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Migration and the Internet

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Abstract

It is widely presumed that information and communication technologies, or ICTs, enable migration in several ways; primarily by reducing the costs of migration. However, a reconsideration of the relationship between ICTs and migration suggests that ICTs may just as well hinder migration; primarily by reducing the costs of not moving. Using data from the US Panel Study of Income Dynamics, models that control for sources of observed and unobserved heterogeneity indicate a strong negative effect of ICT use on inter-state migration within the United States. These results help to explain the long-term decline in internal migration within the United States.

Keywords: Internal migration; migration; ICTs; rootedness; Internet; mobility.

Introduction

Over the last several decades significant advancements in information and communication technologies, or ICTs, have transformed nearly all facets of society. In terms of spatial mobility, research has largely focused on the effects of ICTs on various forms of daily mobility: ICTs are thought to loosen ties to physical space, widen daily activity patterns and cause the fragmentation and blurring of activities across space and time (Line et al., 2011; Schwanen, Dijst, et al., 2008; Schwanen and Kwan, 2008), all of which are thought to have contributed to the emergence of a hypermobile society (Cresswell, 2011; Elliott et al., 2010; Sheller et al., 2006). However, the rate at which Americans migrate internally has steadily declined by nearly 50% over the last 35 years (Cooke, 2013b), thereby challenging the presumption that ICT has enabled hypermobility across all types and spatial scales of mobility. Moreover, demographic processes do not fully account for this decline (Cooke, 2011; Fischer, 2002; Molloy et al., 2011; Wolf et al., 2005), causing Fischer to conclude that that “The social forces that have encouraged stability . . . must be deep and pervasive” (Fischer, 2002: 193). In response, Cooke (2013b) explores the relationships between a broad set of economic and social trends and aggregate migration rates and finds that, among other things, the decline in migration rates since the early 1980s is strongly correlated with the widespread adoption of ICTs over that same time period. This research follows up by more fully considering

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how ICTs may affect migration behavior and empirically estimating the link between ICT use and internal migration within the United States using individual-level data.

Background

Consistent with the "death of distance" hypothesis (Cairncross, 2002), the widespread presumption is that ICTs enable migration. First, ICTs improve the quality and quantity of spatial information, which reduces both the costs and risks associated with migration:

> Information can be personalized on demand and matched to individual preferences in relation to central motives for migration – labor markets, housing markets, education, available leisure options, local environmental characteristics, and local social networks and contacts – in principle, for almost any place. This could reduce the friction of distance and encourage migration, alter migration intensity and distance, and change the ranking of motives and preferences (Vilhelmson et al., 2013: 210).

Second, ICTs allow migrants to communicate more effectively with people and places left behind. This also lowers the cost of migration and allows potential migrants to choose from a broader set of migration destinations (e.g., Barcus et al., 2010).

However, it is important to consider that ICTs not only improve the quality and quantity of information on distant locales but they also improve the quality and quantity of information on the current locale: Indeed, ICTs are now central in the search for local jobs and housing opportunities, romantic partners, affinity groups, and cultural, social, and political events, along with much more mundane tasks such as finding directions. This increase in the quality and quantity of local information may enhance attachment to place (Erickson, 2010; Haythornthwaite et al., 2010; Mesch et al., 2010), which in turn may reduce migration by increasing the costs of migration.

But perhaps most importantly, ICTs may lower the penalty associated with not moving. Specifically, before the advent of contemporary ICTs, the penalty associated with not moving was quite high; it meant a reduced ability to access higher education, it reduced career prospects, and it may have been associated with isolation from friends and family who had already migrated. ICTs reduce these penalties: Isolation from kith and kin who have migrated can now be remediated through ICTs (Benítez, 2012), higher education can now be increasingly accessed online (Mateyka et al., 2012), and employers now increasingly support working from a remote location (Allen et al., 2013). Indeed, ICTs are central to new forms of spatial mobility that provide alternatives to migration: For example, dual-career couples may be able to minimize the disruption of periodic job-related relocation by strategically residing in metropolitan areas with well-connected low-cost airline hubs that allow them to occasionally commute to remote employment centers while more frequently working from home (see Button et al., 2008). Thus, far from the immediate presumption that ICTs are associated with an increase in all forms of spatial mobility, a more nuanced reflection suggests that ICTs may enable new forms of spatial mobility which result in an increase in some dimensions of spatial mobility (e.g., daily activity) but a decrease in other dimensions of spatial mobility (e.g., migration).

However, the empirical relationship between ICT use and changing migration behavior is not established. Cooke (2013b) finds a strong correlation – but not a causal link – between the widespread adoption of ICTs and the decline in aggregate migration rates in the United States since the early 1980s. Vilhelmson and Thulin (2013) more closely explore the relationship between internet use and plans to migrate from a 2009 survey of young adults aged 20-29 in Sweden. They find that both migration plans and internet use increase the degree to which information from the internet increases the interest in moving. However, it is difficult to attribute causality to these results because the dependent variable is defined in such a way that it is already a function of the key independent variables. Thulin et al. (2014) focus on the role that the internet plays in shaping the decision to move among a sample of highly education young Swedes who are planning on moving in the near future. They conclude that "internet use is believed to encourage individual interest in migration, transforming the overall meaning of migration and reducing the perceived friction of distance" (Thulin and Vilhelmson, 2014: 389). However, since the sample consists only of individuals who plan to move it is not known how internet use affects the decision to not move. Hence, it still remains unclear as to the actual relationship between the use of ICTs and migration outcomes.

Data and Methods

The objective of this analysis is to establish the effect of ICT use on inter-state migration within the United States. A standard approach would be to estimate a regression model of the probability that an individual migrates from one state to another between two times periods as a function of internet use:

(1) $M_i = x_i\beta + I_i\gamma + e_{1i}$,

where M_i=1 if individual i migrated between t and t+1 and M_i=0 otherwise, and I_i=1 if the individual used ICTs in time t and I_i =0 otherwise. γ would therefore be an estimate of the effect of using ICTs in time t on the decision to migrate between t and t+1, independent of other observed individual characteristics (x_i). However, a model such as this is likely to produce biased estimates of γ because of unobserved heterogeneity (Angrist et al., 2009): The use of ICTs is likely correlated with unobserved individual characteristics such as affinity for risk and willingness to innovate. These same unobservable characteristics may well also be correlated with migration. Consequently, the estimated value for γ may not only reflect the direct effect of using ICTs but it may also include correlations between the unobserved characteristics that jointly determine the use of ICTs and migration. Hence, the estimated effect of the use of ICTs on migration (γ) would be biased.

There are several econometric approaches to resolving the issue of unobserved heterogeneity, one of which is through the use of instrumental variables (Angrist and Pischke, 2009). The basic approach is to first estimate a model of the focal independent variable (the use of ICTs in this case) as a function of the variables which determine the focal dependent variable (migration in this case) along with one or more instrumental variables – variables which determine ICT use but not migration. The logic is that the predicted value of the focal independent variable has been stripped of the unobservable variables that may jointly determine both the focal independent and dependent variables. As such, the estimated effect of the use of ICTs on migration (γ) will be unbiased.

While the instrumental variable approach is most often associated with interval-level focal independent and dependent variables, in this case both are binary variables requiring estimation through either logit or probit models of the probability of, first, internet use and then, second, migration. The instrumental variable model in this case takes the form of a bivariate probit model with an endogenous treatment effect (Angrist and Pischke, 2009):

$$M_i^* = x_i\beta + I_i\gamma + e_{1i}, \qquad M_i = 1 \text{ if } M_i^* > 0,\ 0 \text{ otherwise}$$
$$I_i^* = w_i\delta + e_{2i}, \qquad I_i = 1 \text{ if } I_i^* > 0, 0 \text{ otherwise}$$
$$[e_{1i}, e_{2i}] \sim \Phi_2(0,0,1,1,\rho),$$

where M* and I* are unobserved latent variables, ρ is the correlation between the unobserved determinants of migration (e_{1i}) and ICT use (e_{2i}), and φ is the standard normal density function. By explicitly modeling the degree to which unobservable variables are correlated with each other (ρ), the model limits γ to just the effect of ICT use.

This model is estimating using data from the US Panel Study of Income Dynamics (PSID) (see McGonagle et al. (2012) for a recent overview of the PSID). The PSID has followed a sample of U.S. individuals and households since 1968 (annually to 1997 and biannually since then) and has added their descendants to the sample. The PSID now includes more than 9,000 families and 24,000 individuals across several generations. The value of the PSID for this analysis is three-fold: First, it provides a prospective measure of migration such that the probability of migration between time period 1 and 2 can be estimated as a function of conditions in time period 1 (see Cooke, 2013a; Cooke et al., 2016 for examples of recent studies using the PSID to analyze internal US migration). In particular, migration is defined as a change in state of residence over a two-year period.

Second, the PSID uniquely provides a measure of ICT use. In particular, ICT use is based upon a question regarding whether the household head (and their partners, if married or cohabiting) used the internet at home. One limitation of this variable is that it does not capture the intensity of ICT use or the use of other types of ICTs (e.g., smartphones). However, this measure does differentiate between two very different populations: Home internet users (who might also include individuals who access the internet at home only through smartphones) who are presumed to be at-risk for more intense forms of ICT use and those who do not use the internet at home and who are presumed not to be at-risk for more intense use of ICTs.

Third, the PSID contains two potential instrumental variables: (1) the degree to which computers are used on the job and (2) a modified county-level code for position on the rural-urban continuum (see Brown et al., 1975). Conceptually, these meet the criteria as appropriate instruments since they are linked to home internet use but not migration: First, the use of the internet both at home and at work are presumed to be mutually reinforcing but there is no reason to suspect that computer use at work is correlated with the unobservable variables associated with migration. Importantly, computer use at work is shaped by the particular needs of the workplace and not unobservable individual characteristics, such as willingness to engage in risk, that may be associated with migration. Second, position on the rural-urban continuum is presumed to be correlated with home internet use because of the lack of internet infrastructure in more rural areas but there is no indication in the migration literature that the unobservable determinants of migration are correlated to position on the rural-urban continuum.

The bivariate probit model is estimated among a sample of never married male and female household heads between the ages of 25 and 59 in 2005 or 2007. Focusing on single-headed households – which account for 27% of all household types in the United States (Vespa et al., 2013) – eliminates the complex and confounding effects of household and family structure on migration. Focusing on 2005 – the first year that home internet data are available in the PSID – and 2007 strikes a balance between maximizing sample size and restricting the sample to years in which there are still sizeable – and presumably less heterogeneous – populations without access to the internet at home. Indeed, in 2007 38% of households still did not have access to the internet (U.S. Census Bureau, 2014).

The selection of variables to include in the bivariate probit model is driven entirely by the determinants of migration and not internet use. That is, the instrumental variable approach requires that all of the variables that determine the focal dependent variable (i.e., migration) are included in the model of the focal independent variable (i.e., the use of the internet at home) regardless of whether or not those variables determine the use of the internet at home – along with the previously discussed instruments. Toward that end, the analysis includes a suite of additional independent variables. These include a set of human capital variables related to migration (see Sjaastad, 1962): Income, years of education, economic activity, and job search. Another suite of variables are included reflecting the influence of life course characteristics on residential change (see Clark, 1986): Family size, race/ethnicity, gender, age, housing tenure, job search, lifetime mobility, and self-reported likelihood of moving. Table 1 presents more specific information on the variables used in this analysis.

Table 1: Variable Definitions and Descriptive Statistics

		Total Sample		Means by Subgroup	
Variable Name	**Variable Definition**	**Mean**	**S.D.**	**Migrants**	**Internet**
Migrant	=1 if Changed State of Residence between t=0 and t=2, =0 Otherwise	0.05	0.22	NA	0.07
Uses Internet at Home	=1 if Uses Internet at Home, =0 Otherwise	0.56	0.5	0.72	NA
County Urbanization	Beale County Urbanization Score; 1 (More Urban) to 9 (More Rural)	2.82	2.15	2.67	2.58
Job Requires Computer Use	0 (Unemployed); 1 (None of the Time) to 4 (All of the Time)	2.2	1.42	2.09	2.59
Income	Log of Previous Year's Labor Income (adjusted for inflation)	9.9	1.09	10.04	10.19
Family Size	Number of People in Family	2.2	1.45	1.85	2.04
Ethnicity:					
White	=1 if Non-Hispanic White, =0 Otherwise	0.39	0.49	0.53	0.5
Black	=1 if Non-Hispanic Black, =0 Otherwise	0.53	0.5	0.38	0.42
Hispanic	=1 if Hispanic, =0 Otherwise	0.06	0.23	0.08	0.05
Other Ethnicity	=1 if Non-Hispanic Other, =0 Otherwise	0.03	0.16	0.02	0.03
Female	=1 if Female, =0 Otherwise	0.53	0.5	0.41	0.51
Age	Age in Years	34.51	8.84	30.79	33.63
Years of Education	Years of Education	13.25	2.28	13.76	14.01
Homeowner	=1 if Own Home, =0 Otherwise	0.30	0.46	0.15	0.36
Economic Activity:					
Employed	=1 if Employed, =0 Otherwise	0.87	0.33	0.86	0.91
Out-of-Work	=1 if Unemployed or Laid-Off, =0 Otherwise	0.09	0.28	0.07	0.06
Out of the Labor Force	=1 if Retired, Permanently Disabled, Keeping House, or Other, =0 Otherwise	0.01	0.11	0.04	0.02
Student	=1 if Student, =0 Otherwise	0.03	0.17	0.04	0.02
Searching for Job	=1 if Searching for a New Job, =0 Otherwise	0.22	0.42	0.25	0.21
Lifetime Mobility	=1 if Ever Lived in Another State, =0 Otherwise	0.44	0.5	0.73	0.48
Likely to Move	Likeliness to Move in Next Year; 0 (will not move) to 3 (certain to move)	1.3	1.3	2.13	1.38
Census Division	9 Census Division Fixed Effects	NA	NA	NA	NA
N	Sample Size	2,152			

5% of the sample are classified as migrants and 56% have access to the internet at home. The sample has a disproportionately large sample of Blacks and a disproportionately small sample of Hispanics. This is consistent with the PSID's historical sampling legacy (McGonagle et al., 2012). Homeownership is also much lower in comparison with the general population but this is also to be expected among a sample of single heads of households. Table 1 also reports sample means for migrants and for those who use the internet at home. Notably, those who use the internet at home share common features with migrants: For example, they tend to be younger, to be more educated, to have higher incomes, to be renters, and to be non-Hispanic whites. Importantly, those who use the internet at home are more likely to migrate than those who do not. However, without controlling for observed and unobserved heterogeneity it is not possible to conclude whether home internet use actually causes an increase in migration. Indeed, given the observed similarity of home internet users and migrants it is likely that this difference is an overestimate of the effect of ICT use on migration.

Results

The analysis proceeds sequentially starting with a model with no control variables (Model 1), proceeding to a model with the full set of previously discussed control variables (Model 2), and then to the final instrumental variable model (Model 3). Table 2 reports the results of all three models.

However, the parameters of probit models as reported in Table 2 have little direct intuitive meaning beyond sign and significance. This is of particular importance in identifying the estimated effect of internet use on residential change. Therefore, the effects of the internet variable on migration are reported in terms of average marginal effects in Figure 1 (see Williams, 2012 for how these are calculated).

These provide an estimate of the effect of ICT use on the probability of changing residence while holding all other variables at their observed values. Hence, for Model 1 (the naïve model with no covariates) the average marginal effect for the use of the internet at home is 3.5% and is statistically significant (see Figure 1). Note, however that this is merely the average difference in the probability of residential change without adjusting for either observed or unobserved heterogeneity.

At a minimum, it is necessary to address observed heterogeneity by including relevant control variables. Toward that end, Model 2 (see Table 2) reports the results of a probit model of migration as a function of internet use along with those control variables. Apart from the role of the internet in shaping migration, this model demonstrates that the probability of migrating decreases with age, increases if they report they are likely to move in the near future and increases if they have previously lived in another state. None of the other variables are significant. On the one hand, this may indicate a poorly specific model or sample but on the other hand the two behavioral variables overwhelm the effects of the demographic characteristics. This is not unexpected because standard models of

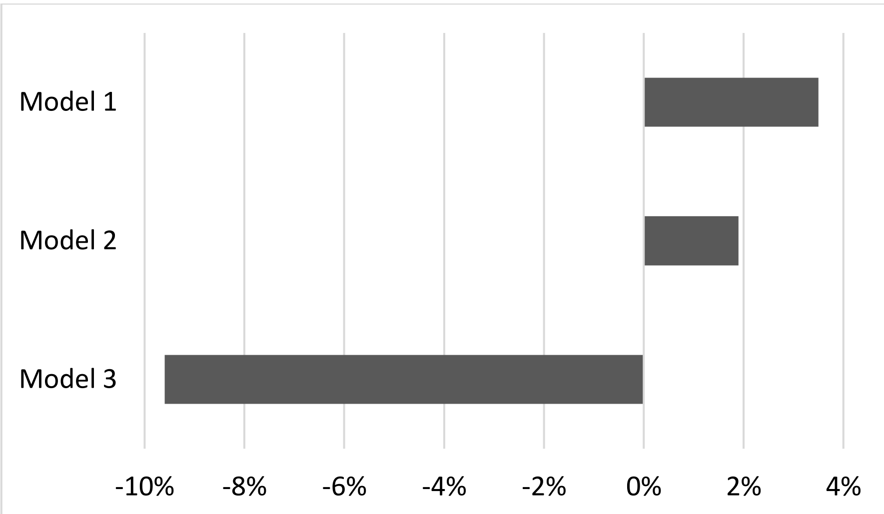
Table 2: Models of Effect of Internet Use on Migration*

Probit Models of Migration	**Model without Controls**		**Model with Controls***	
Variable	**Parameter**	**P-Value**	**Parameter**	**P-Value**
Uses Internet at Home	0.346	0	0.231	0.056
Income			0.039	0.534
Family Size			-0.036	0.442
Black			-0.021	0.872
Hispanic			0.233	0.298
Other Ethnicity			-0.458	0.164
Female			-0.087	0.418
Age			-0.019	0.004
Years of Education			-0.002	0.937
Homeowner			-0.204	0.121
Out-of-Work			-0.045	0.827
Out of the Labor Force			0.347	0.284
Student			0.34	0.181
Searching for Job			0.075	0.537
Lifetime Mobility			0.578	0
Likely to Move			0.176	0
N	2,152		2,152	
Log-Likelihood	-433.35		-379.36	
χ^2	12.51		97.03	
Prob(χ^2>0)	0		0	
Bivariate Probit Model	**Internet Use***		**Migration***	
Variable	**Parameter**	**P-Value**	**Parameter**	**P-Value**
Uses Internet at Home			-0.748	0.004
Income	0.188	0	0.1	0.089
Family Size	0.068	0.01	-0.014	0.758
Black	-0.494	0	-0.135	0.278
Hispanic	-0.432	0.007	0.106	0.629
Other Ethnicity	-0.006	0.982	-0.435	0.171
Female	0.048	0.512	-0.058	0.569
Age	-0.018	0	-0.022	0
Years of Education	0.142	0	0.045	0.121
Homeowner	0.337	0	-0.107	0.401
Out-of-Work	0.138	0.273	-0.099	0.604
Out of the Labor Force	1.786	0	0.584	0.075
Student	0.4	0.042	0.294	0.215
Searching for Job	0.109	0.179	0.091	0.429
Lifetime Mobility	0.077	0.29	0.541	0
Likely to Move	0.066	0.016	0.181	0
Job Requires Computer Use	0.182	0		
County Urbanization	-0.069	0		
N	2,152			
Log-Likelihood	-1536.96			
χ^2	520.17			
Prob(χ^2>0)	0			
ρ	0.58			
Prob(ρ>0)	0			

* Model includes 9 Census Regional Fixed Effects and Yearly Fixed Effects.
Note: P-values are based upon standard errors that have been adjusted for the clustering of observations across years.

migration behavior focus on demographic covariates rather than directly measuring previous migration experience or intent to move. Indeed, supplementary models (available from the author) demonstrate that when these two behavioral variables are excluded from the model most of the demographic variables are significant and in the expected direction. Nonetheless, once all of these control variables are added to the model of migration the effect of using the internet on migration becomes statistically insignificant: ICT use has no behavioral effect on migration.

Figure 1. Marginal Effect of Internet Use on Probability of Inter-State Migration



However, it is also likely that unobserved characteristics are correlated with both migration and internet use at home and therefore the estimated effect of home internet use as reported in Model 2 is biased. Hence, Model 3 in Table 2 presents the results of the bivariate probit model with an endogenous treatment effect. First, the model for internet use indicates that the probability of using the internet decreases with age, is lower for Blacks and Hispanics, and increases with income, family size, education, homeownership, being out of the labor force or a student, and plans to move. Importantly, the two identifying variables are statistically significant and in the expected direction: Internet use at home increases to the degree that their job requires computer use and declines to the degree that the individual resides in a less urban county. Second, apart from the role of the internet in shaping migration, the migration model demonstrates that the probability of migrating decreases with age, increases if they report they are likely to move and increases if they have previously lived in another state. These results are consistent with Model 2. Third, the estimated correlation between the unobserved characteristics that determine internet use and the unobserved characteristics that determine migration is positive (ρ=0.58) and highly significant (p-value<0.001), suggesting that internet users are positively selected for migration: Unobserved characteristics that determine internet use are positively correlated with the unobserved characteristics that determine migration. This would indicate that the parameter estimates for the effect of internet use previously presented in Models 1 and 2 are positively biased. Indeed, in Model 3 the parameter estimate for the effect of home internet use on migration is negative and significant. This suggests that after controlling for both observed and unobserved heterogeneity that home internet use dramatically reduces biannual interstate migration. In this case, Figure 1 shows that the calculated average marginal effect of internet use is -9.6%.

Conclusion

Fueled by the death of distance hypothesis, empirical research on the effect of ICTs on daily mobility, and the rise of a hypermobile global elite, the accepted wisdom is that the widespread adoption of ICTs is associated with elevated levels of migration. Indeed, descriptive results also seem to indicate that home internet users migrate more often within the United States than those who do not use the internet. However, this is not an accurate estimate of the causal effect of ICT use on migration: Both observable and unobservable characteristics of individuals are correlated with both migration and ICT use and failing to address these sources of heterogeneity leads to biased estimates of the causal effect of ICT use on migration. Using a bivariate probit model with an endogenous treatment effect to control for both observed and unobserved heterogeneity, the effect of home internet use is isolated and estimated to be strongly negative. However, since internet use is only presented as a proxy for ICT use, caution is in order in concluding that using the internet directly reduces the chances of moving to this degree. Nonetheless, this result provides a strong empirical foundation for arguing that ICT use may reduce internal migration.

It is already clear that ICTs are behind profound changes in spatial behavior consistent with both an increase in daily mobility and a long-term decline in US migration. This should lead to more nuanced discussions regarding spatial mobility that move beyond trite statements regarding the emergence of an ICT-induced hypermobile society. Rather, research should seek to identify new forms of spatial behavior that have emerged (e.g., irregular long-distance commuting to remote work sites) and the causal links between ICT use and these new forms of spatial behavior and how these provide an alternative to migration (e.g., how ICTs provide alternatives to moving and how ICTs enhance attachment to place). In this regard, social science research lags far behind reality since it continues to rely upon 20th Century theoretical paradigms that link ever-increasing rootlessness with economic, social, and technological progress (Fischer, 2002).

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