norway from 1992 to 2005. They estimate a linear probability model of marital dissolution of workers in firms with more than 10 employees. They control for characteristics of couples, including socioeconomic variables for both the couple and each of the spouses individually, indicators of spousal dependency (children, age and education homogamy), and downsizing experience of the wife. The marriages of husbands originally employed in firms that closed between 1995 and 2000 were 11 percent more likely to end in divorce by 2003 than comparable marriages of husbands in stable firms. The authors also test whether working in a firm before closing increases the divorce rate and find that it does not.

Keldenich and Lücke (2018) use the German Socioeconomic Panel (SOEP) from 1984 to 2015.[6] They use involuntary job loss as a source of variation, including firm closures. for robustness checks, they look at firm closures: They estimate a discrete-time pro-

6. For more information on the dataset, see Wagner, Frick, and Schupp (2007).

portional-hazard model, specifically a complementary log-log model for censored data. They use 1,526 job losses due to involuntary job loss and find a 70 percent larger risk of divorce in the following year if the husband has experienced an involuntary job loss. They compare to results using only firm closures and find no substantive difference in results.

Our study links the family stability literature to the methodology of firm relocation studies. This allows us to provide the first causal estimates of the effect of commuting distance on the probability of couple separation. We also extend the firm relocation literature methodologically by estimating the lower bound of relocation-induced changes in commuting time. Our commuting-time algorithm based on geographical coordinates appears to be the first such algorithm in the literature; it allows for new avenues of research, including that on firm relocation.

3 Data

In this study, we use linked Swedish individual and firm register data from Statistics Sweden.[7] The data includes rich administrative information about firms and employees. Our firm data was limited to single-site firms, allowing us to unambiguously define firm relocation as the change in East and North coordinates of the workplace. These coordinates are available in the administrative data in a 100-meter precision. Due to firm and workplace definitions of Statistics Sweden, the stable and relocating firms we follow keep at least half of their workforce every year. We restrict the sample further to firms with 10 or more employees in the baseline year, as relocation decisions of large firms are plausibly unrelated to the situation of individual workers.[8] We restrict the baseline years to 2010 and 2011 and study the workers in firms that belong to both baseline samples 3

7. This data is available in secure computer labs at Swedish universities that have a contract with Statistics Sweden.

8. Cf. Mulalic, Van Ommeren, and Pilegaard (2014)

and 5 years after each baseline year. [9] From these firms, 702 firms in the baseline year relocated 5-200 km the following year. We restrict the relocating firms to those that relocated less than 200 km, because given larger relocations, workers may be more selective in deciding whether or not to stay with the firm. Another 5,760 firms relocated 5 km or less. These shorter relocations should not have a noticeable impact on commuting distance or commuting time and so they are not included in the main analysis.[10] From the firms that relocated 5-200 km, we selected employees who were either married or cohabiting with common children in the baseline year. This leaves 3,424 employees who met our criteria remained with the relocating firms 3 years after relocation, and 2,197 remained 5 years after relocation, with attrition of 36% of workers. For a comparison, 287,266 employees worked in the firms which relocated 0-5 km 3 years after the relocation, and 222,759 remained 5 years after relocation, with attrition of 22% of workers.

We use the following **firm level variables** from statistics Sweden: workplace coordinates, industry[11], municipality code, number of employees and sales.

Individual variables: Gender, residential coordinates and municipality, education level, single digit occupation, family status, duration of partnership, number of children under the age of 6 in the household, and education level of the partner.

We construct the relocation distance of the firm, commuting distances and distances of any residential moves in meters. The precision of distances is 100 m^2. We construct categorical values for marriage or cohabiting with children, for separation, for occupation and education categories. We also estimate minimal commuting time using ArcGIS and considering available roads, one-way restrictions, tunnels and bridges, including the speed limits.[12] Our model uses the following inputs: first, a table with firm coordinates

9. We consider 3 years for a short-term and 5 years for a long-term effect of induced commuting on relationship separation. We pool workers from both baseline years together to increase the sample size.

10. We include them as a placebo test in Appendix 14.

11. SNI code.

12. To move from estimating minimal commuting time to actual commuting time, it would be ideal to include information about traffic congestion. Unfortunately, we did not have this data and could not take the coordinate pairs out of the computer lab to Google Maps API.

in each year. We include only firms that relocate more 5 - 200 km in this table. Second, a table with employee residence coordinates and firm ID for each year. In this table, we include only the employees working in the relocating company in the baseline. The model matches firms and employees by year and firm ID, then calculates an optimization problem, minimizing the estimated commuting time. The output includes the estimated time of the commute and road distance of the calculated route. The correlation of estimated commuting time and road distance is 0.96 and the correlation of road distance with euclidean distance is 0.97.

Our estimation of commuting time uses an assumption that everyone commutes by car. The Swedish Transport Administration Annual Report for 2017 gives the following statistics: "*On a regular day, nearly 1 million people take a bus, almost as many people choose to cycle, 4.5 million take a car and 370,000 take a train. ... More than 21,600 people take a domestic flight per day.*" (p. 6). The vast majority of travel is by car or bus travel, which use public roads. The number of flights is negligible and we assume that it is used mostly for commutes longer than 200 km, which we do not consider in this analysis. Rail transport may introduce some measurement error, but it is limited by the relatively low use of rail in Sweden. Another possibly more serious cause of measurement error in our commuting time estimates is due to imprecise estimation of travel time. The estimate could be biased upwards due to low compliance with road speed limits, which is only about 40% [13]. It could also be biased downwards due to traffic congestion, which is documented and monitored in the metropolitan areas Stockholm, Gothenburg, and Malmö[14].

We constructed education homogamy based on education levels of both partners in the couple (we used the 7 levels used by Statistics Sweden). Couple education homogamy was rated as 1 if the education levels were the same.

13. Swedish Transport Administration Annual Report for 2017, p. 18.
14. Swedish Transport Administration Annual Report for 2017, p. 11.

4 Research hypotheses

Based on the literature review, we formulate the following hypotheses:

4.1 Hypothesis 1

Increase in commuting distance due to firm relocation increases long-term and short-term risk of separation.

4.2 Hypothesis 2

Increase in commuting time due to firm relocation increases long-term and short-term risk of separation.

5 Identification strategy

For identification of the causal effect of commuting distance, we use firm relocations. To study precisely defined relocations, we focus on firms larger than 10 employees with one workplace. We observe workplace relocation when a workplace changes geographical coordinates and at least half of workplace employees remain with the firm. This is due to the workplace definition by Statistics Sweden. While for some employees the commuting distance has decreased as a result of workplace relocation, for others the distance has increased. However, the average commuting distance grows with average relocation distance.

The identifying assumptions: The relocation needs to be uncorrelated to the error term of the separation regression. Further, the relocation should not affect separation behavior if the commuting distance is held constant.

5.1 Empirical model

In common situations, separation and divorce may be endogenous to commuting distance. Therefore, in our main specification, we use only the quasi-experimental variance in the commuting distance coming from firm relocations that are more likely to be exogenous. Following Mulalic, Van Ommeren, and Pilegaard (2014) we use the first difference of a fixed-effect model:

$$sep_i = \beta_1 \Delta CD_{i,f} + \beta_2 \Delta X_{i,f} + \beta_3 Z_{i,f} + \delta_f + \nu_{i,f} \tag{1}$$

where sep_i denotes the separation of individual i, considered as a change in partnership status, Δ denotes time-differencing operator, CD is a change in commuting distance, X includes time-variant control variables and Z includes time-invariant control variables with a time-varying effect. δ_f denotes a firm-fixed effect. In the analytical samples of this model, we include only those who remain with the firm and do not move residence in the corresponding 3- and 5-year period.

In this setting, there is a possibility for unobserved variables at the individual level. Therefore, fixed effects are needed. We use a linear probability model with fixed effects. Another possibility would be multinomial logit with fixed effects. We choose the linear probability model because the interpretation of coefficients is more straightforward. Odds ratios are incomparable without knowing the baseline probabilities, which the fixed effect multinomial logit unfortunately cannot compute.[15]

We estimate commuting time as a function of work and residence coordinates using network analysis in ArcGIS, taking into account the road network, including speed limits, one-way roads, and tunnels. This allows us to run an analogous regression with estimated commuting time as the independent variable of interest:

15. See Pforr (2014).

$$sep_i = \beta_1 \Delta \hat{CT}_{i,f} + \beta_2 \Delta X_{i,f} + \beta_3 Z_{i,f} + \delta_f + \nu_{i,f} \quad (2)$$

In order to compare the coefficients of relocation-induced changes in commuting distance with other common sources of variation in commuting distance, we also estimate the following model:

$$sep_i = \sum_S \beta_1 \Delta CD_{i,f} \cdot S_{i,s} + \beta_2 \Delta X_{i,f} + \beta_3 Z_{i,f} + \delta_f + \nu_{i,f} \quad (3)$$

where S is a set of sources of variation, including relocation, job change, residential move and other. $S_{i,s}$ is a dummy variable representing the source of variation in commuting distance of individual i.

6 Descriptive statistics

Here we present the descriptive statistics. There were 702 firms that relocated 5-200 km in 2011 or 2012, employing 3,910 employees meeting our criteria,[16] of which 3,424 remained with the firm 3 years after the relocation and 2,197 remained 5 years after the relocation. Firms do not seem to be selective in relocating more than 5 km. Table 2 shows that, prior to relocation, the firms relocating further have higher mean sales but the difference is not statistically significant.

There may be a selection of employees into the kind of firms that relocate. The t-test reveals a significant difference in several potentially important variables before relocation between employees in firms that relocate shorter and longer distances (see Table 3).[17] Comparing with Table 4, we see that the commuting distance increased more

16. Two adults with common residence, married or cohabiting with common children at the baseline.

17. Employees in firms relocating longer distances are older. This suggest that more fragile younger families may have already selected out of the sample. Thus, our estimate of the effect of commuting distance could be a lower bound of the effect in the population.

Table 2: Baseline firm sample comparison by relocating

	(1) Relocated 5-200 km			(2) Relocated 0-5 km			(3) Baseline difference
	Median	Mean	SE	Median	Mean	SE	Δ
Relocating (km)	11.1	22.4	30.0	0.100	0.520	0.940	−22.91***
Profit (SEK 10,000)	9.59	−57.29	2780	12.9	111	1130	160
Sales (SEK 10,000)	265	2570	30300	313	1930	15400	−420.11
Firm size	17.0	65.5	592	20.0	65.3	369	4.79
Δ Firm size	1.00	2.82	47.1	1.00	1.71	30.0	−0.79
Observations	702			5760			7820

for the employees in substantially relocating firms.[18] Still, the majority of workers have a relatively short commuting distance after the relocation (median 12.8, mean 21 km) and 81% of workers have shorter commutes than 30 km.

7 Main results

Table 5 shows the results of the main regressions. While 3 years after relocation there is no significant effect of commuting distance, 5 years after relocation there is a positive significant effect of relocation-induced change in the commuting distance on the separation of workers who remain in substantially relocating firms for at least 5 years. This effect on separation probability is significant but relatively small. Using firm fixed effects (FE) reduces the significance of the estimate. For a 10 km change in CD, this translates to a 0.086 percentage point change in the probability of separation, which is small in comparison with the average of 15 percent of relationships separating over five years. For a 50 km change in the commuting distance, the effect would be 0.43 percentage points, which is a moderate effect on family stability. [19]

The specification with estimated commuting time had unexpected results. Table 6

18. We use substantial relocation as a shorthand for relocating 5-200 km.

19. Interestingly, when we interact the commuting distance with a firm relocation-induced commute longer than 30 km, the threshold used in the literature, we find no effect of crossing a 30 km threshold on the effect of commuting distance.

Table 3: Baseline sample comparison by relocating

	(1) Relocated 5-200 km			(2) Relocated 0-5 km			(3) Baseline
	Median	Mean	SE	Median	Mean	SE	difference
Female	0.	0.300	0.460	0.	0.370	0.480	0.0600***
Age	43.0	44.0	10.2	44.0	44.7	10.2	1.06***
Separated 2010-2016	0.	0.120	0.330	0.	0.110	0.320	−0.02***
No. children 0-5	0.	0.500	0.730	0.	0.470	0.720	−0.05***
Duration of partnership	12.0	12.4	7.40	13.0	13.1	7.44	0.810***
Work income (SEK 1,000)	342	400	345	342	387	305	−3.66
Disposable HH income (SEK 1,000)	552	639	471	552	633	670	8.50
P: Parental leave b. (SEK 1,000)	0.	14.9	32.5	0.	13.3	30.5	−1.80***
Commuting distance (CD) (km)	12.5	20.4	26.5	8.41	14.9	21.3	−13.80***
CD $\geqslant$ 30 km	0.	0.190	0.390	0.	0.120	0.320	−0.07***
CD $\geqslant$ 50 km	0.	0.0900	0.280	0.	0.0500	0.210	−0.04***
CD $\geqslant$ 100 km	0.	0.0200	0.150	0.	0.0100	0.110	−0.01***
Education homogamy	0.	0.490	0.500	0.	0.500	0.500	0.0100
Observations	9750			139000			301000

Table 4: Year after relocation sample comparison by relocating

	(1) Relocated 5-200 km			(2) Relocated 0-5 km			(3) Difference
	Median	Mean	SE	Median	Mean	SE	in T_1
Female	0.	0.310	0.460	0.	0.350	0.480	0.0800***
Age	44.0	44.6	9.85	45.0	45.3	9.87	0.130
No. children 0-5	0.	0.510	0.750	0.	0.450	0.720	−0.02**
Duration of partnership	13.0	13.1	7.16	15.0	13.9	7.18	0.400***
Work income (SEK 1,000)	357	442	389	352	397	266	−29.38***
Disposable HH income (SEK 1,000)	596	699	462	564	655	717	−22.28***
P: Parental leave b. (SEK 1,000)	0.	14.1	31.6	0.	12.6	29.5	−0.92**
Commuting distance (CD) (km)	12.8	21.0	26.2	8.70	15.0	21.3	−11.49***
CD $\geqslant$ 30 km	0.	0.190	0.390	0.	0.120	0.320	−0.07***
CD $\geqslant$ 50 km	0.	0.0800	0.270	0.	0.0500	0.210	−0.03***
CD $\geqslant$ 100 km	0.	0.0200	0.150	0.	0.0100	0.110	−0.01***
Education homogamy	0.	0.500	0.500	1.00	0.510	0.500	0.0200***
Observations	3910			40200			299000

Table 5: Changes in separation probability 3 and 5 years after relocation

	(1) 3 years after relocation	(2) 5 years after relocation	(3) 5 years after, Firm FE
Δ commuting distance (km)	0.000377*	0.000860**	0.000980*
	(0.000211)	(0.000388)	(0.000521)
Sales (10.000SEK)	-0.000000131	0.000000529	
	(0.000000327)	(0.00000110)	
Log number of employees	0.00316	0.0108	
	(0.00783)	(0.0119)	
Δ log number of employees	0.0174	-0.0375	
	(0.0315)	(0.0392)	
Δ number of children 0-5	-0.0132	0.0159	0.0304
	(0.0126)	(0.0212)	(0.0224)
Occupation change	0.000797	0.000138	-0.00902
	(0.00841)	(0.0230)	(0.0370)
Female	0.00835	0.00686	0.00262
	(0.00804)	(0.0131)	(0.0144)
Baseline duration of partnership	-0.00158***	-0.00243***	-0.00279***
	(0.000542)	(0.000863)	(0.000949)
Education homogamy	-0.0587***	-0.0873***	-0.0894***
	(0.00674)	(0.0109)	(0.0122)
Firm FE	NO	NO	YES
Municipality FE	YES	YES	YES
Industry dummies	YES	YES	NO
Observations	3424	2197	2197

Standard errors in parentheses

Source: Astrid database, own calculations. Time-varying and fixed controls included.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

shows effects that are 10 times smaller than the corresponding estimate for the commuting distance, and they are not statistically significant at even the 10 per cent level. These results point to limitations of using ArcGIS for calculating commuting times without recourse to traffic data.

Table 6: Main analysis with commuting time

	3 years after relocation	5 years after relocation
Change in commuting time	-0.000323	-0.0000397
	(0.000276)	(0.000275)
Sales (10.000SEK)	-0.000000152	0.000000656
	(0.000000275)	(0.000000506)
Log number of employees	-0.0000986	-0.00362
	(0.00597)	(0.00513)
Change in log number of employees	0.0429**	0.0268
	(0.0214)	(0.0251)
Occupation change	0.0143*	0.000582
	(0.00835)	(0.00869)
Female	0.0119**	0.0169**
	(0.00569)	(0.00762)
Baseline duration of partnership	-0.000780**	-0.000892**
	(0.000384)	(0.000360)
Education homogamy	-0.0496***	-0.0373***
	(0.00480)	(0.00500)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	4545	3136

Standard errors in parentheses

Source: Astrid database, own calculations. Time-varying and fixed controls included.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

8 Robustness

8.1 Different treatment specifications

There is nothing special about the 5 km threshold that we chose for firm relocations. To see robustness of our results to this specification, we replicated our main analysis using 1 km and 10 km as alternative thresholds. Both show similar and significant results. 1-200 km relocations are more common, which brings a larger sample size but also concerns that these data include more small changes that should not have any impact on separation probability. 10-200 km relocations are less common but more likely to result in a substantive change in commuting distance or time. Tables 7 and 8 show that the main result 5 years from relocation is robust to including firms relocating at least 1 and at least 10 km. The effect is growing with minimal relocation distance. For firms relocating at least 10 km, there is a large protective effect of an induced 30 km commute 3 years from relocation, but the commuting distance for these induced commuters has a negative effect on family stability.[20]

8.2 Alternative specifications

We also replicated the applicable robustness checks from Mulalic, Van Ommeren, and Pilegaard (2014). We ran the main regression without the commuting distance. The coefficients of the control variables did not change in economically or statistically significant ways. We also considered changes in the set of control variables. Including profit as a control variable makes the main result non-significant. Profit is a rather noisy variable, which can be influenced by an accounting strategy, and therefore this variable is not used in our preferred specification. We ran a cubic specification and the only significant effect was the linear one 5 years after relocation, of similar size as the main regression.

Possibly the main limitation of the study is the use of a linear probability model. We

20. In Appendix 11.1 we also report a placebo test with firms that relocated 5 km or less.

Table 7: Is separation influenced by commuting induced by relocations longer than 1 km?

	3 years after relocation	5 years after relocation	5 years after, Firm FE
Change in commuting distance	0.000203	0.000799**	0.00103**
	(0.000192)	(0.000327)	(0.000520)
Induced commute $\geqslant$ 30 km	-0.0192	0.0240	-0.0102
	(0.0207)	(0.0271)	(0.0331)
Induced commute $\geqslant$ 30 km $\times$	0.00156*	-0.00195*	-0.000817
Change in commuting distance	(0.000907)	(0.00113)	(0.00151)
Firm FE	NO	NO	YES
Municipality FE	YES	YES	YES
Industry dummies	YES	YES	NO
Observations	8239	5557	5557

Standard errors in parentheses

Source: Astrid database, own calculations. Time-varying and fixed controls included.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Changes in separation probability 3 and 5 years after relocation > 10 km

	3 years after relocation	5 years after relocation	5 years after, Firm FE
Change in commuting distance	0.000263	0.00177***	0.00143**
	(0.000305)	(0.000646)	(0.000710)
Induced commute $\geqslant$ 30 km	-0.0522**	-0.0189	-0.0649
	(0.0236)	(0.0400)	(0.0442)
Induced commute $\geqslant$ 30 km $\times$	0.00211**	-0.00149	0.00141
Change in commuting distance	(0.00103)	(0.00234)	(0.00262)
Firm FE	NO	NO	YES
Municipality FE	YES	YES	YES
Industry dummies	YES	YES	NO
Observations	1748	1033	1033

Standard errors in parentheses

Source: Astrid database, own calculations. Time-varying and fixed controls included.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

have also estimated logit specifications and there were positive and statistically significant results of similar magnitude as the main linear model. We chose the linear probability model for this study because the interpretation of coefficients is more straightforward.

8.3 Other sources of variation

As we can see in Table 9, when we contrast changes in commuting distance related to firm relocation versus other changes, the possibly more endogenous changes show the opposite correlation: people who change commuting distance for other reasons have, on average, more stable marital or cohabiting relationships. These "other" reasons include moving residence, changing jobs, and combinations of firm relocation with moving or job change. We explore these sources in more detail in Appendix 11.2.

Table 9: Analysis of relocation vs other sources of variation

	3 years after relocation	5 years after relocation
Other variation × Change in commuting distance	-0.000739***	-0.000618***
	(0.000171)	(0.000196)
Relocating 5 - 200 km=1 × Change in commuting distance	0.000307	0.000673*
	(0.000267)	(0.000376)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	290690	224992

Standard errors in parentheses

Source: Astrid database, own calculations. Time-varying and fixed controls included.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

8.4 Checking for ex ante family stability differences

The external validity of our estimates would be low if the kind of workers who leave a company after relocation is also the kind of a person more likely to separate from a

partner. To check for this possibility we calculate a family stability ranking based on employees in non-relocating firms. First, we regress separation on control variables in a sample of workers from non-relocating firms. We then compute an out-of-sample prediction of separation for the workers in relocating companies in the baseline year. This prediction is our baseline family stability ranking. We then look at whether this ranking predicts remaining in relocating firms. We find that remaining in the relocating firms is not predicted by the stability ranking.

Table 10: Remaining with the firm 3 and 5 years after relocation

	(1) 3 years after relocation	(2) 5 years after relocation
Stability ranking	0.0496	0.0682
	(0.0401)	(0.0584)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	3759	2457

Standard errors in parentheses

Source: Astrid database, own calculations. Time-varying and fixed controls included.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Remaining with the firm 3 and 5 years after relocation

	(1) 3 years after relocation	(2) 5 years after relocation
Stability ranking	0.00152	-0.00892
	(0.00581)	(0.00929)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	263722	190626

Standard errors in parentheses

Source: Astrid database, own calculations. Time-varying and fixed controls included.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

8.5 Removing top earners and part-time workers

Two groups of workers could potentially interfere with our results. First, part-time workers may be less affected by time constraints if they do not commute daily. In our data, we cannot identify part time workers precisely. Workers in the bottom income decile are more likely to be part-time workers. Second, the workers in the top income decile are probably among the most productive employees who could be more likely to influence firm relocation decision and break our identifying assumption. Removing both these groups should provide a sense of how much our estimates are sensitive to these concerns. In Table 12 we see the results of the analysis with a restricted sample, removing the top and bottom income deciles. The effect for the restricted sample is quantitatively similar and more significant.

Table 12: Removing top and bottom income deciles.

	(1)	(2)
	3 years after relocation	5 years after relocation
Change in commuting distance	0.000452*	0.00121**
	(0.000257)	(0.000515)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	2815	1811

Standard errors in parentheses
Source: Astrid database, own calculations.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

9 Heterogeneity across groups

9.1 Families with young children

Families with young children may be particularly strongly influenced by commuting distance as children require care that is typically unequally distributed if one of the

partners has to commute long distances. We interact the regression with having any children and find a significant effect of 0.00191 for workers with children 5 years after relocation.

9.2 Heterogeneity in education homogamy

Table 13: Interaction with education homogamy

	(1) 3 years after relocation	(2) 5 years after relocation
Change in commuting distance	0.000669**	0.00114**
	(0.000320)	(0.000514)
Education homogamy=1	-0.0587***	-0.0880***
	(0.00671)	(0.0109)
Education homogamy=1 ×	-0.000734*	-0.000792
× Change in commuting distance	(0.000402)	(0.000494)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	3424	2197

Standard errors in parentheses

Source: Astrid database, own calculations. Controls included.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

When we control for education homogamy in Table 13, we see that education homogamy is a much stronger predictor of separation than relocation distance. The probability of separation for couples that have the same education level is increasing with relocation distance. However, this increase is smaller than the effect of educational homogamy itself.

10 Conclusion

This study analyses the effect of commuting distance and estimated commuting time on family stability using matched register data for firms and workers in Sweden. We

mitigate endogeneity of commuting and family stability by focusing on changes in commuting distance that are due to firm relocations. We show that an increase in commuting distance due to firm relocations leads to a small and significant increase in the probability of separation 5 years later. The result is robust to including relocation-related changes in commuting distance of workers who leave the company a year after the relocation and to a battery of checks in the spirit of Mulalic, Van Ommeren, and Pilegaard (2014).

Focusing on commuting time as the channel through which commuting distance may influence family stability produced mixed results. Depending on the specification, the effect of commuting time may be consistent with the result of commuting distance or may be non-significant. Future research could potentially mitigate missing data problems by adding traffic data to time estimation model.

When comparing our results with observational studies on commuting distance, we find an effect in the same direction as the associations found in Sandow (2014), Kley (2015), and Kley and Feldhaus (2017), but the effect is much smaller than the associations. This study implies that firm relocation induced changes in commuting distance have a measurable but small negative impact on family stability.

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11 Appendix

11.1 Placebo group: relocations under 5 km

We run the main regression on a group of relocations under 5 km. Such small changes should not have a meaningful impact on commuting distance such that if we measured the effect it would falsify our analysis. Our analysis passes this test as we find statistically insignificant results of the effect of commuting distance for this group.

Table 14: Placebo group: 0-5km relocations

	3 years after relocation	5 years after relocation
Increase in commuting distance	0.000232	0.0000129
	(0.000220)	(0.000263)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	238472	170806

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

11.2 More details on other sources of variation

Tables 15-18 show the association of commuting distance with separation for other sources of variation in commuting distance. In Tables 15-16 we look at job changes in 2010 and 2011 in stationary and relocating firms. For workers changing jobs in stationary firms, family stability is correlated with several control variables but not with the change in commuting distance. For workers changing jobs while firms are relocating, family stability is not significantly associated with commuting distance.

The picture for workers who remain at their company but move their residence looks different (Tables 17-18). Moving residence while working in a stationary firm is probably a choice endogenous to relationship stability expectations.

Table 15: Job moves and changes in separation probability in stationary firms

	(1)	(2)
	3 years after relocation	5 years after relocation
Job change related Δ CD	0.0000495	-0.0000615
	(0.0000681)	(0.0000875)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	188417	155409

Standard errors in parentheses

Source: Astrid database, own calculations.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Job moves and changes in separation probability in firms relocating 5-200 km

	(1)	(2)
	3 years after relocation	5 years after relocation
Job change related Δ CD	-0.0000824	-0.000372
	(0.000212)	(0.000300)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	3947	3066

Standard errors in parentheses

Source: Astrid database, own calculations.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 17: Separations for residence movers in stationary firms

	(1)	(2)
	3 years after relocation	5 years after relocation
Move-induced change in commuting distance	-0.00120***	-0.00121***
	(0.000241)	(0.000307)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	19321	14442

Standard errors in parentheses

Source: Astrid database, own calculations.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 18: Separations for residence movers in firms relocating 5-200 km

	(1) 3 years after relocation	(2) 5 years after relocation
Move-induced change in commuting distance	0.00167	-0.000505
	(0.00205)	(0.00415)
Firm FE	NO	NO
Municipality FE	YES	YES
Industry dummies	YES	YES
Observations	395	262

Standard errors in parentheses

Source: Astrid database, own calculations.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

11.3 Removing groups of controls

Our results are robust to removing fixed controls (gender dummy, education homogamy and baseline length of the partnership). Using only municipality and industry dummies as controls leads to nonsignificant coefficients of similar magnitude as the main regression.

Abstrakt

Zkoumáme dopady relokace firem na vzdálenost dojíždění zaměstnanců a pravděpodobnost rozchodu sezdaných párů a nesezdaných párů žijících v jedné domácnosti s dětmi. Využíváme švédská data za léta 2010 až 2016 a vybíráme pouze zaměstnance relokovaných firem s jedním pracovištěm a více než 10 zaměstnanci. Takový podvýběr nám umožňuje využít exogenní variaci v dojezdové vzdálenosti, která plyne z relokace. Přispíváme k literatuře o vlivu dojíždění do zaměstnaní na stabilitu vztahů snížením možného zkreslení odhadů způsobeného nepozorovanými faktory, které jsou proměnlivé v čase. Zatímco existující literatura se zaměřuje na rozdíly mezi krátkou a dlouhou dojezdovou vzdáleností, my se zaměřujeme na změny v dojezdové vzdálenosti, které jsou dány externě rozhodnutím vedení firmy. Nacházíme malý, ale statisticky významný negativní efekt zvýšené dojezdové vzdálenosti na stabilitu rodiny. Zvýšení dojezdové vzdálenosti o 10 km vede ke zvýšení pravděpodobnosti rozchodu páru o 0.09 procentního bodu, pokud dojíždějící zůstane u firmy dalších 5 let.

Klíčová slova: rozchod, manželství, čas dojíždění, vzdálenost dojíždění, quasi-experiment, prostorová mobilita

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