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Do People Follow Jobs or Do Jobs Follow People? The Case of Finland in an International Context

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Abstract: Traditionally, people are believed to follow jobs; however, a contradictory view that jobs follow people has also gained popularity. In this study, two methods are used to analyze regional growth processes in Finland between 1990 and 2010, and the results are compared with the findings obtained elsewhere. In accordance with the results from many countries, the conventional regional adjustment model shows that people have largely followed jobs in Finland, i.e., that regional growth is demand induced. A closer examination suggests, however, that highly educated people drive regional change in Finland and that economic fluctuations also have an effect. Another approach, based on the Granger causality method in a panel framework, reveals heterogeneity among regions, implying that regional growth is particularly supply induced for large and dynamic city regions. These results confirm expectations of complicated regional growth processes and the hypothesis that population and employment growth drive one another.

1. Introduction

Over the past 50 years, regional and urban researchers have discussed the fundamental causes of regional growth processes. The chicken-and-egg controversy of whether people follow jobs or jobs follow people is a recurring subject. Which comes first, demand or supply? Does population drive employment changes, or does employment drive population changes? Specifically, do regions grow because firms create jobs and people follow, or do people move to a region for quality-of-life and other non-economic reasons and jobs follow (Ferguson et al., 2007)? The traditional view is that people follow jobs; however, the contradictory view, according to which jobs follow people, has also gained popularity, especially in the U.S., where many studies have demonstrated that people desire to move to high-amenity locations, suggesting that people drive regional change.

This study analyzes regional growth processes in Finland during the period of 1990–2010 and compares the processes to those in other countries. Although the question of whether people follow jobs or jobs follow people and general questions about the employment–population relationship in regional economies have been analyzed in many countries, especially in the U.S., these questions have not been evaluated thoroughly in Finland.

Finland is a country with a small population but a large area. Consequently, regional structures in Finland differ from those of many other countries. This fact underlines the significance of an analysis of regional growth processes in Finland. Identical to that in many other countries, Finnish regional development has been characterized by rapid economic expansion together with structural change, which has had the effect of centralizing both economic activity and population (Tervo, 2005). The trend has been toward development of the southern and central regions, where the metropolitan area of Helsinki and most of the larger towns and urban centers are located. The 1990s were a time of great economic flux and drastic structural change. Finland was hit by a severe recession in the early part of the 1990s, and employment fell sharply. Rapid economic recovery was based on export and knowledge-based industries. The most competitive regions were those that had an urban center and especially those with a university. Migration to these centers accelerated. For example, more than two thirds of the new jobs created after the depression were established in the three largest urban centers: Helsinki, Tampere, and Turku. In the 2000s, the centralizing development became more even; however, rural areas still lost population and employment. A scattered pattern of settlement, characteristic of sparsely populated countries, continues to strengthen in Finland.

In the empirical analysis, the conventional method of regional adjustment is first used, and then the picture of regional growth is widened using an approach based on the Granger causality method in a panel framework. A regional adjustment model, first employed by Carlino and Mills (1987), has become an increasingly common method of analyzing the interdependent processes of population and employment growth in the context of dynamic adjustment processes. The findings obtained using a regional adjustment model can be used to gain insights into the debate about whether people follow jobs or jobs follow people. The regional adjustment model has been used to analyze the processes and outcomes of population and employment changes in regional economies with different employment groups and time lags and within various spatial frames of reference. The studies suggest that population and employment are subject to a dynamic adjustment process and are jointly determined (Carruthers and Mulligan, 2007); however, the empirical results based on this framework may yield rather unclear conclusions (Hoogstra et al., 2005; de Graaff et al., 2012).

In this paper, employment is assumed to be homogenous; however, the population is divided to distinguish the highly educated from the total population because the focus is on the potential effect of human capital. Furthermore, the study period is divided into different sub-periods to analyze the effect of economic fluctuations on the interdependent processes of population and employment growth. The particular question asked is the following: does a deep recession break the interdependency?

The second approach, based on the notions of Granger causality and heterogeneous panels, overcomes some of the limitations of the regional adjustment model. The method evaluates causal relationships in panel data but does not assume that each member of the panel (i.e., each region) behaves similarly. Thus, it allows that a causal relationship between employment and population growth is present in some regions but not in others.

A meta-analysis of former empirical studies provided support for the "jobs follow people" hypothesis, although the literature has shown large variation in research findings indicating the direction of causality (Hoogstra et al., 2005). A widespread conjecture in Finland is that regional development is heavily demand induced. This is also the main finding of this study, based on results obtained using the traditional regional adjustment model: people have largely followed jobs. This is also the result obtained from other Nordic countries (Østbye et al., 2012), perhaps reflecting prevailing regional structures of these sparsely populated countries. During the deep recession in the early 1990s, however, our results show no interaction between population growth and employment growth. However, when highly educated people are analyzed, rather than the total population, the main finding is that jobs follow people. The Granger analysis indicates bidirectional causality both among the total population and the highly educated. However, the analysis also indicates heterogeneity among regions, implying that regional growth is supply induced within the three largest urban regions, i.e., Helsinki, Tampere, and Turku. Urban regions can offer versatile opportunities and amenities that particularly attract highly educated people. Ultimately, population and employment growth drive one another.

The remainder of the paper is organized as follows. Section 2 provides background by briefly presenting the demand- and supply-driven theories from the empirical literature. The data and methods are described in Section 3, and the results obtained with both methods are presented in Section 4. Section 5 summarizes the empirical facts for Finland and discusses the results by comparing them with the results from other countries. Section 6 concludes.

2. Two opposing views on regional growth

The research question of whether regional growth is demand or supply induced reflects a longstanding debate in regional science dating to the early works of Borts and Stein (1964), Lowry (1966), and Muth (1971). According to demand-driven employment theories, employment growth is exogenously determined and consequently determines population growth and migration. The reason for population change is the local community's economic strength. The early literature, primarily based on the export-base theory of regional growth, states that differential rates of migration are induced by differential growth in job opportunities or employment. By contrast, Borts and Stein (1964) followed the neoclassical route and stressed the role of increased labor supplies as a growth-inducing factor. Differential changes in employment are induced by differential rates of migration. Personal preferences, rather than economic opportunities, dominate. People are attracted by regional amenities, or they move for other non-employment-based reasons, and employers follow, both to employ the migrated workers and to provide support services to the newly expanded population (Freeman, 2001).

Later, especially in the United States, population shifts were described by the competing regional restructuring and population deconcentration explanations (Frey, 1993; Vias, 1999; Carruthers and Vias, 2005). According to the former, firms' decisions about where to locate are important to population shifts, while the latter suggests that residential consumption preferences account for the redistribution of people and jobs within and among regions. Thus, the regional restructuring perspective states that people follow jobs, while the primary content of the deconcentration perspective is that people drive regional changes, i.e., jobs follow people.

The question of the basic causes of regional growth processes has been analyzed in many countries but not extensively in Finland. Muth (1971) and later Chun (1996), for example, evaluated the two opposing views of the causal relationship between migration and employment change using a simultaneous equation model. Migration and employment growth were found to be mutually dependent, although employment was found to affect net migration more strongly than net migration was found to affect employment. Likewise, Chun (1996) showed that economic opportunity variables (employment and investment) are the most important determinants of migration, and a weaker positive relationship arises from people's desire to live in amenity-rich environments.

A regional adjustment model, first presented by Carlino and Mills (1987), has been utilized in many of the studies aiming to analyze the causes of regional growth.[1] Carlino and Mills (1987) analyzed county-level growth across the USA during the 1970s, and Clark and Murphy (1996) carried out a follow-up study analyzing growth during the subsequent decade of the 1980s. Together, these two studies suggested that dual causality and stable growth characterized population and employment developments.

Since these pioneering studies, regional adjustment models have been used widely, especially in the U.S. but also in Europe. For example, Boarnet (1994), using municipality-level data in a part of New Jersey, and Vias (1999), who looked at the rural Rocky Mountain regions, reported that jobs tend to follow people, while the effect of employment changes on population appeared weak. In Catalonia, Spain, Arauzo-Carod (2007) found that the location of population was more important for the location of jobs than *vice versa*, although the locations of population and jobs were simultaneously determined. Accordingly, the results from Catalonia favored the hypothesis that jobs follow people more than the opposing hypothesis. Then again, in the case of the Netherlands, Vermeulen and van Ommeren (2009) found that employment adjusted to the regional supply of labor. Interestingly, they identified housing supply as a driving force behind regional development. Increase in labor supply induced by regional housing supply is matched by demand in the long run. Also in the Netherlands, de Graaff et al. (2012) showed that population changes drive employment, particularly in the industrial and retail sectors. Additionally, employment in all sectors depends strongly on intersectoral dynamics.

As for the Nordic countries (Sweden, Norway, and Finland), the results obtained by Østbye et al. (2012) supported the hypothesis that people follow jobs but not the reverse. In another study from Sweden, however, Sörensson (2012) obtained the result that the endogenous population and employment variables were highly interactive, even if the hypothesis that people follow jobs garnered somewhat stronger support than the reverse.

In all, the results about the nature of regional growth processes seem to vary greatly among different studies. This variation was also confirmed by

[1] The regional adjustment model, which is also utilized in this study, is presented more thoroughly in Section 3 and the Appendix.

Hoogstra et al. (2005) in their meta-analysis of Carlino–Mills-type studies. They found 37 studies published between 1987 and 2003. The meta-analysis showed that the question about the nature of the growth process does not have an unambiguous answer. Only 15% of the total sample of 308 study results were found to establish some form of bidirectional causality, while 28% of the results indicated that "people follow jobs", and 32% indicated that "jobs follow people"; for 26% of the sample, the results were inconclusive in terms of the dominating mechanism (see also de Graaff et al., 2012). It was found, however, that the empirical evidence for "jobs follow people" is stronger than that for "people follow jobs".

The inconclusive results obtained in the Carlino-Mills-type studies may appear somewhat dissatisfying and give one cause to doubt that choices with respect to various methodological alternatives have an effect. However, the results may also indicate that the jobs–people direction of causality varies over time, over space, and among employment groups, i.e., the results characterize real-world differences (Carruthers and Vias, 2005; Hoogstra et al., 2011). In Canada, Ferguson et al. (2007) found that amenities and economic factors were approximately equally important as determinants of population change in urban communities, while economic factors clearly dominated in rural communities. They also found variations among age cohorts in both types of areas. Amenities were found to be more important in the location decisions of young people and workers nearing retirement (Ferguson et al., 2007; Brown and Scott, 2012). Furthermore, a metaregression analysis of empirical results generated using data for the northern Netherlands (Hoogstra et al., 2011) showed that the result "jobs follow people" is gaining significance over time, which the authors believe to describe a shift toward a knowledge-based economy.

3. Data and methods

3.1. Data and descriptive statistics

The data from the years 1990–2010 originate from Statistics Finland's PX-Web Databases. The regional classification is from the year 2011, based on sub-regional units, LAU-1 level regions (in Finnish, *seutukunta*). For each EU member country, two levels of Local Administrative Units (LAU) are defined: LAU-1 and LAU-2, which were previously called NUTS-4 and NUTS-5, respectively. In Finland, LAU-1 consists of sub-regional units and LAU-2 consists of municipalities. Finnish LAU-1 regions consist of several municipalities that represent the local labor market reasonably well and can be considered approximations of commuting areas and functional regions. Their total number is 67.[2] In the panel Granger analysis, regional growth in the group of the three largest urban regions—Helsinki, Tampere, and Turku—is analyzed separately and compared with the growth in the rest of regions. The regions in this group are primarily rural or sparsely populated sub-regions; however, this group also includes some larger city regions.

Two variables are needed for the analysis, one for population and one for employment. Two population variables are used: the first concerns the population aged 15–69 and the second the highly educated—those who have a master's degree or doctorate or the equivalent. The value of the employment variable is determined on a place-of-work basis and expresses the daytime population. The variable describes workplaces or jobs, i.e., persons working in the region.

Table 1 shows the growth in the number of people and jobs in Finland during the study period. The population increased by 7% between 1990 and 2010, while the number of jobs slightly decreased. Human capital increased remarkably: the number of highly educated persons more than doubled during this period. Table 1 also provides an approximate picture of regional variation. The population increased by almost a quarter during this period in the three largest cities, while it decreased in the group of other regions. The number of jobs also increased in the three largest cities, while it decreased in the other group by almost 9%.[3] Interestingly, there were no great differences in the growth of the numbers of highly educated people between the two groups of regions. The educational level seems to have increased quite evenly across the country. This observation accentuates the importance of analyzing the effect of human capital on the causality between jobs and people.

[2] The three very small offshore sub-regions of Åland are excluded due to their special character. Åland is an island between Finland and Sweden that has an isolated geographical position and is self-regulated.

[3] The group of other regions, however, also included increasing regions: there were 16 sub-regions in which the population increased and 11 sub-regions that experienced an increase in the number of jobs.

Table 1. Population (aged 15-69) and job growth in Finland, 1990–2010.

	Total			*Highly educated*			*Jobs (millions)*		
Region	1990	2010	% Change	1990	2010	% Change	1990	2010	% Change
Finland	3.567	3.809	6.8	0.162	0.378	134.3	2.318	2.310	-0.0
3 largest urban regions	1.240	1.541	24.3	0.094	0.224	137.3	0.911	1.029	13.0
Other regions	2.327	2.268	-2.5	0.067	0.154	130.0	1.407	1.281	-8.9

Figure 1 shows the yearly change in the numbers of jobs in Finland and in the two groups of regions. This graphic representation indicates the severe consequences of the two great recessions on job development at the beginning and end of the study period. The "Finnish Great Depression" took place in 1990–1994, while the most recent global finance crisis started in 2008. During the first period, Finland experienced the deepest economic downturn in an industrialized country since the 1930s. While the collapse of Finnish–Soviet trade in approximately 1990-1991 played a considerable role in this depression, the financial shocks that resulted from the collapse in the banking sector and the asset price bust played an even larger role. This depression caused a rapid decline in employment in both regions. Growth in employment started again in 1993 and was much faster in the group of the three urban regions than in the other group. Consequently, the share of jobs in the three largest cities increased from 39% to 45% during the study period. The effect of the global financial crisis that occurred at the end of the period, with the resulting decline in export demand and increase in global financial stress, is also evident in the employment figures. The intermediate period of 1994–2007 was a time of growth—first export-led growth supported by currency depreciation, wage moderation, and positive shocks from the rapid growth of information technology (Nokia) and then rising domestic demand (tax cuts and low ECB interest rates). In addition to the two depressions, there was a recession at the turn of the century that followed the burst of the dot-com bubble, although the number of jobs did not decrease during this period.

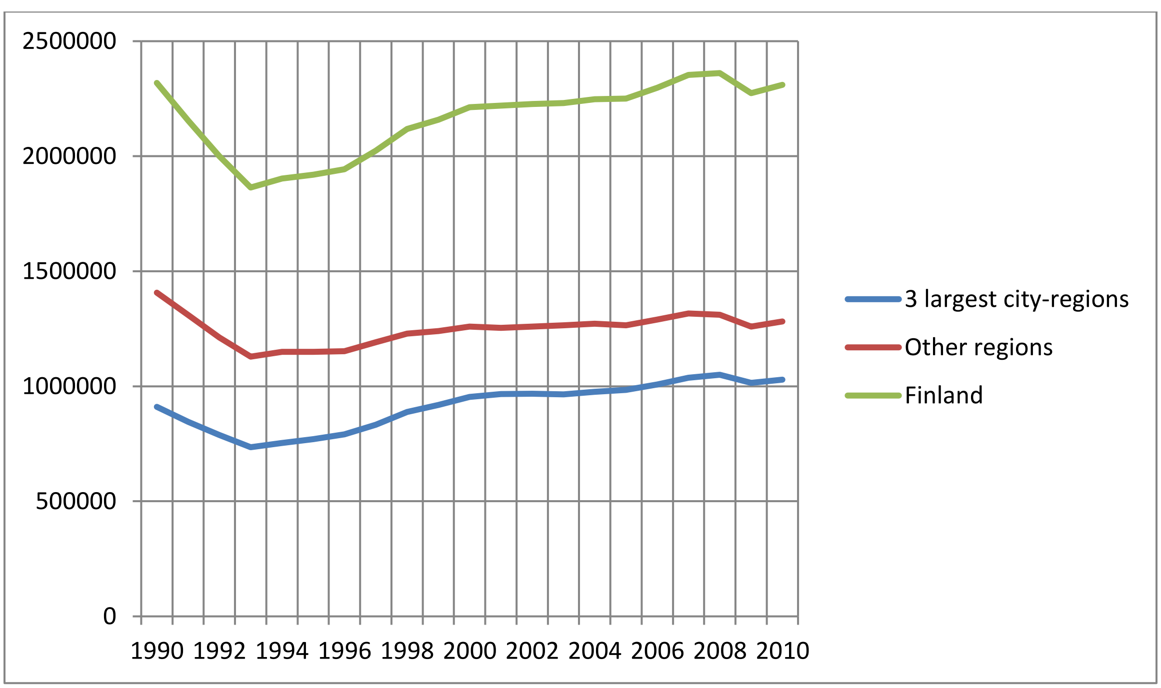

Figure 1. Jobs in Finland, 1990–2010.

3.2. Methods

This study utilizes two methods, an analysis based on an established regional adjustment model and a Granger causality analysis in heterogeneous panels, in examining regional growth processes in Finland (for a thorough presentation of the methods, see the Appendix). Carlino and Mills (1987) presented a model based on the idea of general equilibrium to assess how population and employment interact in the growth process. Their point of departure was a conventional equilibrium model in which both households and producers are geographically mobile. A two-equation regression procedure—i.e., a regional adjustment model, wherein population (employment) change between two points in time is a function of employment (population) at the end of the time period, population (employment) at the beginning of the time period, and a set of initial conditions—was used to examine the interactions between population and employment in the growth process (Mulligan et al., 1999; Carruthers and Vias, 2005). The lagged adjustment model assumes that population and employment changes are adjustments toward an equilibrium determined by local characteristics.

The basic premise of a regional adjustment model is that population and employment growth drive one another, i.e., that they are endogenously determined. It is assumed that firms and households adjust to disequilibrium by distributed lag adjustment equations. Within the partial adjustment model framework, population and employment tend toward some unknown spatial equilibrium that is theoretically attainable but can be characterized as an unobservable outcome. Households make their location choices to maximize utility. Each individual's utility is maximized with respect to his or her consumption of goods and services, proximity to his or her workplace, and access to location-specific amenities, including both natural attractions and locally produced amenities (Carruthers and Vias, 2005; Carruthers and Mulligan, 2007). Thus, compensating differentials are at the core of the equilibrium perspective. Likewise, firms seek to identify optimal locations that will maximize profits. Profit-maximizing firms are disposed to make optimal use of agglomeration economies, regional comparative advantages, wage differentials, transportation networks, labor supply differences, and other factors that affect the variable costs of production. While a perfect spatial distribution of population and employment can never be achieved, it is deduced that the economy is constantly adjusting itself toward this ideal.

In our analysis, the focus is restricted to the core relationships between the interrelated population and employment regularities. Mulligan et al. (1999) showed that the regional adjustment model works remarkably well despite the absence of control variables for socioeconomic and fiscal conditions, amenities, infrastructure, and location within a country.

The second method is based on the notion of Granger causality. In the case of two variables, x and y, the first variable, x, is said to cause the second variable, y, in the Granger sense if the forecast for y improves when lagged values for x are considered (Granger 1969). By estimating an equation in which y is regressed on lagged values of y and lagged values of x, we can evaluate the null hypothesis that x does not Granger-cause y. If one or more of the lagged values of x is significant, we can reject the null hypothesis that x does not Granger-cause y.

The Granger method used in this paper evaluates causal relationships in panel data but does not assume that each member of the panel (i.e., each region) behaves similarly. The introduction of a panel data dimension permits the use of both cross-sectional (regional) and time series information to test causality relationships, which apparently improves the efficiency of Granger causality tests. The approach has three main steps, which are related to the homogeneous non-causality, homogeneous causality, and heterogeneous non-causality hypotheses. While regional adjustment models make use of only two arbitrary points in time, the first and last years of the research period, and assume homogenous causality processes between regions, this approach avoids these shortcomings. Thus, it allows for a causal relationship between employment and population growth in some regions but not in others. The hypothesis is that jobs follow people, especially in flourishing, amenity-rich regions that attract many people. The results are compared and interpreted with the results obtained using the regional adjustment model.

4. Results

The results based on the regional adjustment model are shown in Tables 2 and 3. For each case, the model includes two equations because there are two endogenous variables, population change and employment change. Population change between times t and $t-1$ is modeled as a function of the employment at t and population at $t-1$, and employment change between times t and $t-1$ as a function of the population at t and employment at $t-1$ (see Appendix, equations 5 and 6). Because this is a simultaneous equation model, it is estimated using the method of two-stage least squares. With respect to people, the model is estimated both for the total population and for the highly educated. The estimations were made for the entire study period of 1990–2010 and for six different sub-periods constructed by the fluctuations in the economic situation (see Figure 1 and the related text). In the first separation, the study period was divided into three business cycles: two periods of recession, 1990–1994 and 2007–2010, and a period of growth, 1994–2007. In the second separation, acknowledging the effect of the burst of the dot-com bubble at the turn of the century, the intermediate period was divided into the three sub-periods of 1994–2000, 2000–2002, and 2003–2007, of which the period 2000–2002 was considered a period of economic depression.

The two columns in each table show the results of the population/human capital and employment models, respectively. For the entire period, the results are drastically different depending on whether the total population or the highly educated segment of the population is used to describe population change. In the first case, the population model has a high coefficient of determination ($R^2 = 0.83$), and what is most important is that the estimate of "*Employment t*" is positive and highly significant. The estimate of "*Population t-1*" is negative and significant, as expected. The employment model, by contrast, does not work well. Both adjustment variables are insignificant. Hence, the conclusion drawn is that people follow jobs. In the second case, in which the highly educated segment of the population is analyzed, the opposite result is obtained. The population (human capital) model does not yield significant results, while the employment model does. The positive estimate of "*Human capital t*" suggests that jobs follow highly educated people.

The results for the intermediate period of growth, 1994–2007, lead to the same conclusions: people followed jobs, while jobs followed highly educated people. These results do not change even if the period is divided into three sub-periods, as the last three panels in Tables 2 and 3 indicate. Hence, the small downturn at the turn of the century did not change the population–employment interaction in Finland.[4]

By contrast, the results from the era of Finland's Great Depression are completely different. In the course of the crisis, when employment fell and unemployment rose dramatically, resulting in sharply declining interregional migration, the population–employment interaction did not behave in the same way as it did after the depression. The results for the total population suggest that there was no interaction: jobs did not follow people, nor did people follow jobs. By contrast, as Table 3 shows, perhaps surprisingly, highly educated people followed jobs, whereas for the period of rapid economic recovery after the depression, jobs followed highly educated people. Because of lagging data from the period before the deep depression, it remains unanswered whether these results are simply a consequence of the crisis or whether they indicate a permanent change in the population–employment relationship, which just happened to take place in the mid-1990s.

The results for the last period, 2007–2010, which was also a time of downturn, are the same for the total population as those obtained for the preceding period: people followed jobs. Hence, the downturn that resulted from the global financial crisis did not have an effect on the population–employment interaction. By contrast, in the case of highly educated people, the downturn did have an effect on this interaction: jobs did not follow highly educated individuals during this period but followed them in other periods (except for the period 1990–1994). The conclusion from this finding is that the interaction between human capital and employment died away in the last sub-period. We do not yet know, however, whether this is a temporary phenomenon or a permanent change that had its origin in the financial crisis.

Next, the relationship between population / human capital growth and employment growth is analyzed with the help of the Granger causality notion. The nested procedure consists of three main steps: testing the homogeneous non-causality hypothesis, testing the homogeneous causality hypothesis, and testing the heterogeneous non-causality hypothesis. The tests between the growth of employment and population in the 67 regions were performed for the period 1990–2010, with lags from one to three. The tests were based on the Wald statistics presented in the Appendix. To test the various hypotheses, the test statistics using the sum of the squared residuals from the unrestricted model (see Appendix, equation 7) and the sum of the squared residuals from the requisite restricted models were calculated. The sums of the squared residuals were obtained from the

[4] As Figure 1 shows, employment did not decrease, although the Internet boom collapsed at that juncture.

Table 2. Regional adjustment model: estimation results I from Finland -total population.

	Population change		*Employment change*		*Conclusion**
	Coefficient	t-statistic	Coefficient	t-statistic	
1990-2010					PJ
Employment t	0.415***	4.79			
Population t-1	-0.373***	-3.74			
Population t			-1.583	-1.06	
Employment t-1			1.775	1.13	
Constant	-0.024	-1.13	-1.349***	-3.54	
R^2	0.831		0.021		
1990-1994					NI
Employment t	0.051	1.52			
Population t-1	-0.038	-1.07			
Population t			-0.136*	-1.88	
Employment t-1			0.138**	2.04	
Constant	-0.096*		-0.153	-1.45	
R^2	0.406		0.041		
1994-2007					PJ
Employment t	0.283***	3.87			
Population t-1	-0.241***	-2.92			
Population t			-0.357	-1.28	
Employment t-1			0.457	1.59	
Constant	-0.315*	-1.97	-0.653***	-3.93	
R^2	0.782		0.242		
2007-2010					PJ
Employment t	0.071**	2.15			
Population t-1	-0.058	-1.66			
Population t			0.027	0.53	
Employment t-1			-0.013	-0.27	
Constant	-0.097**	-2.09	-0.198**	-2.45	
R^2	0.587		0.155		
1994-2000					PJ
Employment t	0.142***	3.81			
Population t-1	-0.116***	-2.82			
Populationt t			-0.176	-1.55	
Employment t-1			0.227**	2.01	
Constant	-0.219***	-3.03	-0.308***	-2.79	
R^2	0.758		0.430		
2000-2002					PJ
Employment t	0.057***	3.41			
Population t-1	-0.049***	-2.72			
Population t			-0.038	-0.88	
Employment t-1			0.047	1.16	
Constant	-0.068**	-0.073	-0.073	-1.29	
R^2	0.607		0.194		
2003-2007					PJ
Employment t	0.106**	2.64			
Population t-1	-0.092**	-2.15			
Population t			-0.067	-1.30	
Employment t-1			0.086*	1.74	
Constant	-0.094	-1.64	-0.113	-1.57	
R^2	0.577		0.271		

* PJ = people follow jobs; JP= jobs follow people; NI = no interaction

Table 3. Regional adjustment model: estimation results II from Finland –highly educated.

	Human capital change		Employment change		Conclusion*
	Coefficient	t-statistics	Coefficient	t-statistics	
1990-2010					
Employment t	-0.107	-0.84			JP
Human capital t-	0.148	1.40			
Human capital t			0.153***	3.77	
Employment t-1			-0.093	-1.70	
Constant	0.786	1.43	-0.364***	-1.41	
R^2	0.096		0.620		
1990-1994					PJ
Employment t	0.076*	1.94			
Human capital t-	-0.060*	-1.93			
Human capital t			0.018	0.77	
Employment t-1			-0.014	-0.45	
Constant	-0.142	-0.78	-0.189	-1.25	
R^2	0.085		0.062		
1994-2007					JP
Employment t	-0.202**	-2.37			
Human capital t-	0.223***	3.19			
Human capital t			0.132***	3.99	
Employment t-1			-0.085*	-1.88	
Constant	0.872**	2.37	-0.053	-0.25	
R^2	0.213		0.648		
2007-2010					NI
Employment t	-0.027	-1.40			
Human capital t-	0.029*	1.92			
Human capital t			0.022	1.58	
Employmentt-1			-0.014	-0.80	
Constant	0.155*	1.98	-0.059	-0.73	
R^2	0.105		0.173		
1994-2000					JP
Employment t	-0.027	-0.71			
Human capital t-	0.053*	1.68			
Human capital t			0.064**	2.63	
Employment t-1			-0.030	-0.93	
Constant	0.097	0.57	-0.097	-0.68	
R^2	0.309		0.559		
2000-2002					JP
Employment t	-0.068***	-3.21			
Human capital t-	0.063***	4.18			
Human capital t			0.023**	2.64	
Employment t-1			-0.018	-1.61	
Constant	0.281**	2.67	0.001	0.02	
R^2	0.269		0.257		
2003-2007					JP
Employment t	-0.069**	-2.13			
Human capital t-	0.068***	2.75			
Human capital t			0.036**	2.67	
Employment t-1			-0.024	-1.37	
Constant	0.330**	2.29	-0.003	-0.04	
R^2	0.194		0.377		

* PJ = people follow jobs; JP= jobs follow people; NI = no interaction

maximum likelihood estimation, which in this case corresponds to the fixed effects estimator. To perform the estimations required, the constrained regression technique was used.

As a first step in exploring the bidirectional Granger causality between population/human capital and employment growth, the homogeneous non-causality (HNC) hypothesis was tested. Up to three lag lengths were used. Additionally, to save degrees of freedom, the three lags were added up (∑lags). In this case, the assumption is that all that occurred in the region during the previous three years may have an aggregate effect on the adjustment process. The test statistics are presented in Table 4: with one lag and ∑lags, they are all statistically significant, except for the case "jobs follow highly educated" with ∑lags. With two and three lags, no significant results were obtained. Based on these results, the homogeneous non-causality hypothesis is rejected and the testing procedure continues. For at least one region (and possibly all), there is statistical evidence of Granger causality from population (human capital) growth to employment growth and *vice versa*.

Given the rejection of the HNC hypothesis, the homogeneous causality (HC) hypothesis was tested with one lag and ∑lags. The results are also shown in Table 4. The hypothesis that population growth causes homogenous employment growth in all the regions is rejected with ∑lags but not with one lag. The opposite hypothesis—that there is homogenous causality from employment growth to population growth—is rejected with both one lag and ∑lags. When highly educated people are considered rather than the total population, all three F_{HC} test statistics are significant. As a whole, these results imply that jobs follow people/highly educated and people/highly educated follow jobs in some but not all regions. The causal processes are not uniform.

Table 4. Test results for homogenous non-causality (HNC hypothesis) and homogeneous causality (HC hypothesis).

Direction of causality and lags	*Population - employment* F_{HNC}	*Population - employment* F_{HC}	*Highly educated – employment* F_{HNC}	*Highly educated – employment* F_{HC}
Jobs follow people / highly educated				
Lag 1	1.294*	0.604	1.630***	1.260*
Lag 2	0.541	-	0.560	-
Lag 3	0.357	-	0.293	-
∑lags	1.324**	1.308*	1.062	-
People / highly educated follow jobs				
Lag 1	2.268***	2.428***	1.776***	1.710***
Lag 2	0.702	-	0.907	-
Lag 3	0.438	-	0.424	-
∑lags	1.313*	1.986***	1.490***	1.743***

The question of which regions are different remains. The last step in the search for Granger causality is to examine the contributions of individual regions to the existence of causality, i.e., to test the heterogeneous non-causality hypotheses. Because at 67 the number of regions is high, the contribution of each individual region to the existence of causality is not tested. Instead we analyze the group of regions of greatest interest, the three largest and most dynamic urban regions (Helsinki, Tampere, and Turku), in which jobs, people, and human capital have grown very rapidly. As suggested by the previous results, the test statistics are calculated for one lag and ∑lags. The results presented in Table 5 show that the test statistics are not significant, with one important exception: the non-causality hypothesis that jobs follow people in the three largest urban regions is clearly rejected with ∑lags. This result is not, however, obtained for the pair of variables "*highly educated*" and "*employment*". These results suggest that jobs follow people, especially in the rapidly growing urban regions.

Table 5. Test results for heterogeneous causality (HENC hypothesis): the three largest urban regions in Finland.

Direction of causality and lags	Population/ employment F_{HENC}	Highly educated/ employment F_{HENC}
Jobs follow people / highly educated		
Lag 1	1.394	0.768
∑lags	3.215**	(0.720)
People / highly educated follow jobs		
Lag 1	0.490	0.130
∑lags	0.176	0.031

5. Discussion

The answer to the longstanding debate in regional economics whether regional growth is demand or supply induced is ambiguous. Therefore, the aim of our study was to analyze the question from various aspects. For that purpose, in addition to the approach based on the traditional regional adjustment model being concerned with the entire period, it was also directed to separate sub-periods differentiated with economic fluctuations. Additionally, population growth was also analyzed for the highly educated segment of the population, which made it possible to assess the role of human capital. For simplicity, however, employment was assumed to be homogeneous in the analyses. Second, a Granger causality method in a panel framework was applied to the analysis of the employment–population relationship in the regions. With this method, it is not necessary to assume that each region behaves similarly; a causal relationship between employment and population growth may exist only in some regions. These different approaches illuminate the issue of whether regions inevitably share a common growth process (cf. Hoogstra et al., 2011).

Evidence for both views was found in Finland. The main result obtained with the traditional regional adjustment model showed that people largely followed jobs in Finland during the study period 1990-2010. The result accords with the results obtained in other Nordic countries (Østbye et. al., 2012) and with some other results, as the meta-analysis by Hoogstra et al. (2005) showed, but differs from many obtained, especially in the U.S. Specifically, as de Graaff et al. (2012, p. 61) state, there is evidence suggesting that the results obtained for the U.S. may be markedly different from the results obtained for other countries, especially in Europe (see also Ferguson et al., 2007). Many of the U.S. studies provide evidence of one-way interaction from population to employment. This is also the result of the meta-analysis by Hoogstra et al. (2005), in which many factors were controlled. There are, however, U.S. studies that have found contrary evidence. For example, Partridge and Rickman (2003, p. 96) concluded, using data on the lower U.S. 48 states for 1970-1998, that "people are slightly more likely to be following jobs rather than the converse" (see also Partridge and Rickman, 2006). Cebula and Alexander (2006) also found evidence for the 2000-2004 period that people followed jobs in the U.S.

The Finnish result may well reflect regional structures and developments characteristic of Finland. Due to higher productivity, agglomerations are needed. As a sparsely populated country, Finland can only have a few greater cities. The jobs created in these agglomerations play a dominant role in the migratory processes, while amenities play only a smaller role. Many Finns are obliged to move to the places where the jobs are. In this sense, people do not drive regional change.

Although the results obtained with the traditional regional adjustment model showed that people largely followed jobs in Finland during the study period, this was not the case in the early part of the 1990s, when Finland was hit by a severe recession and a great number of jobs vanished. During this crisis, there was no interaction between employment and population changes; people did not follow jobs, nor did jobs follow people. Conversely, the downturn that resulted from the financial crisis at the end of the period, which did not affect the labor market as severely as the deep depression in the 1990s, did not break the employment–population interaction; people still followed jobs. Concerning population and employment changes in the U.S. during the period of 1969 – 1994, Mulligan et al. (1999) showed similarly that the time period and different lags had an effect on the results obtained. In their results, neither population nor employment change was particularly stable during the time period. Mulligan et al. (1999), however, did not separate the periods according to economic fluctuations as was done in our analysis.

Interestingly, the results concerning the interaction between human capital and employment showed that highly educated people drive regional change. This was especially true during the period of rapid economic growth after the deep recession. This result also conforms to some of the results obtained elsewhere: workers with high levels of human capital in particular may be choosing where they live based on personal preferences and local amenities rather than on earning opportunities (Ferguson et al., 2007; Hoogstra et al., 2011; Brown and Scott, 2012). Østbye et al. (2012) analyzed the role of the creative class in regional growth processes and found that creative class jobs followed highly educated people in Sweden and Norway but not in Finland. Nonetheless, according to these results, less educated people followed highly educated people in Finland.

Our results from the Granger analysis widened the picture of the nature of regional growth in Finland by supporting the assumption that the causal processes are not uniform across regions. Concerning the U.S., Mathur and Song (1995) showed in their analysis that population tends to precede employment in the snowbelt region, while the opposite is true in the sunbelt region. Freeman (2001) found strong evidence that employment Granger-causes population using individual state, region, and national U.S. data but also found that population Granger-causes employment using a pooled sample of all the states. Our finding was that regional growth is supply induced for large and dynamic urban regions. This result at least to some degree parallels the conclusions obtained, for example, in Canada (Ferguson et al., 2007) and the Netherlands (Hoogstra et al., 2011). People are attracted to these urban areas, with the multifaceted opportunities and cultural and other locally produced amenities that only they can offer. Migration responds to personal preferences, particularly to locally produced amenities, lifestyles, and other quality-of-life improvements in the spirit of "Bright Lights, Big City". The strong concentration of people in the major centers also attracts jobs to these regions. Migration of people to these areas increasingly results in higher productivity levels and greater economic growth.

6. Conclusions

To recapitulate the main findings from the study, we can divide them into three parts:

1. People largely followed jobs in Finland during the study period. There was, however, temporal variation in this phenomenon due to economic fluctuations: people did not follow jobs, nor did jobs follow people, during the exceptionally deep recession in the early part of the 1990s.
2. Jobs followed highly educated people in Finland. This result also includes temporal variation. During the deep recession in the early part of the 1990s, the interaction between human capital and jobs was the reverse, and in the last sub-period, after the financial crisis, the interaction ceased to exist.
3. Regional growth in Finland was supply induced for large and dynamic city regions.

A straightforward interpretation of our results is that major centers offer amenities that particularly attract highly educated people. Jobs follow them, while less educated people follow jobs. Ultimately, population and employment growth drive one another. The result is a Myrdal-type process of cumulative causation, a process that has taken place in Finland and in many other industrialized countries.

Our results confirm the finding obtained in different countries that regional growth processes are complicated and may take different forms in different economic environments. Rather than yes/no, the answer to the question of whether people follow jobs or jobs follow people can be multifaceted and dependent on the time period and the development level of the economy.

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Appendix: A description of the methods

Regional adjustment model

Regional adjustment models are partial adjustment models in which it is presupposed that population and employment levels are constantly adjusting themselves toward an unknown spatial equilibrium (Mulligan et al., 1999; Carruthers and Mulligan, 2007). Following Carruthers and Mulligan (2007), a general form of the adjustment model can be expressed mathematically as follows:

$$\Delta y_t = (y_t - y_{t-1}) = \lambda_y(y^*_t - y_{t-1}) \qquad (1)$$

where $t-1$ and t denote two successive points, y_t represents an observable variable that adjusts toward equilibrium over time, y^*_t represents the equilibrium level of that variable, and λ_y represents a positive fractional parameter between zero and one.

The observed level of y lies somewhere between y^* and y_{t-1} because it can be described as the weighted average of the equilibrium level and the previous level of the variable:

$$y_t = \lambda_y y^*_t + (1-\lambda_y)y_{t-1} \qquad (2)$$

In regional adjustment models, population and employment are described as functions of one another. This conceptualization creates a system of two simultaneous equations in which the population change between times t and $t-1$ is modeled as a function of the employment at t and the population at $t-1$ and *vice versa*:

$$p_t = a_o + a_1 e_t + a_2 p_{t-1} + \varepsilon_{pt} \qquad (3)$$

$$e_t = \beta_o + \beta_1 p_t + \beta_2 e_{t-1} + \varepsilon_{et} \qquad (4)$$

where: p and e represent population and employment; a_o, a_1, a_2, β_o, β_1, and β_2 represent parameters; and ε_{pt} and ε_{et} represent stochastic error terms. The equations are specified in multiplicative form to characterize the nature of the growth process. From this follows a log-linear specification in terms of growth rates of regional population and employment, which contributes to the stability and stationarity of the model results (cf. de Graaff et al., 2012):

$$\ln(p_t/p_{t-1}) = a_o + a_1 \ln e_t + a_2 \ln p_{t-1} + \varepsilon_{pt} \qquad (5)$$

$$\ln(e_t/e_{t-1}) = \beta_o + \beta_1 \ln p_t + \beta_2 \ln e_{t-1} + \varepsilon_{et} \qquad (6)$$

The estimates for a_1 and β_1 determine the nature of the employment–population relationship: if both are positive and significant, this suggests a dual or bidirectional causality (people follow jobs and jobs follow people); if only a_1 is positive and significant, the causality runs from employment to population (people follow jobs); if only β_1 is positive and significant, the causality runs from population to employment (jobs follow people).

In many studies, population and employment levels have been transformed into densities by using the appropriate areas for the regions (e.g., built-up areas) considered. In this study, these transformations have not been used. As Mulligan et al. (1999, p. 857) stated, there is no a priori reason to expect that estimates based on levels will resemble estimates based on densities because the two approaches represent entirely different conceptualizations of the space economy. Some studies that have used the Carlino-Mills framework have also included three or more dependent variables in systems of simultaneous equations (e.g., Carruthers and Mulligan, 2008; Vermeulen and van Ommeren, 2009).

Because the system includes endogenous variables, regional adjustment has typically been estimated using two-stage least squares regression or other appropriate models to arrive at unbiased estimates. To solve the fundamental problem of the endogeneity of both factors, instrumental variables have been utilized to estimate employment and migration equations simultaneously. Finding appropriate exogenous identifying instruments can, however, be problematic. The tradition has been to use $t-1$ observations to form instrumental variables in the estimation process. For the sake of comparison, this tradition is also followed in this study. The issues of instrument weakness and validity have not received much attention in the literature on regional adjustment models (for the critique, see Rickman, 2010; see also Carruthers and Vias, 2005; Vermeulen and van Ommeren, 2009).

A Granger causality analysis in heterogeneous panels

The second approach is based on the Granger causality method and employs a time-stationary VAR representation adapted to a panel context (Hurlin and Venet, 2001; Hood et al., 2008; Tervo, 2009). For each region *i* (*i* = 1,…, N) and time period *t* (*t* = 1,…,T), we have:

$$y_{i,t} = \sum_{k=1}^{p} \gamma^{(k)} y_{i,t-k} + \sum_{k=1}^{p} \beta_i^{(k)} x_{i,t-k} + v_{i,t} \qquad (7)$$

where $v_{i,t} = a_i + \varepsilon_{i,t}$ are *i.i.d.* (0, σ_ε^2) and p is the number of lags. The regressors are lagged values of the dependent variable $y_{i,t-k}$ and lagged values of the independent variable $x_{i,t-k}$, both for all regions. Alternately, both changes in employment and population are used as dependent and independent variables. The autoregressive coefficients $\gamma^{(k)}$ and the regression coefficient slopes $\beta_i^{(k)}$ are assumed constant for all the lag orders k ε [1, p]. It is also assumed that $\gamma^{(k)}$ is identical for all units, whereas $\beta_i^{(k)}$ is allowed to vary across individual cross sections. This is a panel data model with fixed coefficients.

Employing conventional Granger tests with panel data is not unproblematic. These problems may be caused by heterogeneity between the cross-section units (regions). The first potential type of cross-section variation is due to distinctive intercepts. This variation is addressed with a fixed effects model in which heterogeneity is controlled by the introduction of individual effects a_i. Another basis for heterogeneity is caused by heterogeneous regression coefficients $\beta_i^{(k)}$. This situation is more problematic than the first and requires a more complex analytical response. In model (7), the general definitions of causality imply testing for linear restrictions on these coefficients. The procedure has three main steps related to the (I) homogeneous non-causality, (II) homogeneous causality, and (III) heterogeneous non-causality hypotheses.

The homogeneous non-causality (HNC) hypothesis implies the non-existence of any individual causality relationships: for all *i*, *x* does not cause *y*. To test *Np* linear restrictions, the following Wald statistic is computed:

$$F_{HNC} = \frac{(RSS_2 - RSS_1)/Np}{RSS_1/(NT - N(1+p) - p)} \qquad (8)$$

where RSS_2 denotes the restricted sum of the squared residuals obtained under H_o, and RSS_1 corresponds to the sum of the squared residuals of model (7). If the individual effects a_i are assumed to be fixed, the sum of the squared residuals is obtained from the maximum likelihood estimation (MLE), which in this case corresponds to the fixed effects (FE) estimator. Accordingly, the testing procedure can be implemented using the constrained regression technique (Hurlin and Venet, 2001; Hood III et al., 2008). Interpretation of the statistic relies on the Fischer distribution with *Np* and $(NT - N(1+p) - p)$ degrees of freedom.

If the HNC hypothesis is rejected, the next step is to test the hypothesis of homogeneous causality (HC): for all *i*, *x* causes *y*. The F_{HC} test statistic is calculated using the sum of the squared residuals from the unrestricted model described above (RSS_1) and the sum of the squared residuals (RSS_3) from a restricted model in which the slope terms are constrained to equality for all of the panel members in the sample. Thus, the test statistic is:

$$F_{HC} = \frac{(RSS_3 - RSS_1)/p(N-1)}{RSS_1/(NT - N(1+p) - p)} \qquad (9)$$

As in the case of HNC, if the individual effects a_i are assumed to be fixed, the ML estimator is consistent with the FE estimator.

Rejection of the HC hypothesis implies that the data-generating process is non- homogeneous and that no homogeneous causality relationships can be obtained. It may, however, still be possible that for one or more cross-section units, i.e., regions, causality relationships exist. Consequently, the third step is to test the heterogeneous non-causality hypothesis (HENC): for a subgroup of regions *j*, *x* does not cause *y*. The F_{HENC} statistic is calculated using RSS_1, obtained above, in addition to the sum of the squared residuals (RSS_4) from a model in which the slope coefficients for the panel members *j* in question are constrained to zero:

$$F_{HENC} = \frac{(RSS_4 - RSS_1)/(n_{nc}p)}{RSS_1/(NT - N(1+p) - n_c p)} \qquad (10)$$

where n_{nc} is the number of regions in subgroup *j* and n_c is the number of regions not belonging to subgroup *j* (for which β is not constrained to 0).