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COMMUTING AS A RURAL GROWTH STRATEGY?

Evidence from Sweden

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Abstract

The aim of this paper is to examine the extent to which rural regions benefit from closeness to large cities. It is often argued that rural regions can enjoy urban-based growth through urban sprawl, i.e. deconcentration of urban activities to rural regions. Analyses of rural regions in e.g. Canada show that thriving and prosperous regions (in terms of employment and population growth) often are located within commuting distance to urban centers (e.g. Partridge et al 2010). This suggests that one mechanism behind these patterns involves the process of people moving to the countryside while working in the city (Betrand & George-Marcelpoil 2005), which put rural-to-urban commuters at the center of attention (cf. Goetz et al 2010). Even if this type of commuting flows are prime examples of rural-urban integration and a main way in which rural regions may enjoy urban spread effects, there are few analyses that directly examines rural-to-urban commuting (Partridge et al 2010). In this paper, geographical distances are also calculated to reveal how far the impact from cities (of different sizes) reach. This is done for different parts of the working population, divided by education and type of occupation.

It is shown in the paper that rural population growth is a (the) key determinant behind rural-to-urban commuting, thus indicating that rural regions benefit from being close to urban regions. Moreover, the critical distances of urban spread effects point toward that regions with highly educated and workers in knowledge occupations more easily experience spread effects.

Keywords

urban sprawl, urban spread effects, deconcentration, rural-to-urban commuting, rural-urban interdependence

1. INTRODUCTION

Geographical regions differ and there exist several types of rural regions. Population and employment growth may spur in one rural region, while it is declining in another. Some rural regions are in geographical proximity to urban centers, while others are more distant. Against this background, the aim of this paper is to examine the extent to which rural regions benefit from closeness to large cities. It is often argued that rural regions can enjoy urban-based growth through proximity to large cities due to deconcentration of urban activities to rural regions. Analyses of rural regions in e.g. Canada show that thriving and prosperous regions (in terms of employment and population growth) often are located within commuting distance to urban centers (e.g. Partridge *et al* 2010). This suggests that one mechanism behind these patterns involves the process of people moving to the countryside while working in the city (see e.g. Bertrand and George-Marcelpoil 2005), which put rural-to-urban commuters at the center of attention (cf. Goetz *et al* 2010). Even if this type of commuting flows are prime examples of rural-urban integration and a channel through which rural regions may enjoy urban spread effects, there are few studies that directly examines rural-to-urban commuting as a mean for rural development (Partridge *et al* 2010). As a matter of fact, many key issues are not fully analyzed. For instance, what are the critical distances for urban spread effects through rural-to-urban commuting? To what extent do they differ across different categories of the labor force? In this paper, these questions are examined using detailed Swedish longitudinal matched employer-employee data.

The method used in this paper is built upon Partridge *et al* (2010). First of all, a job-growth equation is performed in order to determine if rural-to-urban commuting positively impact rural-job growth. This is a prerequisite for further analysis and once it is established that commuting has a positive impact on rural employment growth a rural-urban commuter regression is performed. Two contending hypotheses are examined in the commuter regression. These are (1) the rural restructuring and (2) the urban deconcentration hypotheses. The rural restructuring hypothesis (1) states that spatial changes in rural employment opportunities cause changes in rural-to-urban commuting (Partridge *et al* 2010: Renkow and Hoover 2000). Increased work opportunities at individuals' dwelling place likely decrease commuting to urban regions since people preferably avoid travelling time, congestion costs and inconveniences that commuting entails (Swedish Board of Agriculture 2013). When rural restructuring applies, (positive) rural job growth is the driving factor of (negative) rural-to-urban commuting. Thus, one part of focus in the commuter regression is the effect of rural

employment growth on rural-to-urban commuting. The urban deconcentration hypothesis (2) focuses on population movements from urban regions to its rural surroundings (Renkow and Hoover 2000). Advocates of the urban deconcentration hypothesis interpret rural-urban population dynamics in terms of individuals' preferences for housing and living (Renkow and Hoover 2000). For instance, urban congestion and high crime-rates may incline individuals to leave urban areas in search for better living conditions at the countryside (e.g. natural amenities and lower crime rates). When deconcentration of urban population to rural regions occurs, rural population growth will increase and work as the main force behind increases in rural-urban commuting given that the ex-urban dwellers keep their work on the urban labor market. This signals that urban spread effects exist. When the urban deconcentration hypothesis is considered in the analysis, the second part of focus is on the effect of rural population growth on rural-to-urban commuting.

The findings in this paper suggest that that regions in proximity to urban centers experience positive spread effects from closeness to cities. Evidence shows that rural population growth derived from large cities and metropolitans is a key determinant behind rural-to-urban commuting and thus the deconcentration hypothesis applies. Using the methodology developed by Partridge *et al* (2010), the paper also estimate how distance to nearest urban center influence commuting patterns; as a way to capture the rural-urban interdependence. A novelty in the analysis is that critical distances where urban spread effects for rural regions cease are estimated for different parts of the labor force with respect to education level and occupation. The main results show that regions with highly educated individuals experience urban based growth over larger geographical distances than regions with less educated labor. In the case of urban spread effects related to different occupations, regions with a knowledge-intensive workforce experience spread effects farther away than other less knowledge-intensive regions. In all, regions with highly educated individuals experience urban-based growth farther away than any other type of region. As a robustness test, all calculations are performed with two different centroid measures. One is based on centroid distances in kilometers while the other is based on centroid driving time in minutes, in both cases the centroid is measured from the regions' most populated areas. The main results in the paper are not dependent on which of the measures that are used.

The main contributions to the research field of this paper are as follows. First, most studies on urban deconcentration and its effect on its rural surroundings focus on countries such as

China, Canada and the United States (e.g. Chen and Partridge 2013; Partridge *et al* 2010; Partridge *et al* 2007; Partridge *et al* 2008; Renkow and Hoover 2000). The geographical landscape in these countries is characterized by the existence of growing and large cities exhibiting strong impact on its surroundings (Demographia 2014; Partridge *et al* 2010). The Sun Belt in the United States is one example of a belt of cities that experienced high growth for a long time (Pacione 2005). Countries' geographical landscapes differ and countries not necessarily have belts of growing cities or even have strong growing metropolitans. The size of metropolitans differ in terms of area and in population density, thus, viewing research findings as general from studies that focus on countries with large and multiple metropolitans could be severely misleading in other contexts. Seemingly, there is a need for this research applied to countries with fewer large cities. Second, the data material used in this paper utilizes where individuals live, work, in which occupations they operate and what type of education they have. The ample data also enables the possibility to calculate breakpoints where urban spread effects to rural regions cease to exist, but foremost these breakpoints can be calculated for individuals by education and occupation. Acquiring such quantitative measures could be useful in assessing the impact cities have on its spatial surroundings and provide a basis for designing policies for governments and policymakers.

The disposition of the paper is as follows. In Section 2, rural-urban interdependence and rural-to-urban commuting are discussed. Different types of rural regions are discussed in a rural-urban continuum context. In Section 3, it is deliberated in terms of choices and constraints what factors impact individuals' commuting decisions. In Section 4 and 5, the data material and method used in the paper are presented, respectively. The essence of the paper is found in Section 6-8. In Section 6, descriptive statistics of regions are presented and discussed while in Section 7 the core analysis is performed. Finally, in Section 8, the results are summarized and discussed. Moreover, further research and related issues are discussed here as well.

2. THE RURAL-URBAN CONTINUUM AND RURAL GROWTH PROSPECTS

Rural regions can be seen as places composed of a mix of urban and rural elements along an economic and geographical continuum. (Irwin *et al* 2009). The degree of rural-urban integration decides whether rural areas experience positive or negative growth. The "most rural" regions, e.g. regions close to the rural extreme of the continuum, are characterized by long distances to larger cities (and the goods and services provided there), poor infrastructure and declining economic opportunities. Moreover, the labor market is limited due to the fact

that commuting is not always an alternative for rural inhabitants. As a consequence, these rural regions face difficulties attracting and retaining population (Polése and Shearmur 2006). This is also pointed out in Stockdale (2006): *'Rural depopulation [...] is primarily driven by the out-migration of young, often the brightest, adults'*. Therefore, what is left in rural areas are high concentrations of younger (aged 10-19) and older individuals (Eurostat 2013), as well as low-skilled workers, that contribute less to economic development. In European Commission 2012, migration of young people to urban areas is pointed out as one of the major barriers for rural development as well. As people leave, social expenditures are put under pressure since the working population drops over time and for sparsely populated regions, it becomes difficult to maintain the standard of infrastructure, health care facilities, the educational system and other public services (Delfman *et al* 2014). Furthermore, the loss of labor, their purchasing power and their contributions to the local tax base, may in the long run also impoverish the demand for goods and services in the rural economy. Remote rural regions are also disadvantaged since the rural economy has been subject to major restructuring changes, e.g. to changes from natural resource intensive industries through implementation of less labor-intensive techniques or by the loss of their land and labor cost advantages through the impingement of global firms to the market (Stephens and Partridge 2011). Another way in which rural regions may be disadvantaged is when investors and capital is attracted to urban growth poles and such investments is forgone in rural regions which deprives the local economy and has negative impact on rural residents (Partridge and Chen 2013).

On the other hand, rural regions with a high degree of urban elements, i.e. regions placed close to the urban extreme in the continuum, or those that can be considered as “least rural and most urbanized” regions, often find themselves in a appreciably situation. Urban areas work as centers of growth in countries (Bosma and Sternberg 2014) and regions with a high degree of urban elements (e.g. being in proximity to an urban area) tend to experience ‘spread effects’ inferred from urban growth. ‘Spread effects’ is the term used in the literature when urban agglomeration economies yield positive effects on its surrounding rural economies (e.g. Partridge *et al* 2007; Partridge and Rickman 2007). Agglomeration economies are only found in cities and in broad terms refer to benefits of having resources (firms, industries, individuals *et cetera*) within spatial proximity (Combes *et al* 2012; Bosma and Sternberg 2014). According to Rosenthal and Strange (2004), agglomeration economies generate strong linkages between industries and contributes to a diversified labor pool available for firms.

Firms can therefore employ workers from the same labor pool as their competitors (Combes *et al* 2012). For the worker, this means that agglomeration economies facilitate ‘job shopping’. Since firms are geographically agglomerated, workers easily can change job, going from firm to firm, in order to find a good job-match (Glaeser and Scheinkman 2000; Glaeser and Maré 1994; Mion and Naticchioni 2009). When rural dwellers get access to urban labor markets, a better match on the labor market is enabled. A functioning commuting system is therefore of uttermost importance for rural regions. The importance of rural-to-urban commuters for rural regions is emphasized as a mean for rural development in Partridge *et al* (2010): “*Commuting by rural dwellers is one of the means by which rural areas enjoy spread effects*”. Moreover, in agglomerated areas, services and goods are provided that not necessarily, or easily, are accessed from the countryside. Thus, it is often argued that regions with a high urban interdependence are more attractive than regions far away from large cities. Obviously, space and concentration matters and the significance of concentration was pointed out by Krugman (1991), where it was described as “*the most striking feature of the geography of economic activity*”.

A rough generalization is that people dwelling in rural regions with a high degree of urban interdependence *commute* to urban regions, while individuals in more remote and sparsely populated regions rather *migrate* to urban regions, something that is closely linked to the quality of commuting systems to urban areas. Seemingly, there are good reasons to invest in cities for governments. If cities grow, rural residents may automatically get access to large labor markets. Moreover, demand for goods increase as a consequence of urban growth. Firms may therefore locate in the urban surrounding areas (i.e. smaller cities or rural regions) in order to serve urban markets. Push-effects may also arise since urban growth brings congestion costs in large cities. Firms might be pushed to establish activities in urban surroundings to avoid such congestion costs. Thus, rural economies are benefitted in terms of rural work opportunities (Partridge and Chen 2013).

3. DECISIONS BEHIND RURAL-TO-URBAN COMMUTING

Partridge *et al* (2010) states that individuals in rural areas derives utility from consumption of traded goods, housing (e.g. quality and price), amenities (quality-of-life factors such as recreation possibilities and natural amenities) and leisure time (the number of hours a utility maximizing individual spend on leisure activities). Of course, individuals face constraints as well. For instance, individuals that prioritize leisure time likely spend less time working, thus

some income and consumption possibilities are foregone. Rural dwellers also face constraints in terms of wages, housing rents and prices on traded goods. Individuals in rural regions are confronted with different factors in their commuting decision as well. Rural-to-urban commuters face the same constraints as rural dwellers but with the addition of distance related restraints of commuting. According to the reduced form commuting function presented in Partridge *et al* (2010) the probability of finding and/or retaining employment at home (rural) and in the nearest urban center is part of the commuting decision. Moreover, time and distance costs related to work are included in rural-to-urban commuters' commuting decision as well. Distance intend to capture the infringement it has for the commuting individual on available hours of leisure time, work and primarily on commuting time (Partridge *et al* 2010).

According to Partridge *et al* (2010), as distance to urban centers increases, so do costs related to transportation (influencing wage rates and price of traded goods), and travelling time to work for individuals. Large urban centers provide rural residents the highest ordered goods and services, while urban centers in the lower end of the urban hierarchy not have the same possibilities to do so. The "urban hierarchy" (measured as the distance to nearest urban center and the incremental distance to a larger urban center) reflects the accessibility of higher order goods for rural dwellers and according to the engine of growth model, the impact on its surrounding increase with the size of the city (Partridge *et al* 2010). Rural residents far away from urban areas are constrained by remoteness, i.e. long travelling distances to a large city hamper the possibilities to access higher-order goods for rural inhabitants. In Partridge *et al* (2010), region specific factors for the rural dwelling area as well as for the closest urban center is taken into consideration in the commuting decision, e.g. if there exist a wealth of job opportunities at home, the incentives of commuting may vanish. In all, the determinants of rural-to-urban commuting decisions primarily are categorized as employment prospects in rural and urban regions, distance-related costs and also local factors (Partridge *et al* 2010).

4. DATA

The data material in this paper is created from Statistics Sweden's *Longitudinal Integration Database for Health Insurance and Labor Market Studies* (LISA). LISA contains all individuals (aged 16 years and older) in Sweden with a Swedish personal identity number. *Statistics Sweden* is using sources as the *Swedish Tax Agency* and from the *Swedish Civil Register*. When creating the data material used in this paper, data on micro level has been treated and collapsed to municipality level. To get a time coherent definition of municipality

codes (since these change over time), all municipality related data has been coded into 2009 years definition of municipalities. The data is further complemented with geographical information from the *Swedish Agency for Economic and Regional Growth* and the *Swedish Board of Agriculture*. The definition of rural and urban municipalities is derived from these sources.

To consider the effects of accessibility to higher-ordered goods a measure of where the rural municipalities exist in the urban hierarchy is included in the analysis. The urban hierarchy measure is created by employing definitions from the Swedish Board of Agriculture and put restrictions on the population size. To be considered as a large urban center, the population in the municipality must be at least 250 000 individuals. Three urban centers are discerned according to this definition – Stockholm, Gothenburg and Malmö. Medium-sized urban centers are considered as municipalities with at least 50 000 individuals but less than 250 000. Using this definition, there are 36 medium urban centers in Sweden.

In the LISA database, the data quality for younger individuals is limited. Younger people are often incorrectly registered as dwelling at their parent's place of living. In that case, younger individuals that in fact reside at the same place where they work, which possibly is far away from their parent's home, might incorrectly be considered as rural-to-urban commuters in the data material. Consequently, an upward bias arises for some regions, thus exaggerating the effects of commuting and proximity to urban centers. Even though the individual contribute to the economic base in the municipality where he or she is registered, such positive effects is not due to commuting but rather as a form of tax remittances to their parents' dwelling municipality. To overcome these data limitations, potential commuters aged 16-19 are excluded from the data material. In some sense, it is also likely that the working population is better described by individuals aged 20-64 since they probable are established on the labor market. Primarily, in order to capture the rural-urban interdependence, focus is on commuting workers that contribute to a dynamic labor market and increase rural ties to urban regions.

5. METHOD

The method used in the paper is as follows. As in Partridge *et al* (2010), a job growth regression (OLS) model is conducted. This is done in order to establish whether rural-to-urban commuting in fact benefit job growth in rural areas e.g. due to increased local spending of the commuters. Consequently, increased spending on goods and (maybe foremost) services

enhances the local labor market and create job opportunities. If this is the case, a rural development strategy may be to improve rural-urban commuting ties as a mean for rural development. If no relationship exists, rural-to-urban is not having a positive effect on employment in rural regions and other development strategies need to be considered.

As a second step, a commuting regression function is conducted. The intention of running the commuting regression is to conclude whether rural restructuring dominates the process of rural development or if the urban deconcentration hypothesis applies, or in other words: Are there spread effects from rural-to-urban commuting?

First, the job-growth regression is defined as:

$$\%JobGrowth_i = \alpha + \beta_1 Dist_i + \beta_2 Dem_i + \varepsilon_i \tag{1}$$

Second, the commuting regression is defined as:

$$\%Com_{ij} = \alpha + \beta_1 Dist_i + \beta_2 Dem_i + \beta_3 Econ_{ij} + \omega_i \tag{2}$$

Table 1: Dependent variables

Rural-to-urban commuters (in 2009) as	
i.	all individuals in working age 20-64 as a share of all workers (20-64)
ii.	highly educated individuals in working age 20-64 as a share of all workers (20-64)
iii.	low educated individuals in working age 20-64 as a share of all workers (20-64)
iv.	individuals in knowledge intensive occupations in working age 20-64 as a share of all workers (20-64)
v.	individuals in other occupations than (4) in working age 20-64 as a share of all workers (20-64)

In the job-growth regression (1), the dependent variable is job-growth between 2003 and 2009 in rural regions. In the commuter regression (2), there are five different variants of job growth considered, dependent on what is scrutinized. These are summarized in Table 1. By regressing job growth of different categories of the labor force on population growth, it is possible to examine to which extent these groups contribute to the deconcentration of urban activities (by education, see ii and iii in Table 1 and by occupation, see iv and v in Table 1). In Table 1, the dependent variables used in the analysis are found.

Table 2: Explanatory variables

Distance variables ($Dist_i$)
1a. Distance to nearest urban center (DNUC), in kilometers. 1b. Squared distance to nearest urban center, in kilometers. 1c. Incremental distance measure (additional distance to nearest urban center), in kilometers.
2a. Distance to nearest urban center (DNUC), in minutes. 2b. Squared distance to nearest urban center, in minutes. 2c. Incremental distance measure (additional distance to nearest urban center), in minutes.
Demographical variables (Dem_i)
Initial (rural) population in year 2003 Percentage share of workers in age 20-64, in year 2003 Percentage share of workers with secondary education or higher education, aged 20-64, in year 2003 Population growth in nearest urban center, during the period 2003-2006
Economic variables ($Econ_{i,j}$)
Rural population growth during 2003-2006 (all individuals) Rural job growth during 2003-2006 (all individuals) Interaction term between distance to nearest urban center (DNUC) and population growth in rural area i during 2003-2006 (i.e. $DNUC * PopGr_i$).

The explanatory variables in regression (1) and (2) are summarized in Table 2. The distance variables in $Dist_i$ is included in the analysis to examine rural municipalities' spatial locations in relation to urban centers. Distance to nearest urban center reflects the impact of how accessibility to higher-ordered goods (which are found in urban regions) influence commuting from rural to urban areas. The expected sign of the coefficient for this variable in the regression analysis is negative, thus reflecting that the more remote a rural region is from an urban center, the lower the commuting rate and less is the urban spread effects for such regions. The square of distance to nearest urban center is also included in the analysis to capture possible non-linearities in the data material. For instance, it could be the case that the distance effects attenuate, or rise, with rural remoteness. The incremental distance measure (additional distance to nearest urban center) found in the vector $Dist_i$ represent the additional distance from a medium-sized urban center to a larger urban center (the closest of Stockholm, Gothenburg and Malmö). The reasoning when including this variable is to examine if large urban centers have stronger impact on their surroundings than medium-sized urban centers

(c.f. Partridge 2010). The impact on commuting rates is expected to be negative for this variable, showing that regions with high incremental distance to large urban centers are less well-off than those in proximity to metropolitans.

The vector Dem_{it} contains demographic variables such as the rural population size and the share of individuals with higher education. Moreover, employment related information and past commuting rates among rural residents are included in the subsequent regression analysis. To be able to understand the dynamics behind rural-to-urban commuting, information on past events in the local economy also works as explanatory variables in the regression analysis. Local economies are dependent with its surrounding economies; therefore, population growth in nearest urban center is included as a proxy for surrounding economic growth. An advantage with using explanatory variables based on earlier years is to avoid endogeneity problems (for instance to avoid simultaneity issues). The variables related to economic conditions is found in $Econ_{ij}$. As can be seen in Table 2, all regressions are performed with both time and distances in kilometers (separately). This is partly done as a robustness test but also to obtain indications of whether distance in kilometers and time have different impacts on commuting. The variables of main interest in the analysis are found in the $Econ_{ij}$ vector. If urban deconcentration to rural areas prevails, the rural population growth has significant effect on rural-to-urban commuting. If this coefficient is positive, urban spread effects exist. On the other hand, if the rural employment growth is negatively significant, the restructuring hypothesis applies. If both are significant, it is assessed that both deconcentration and rural restructuring occurs at the same time (c.f. Partridge *et al* 2010).

Income variables are not included in Table 2 and the commuting regression due to the fact that out-commuting from rural regions affects the labor supply and in turn, this influence wages (noted in Partridge *et al* 2010). Similar issues arise for housing costs, proximity to urban regions influence house prices positively and there for housing costs are excluded from the analysis. The idea in Partridge *et al* (2010) is that distance pick up most of these effects (wages and house costs) since distance is one of the most important factors behind rural-to-urban commuting decisions.

The critical distances where urban spread effects cease to exist reveals something about the geographical magnitude of the potential spread effects from rural regions urban surroundings.

In order to calculate the breakpoints, Equation (2) is set to zero and partial derivatives are taken with respect to population growth yielding:

$$\frac{\partial}{\partial \text{PopGr}_i, 2003-2006} \%Com_i = \delta + \theta_1 \text{PopGr}_i + \theta_2 \text{DNUC} * \text{PopGr}_i \tag{3}$$

$$\text{DNUC} = - \frac{\theta_1}{\theta_2} \tag{4}$$

Equation (3) and (4) are only calculated when the coefficients are significant from the commuting regression.

6. DESCRIPTIVE ANALYSIS

Figure 1 shows percentage commuting share of rural working individuals in rural regions by distance to nearest urban center. As expected, commuting from rural regions close to cities or metropolitans is more frequent the closer these are located an urban center (of any size). The tendency to commute to urban areas decline at the distance of 65-90 kilometers. The commuting share of working individuals is relatively low and constant for rural regions located 90-115 kilometers and beyond. As Figure 1 reveals, the closest rural region to an urban center is about 15 kilometers away while the most remote region is located more than 265-270 kilometers away from an urban center.

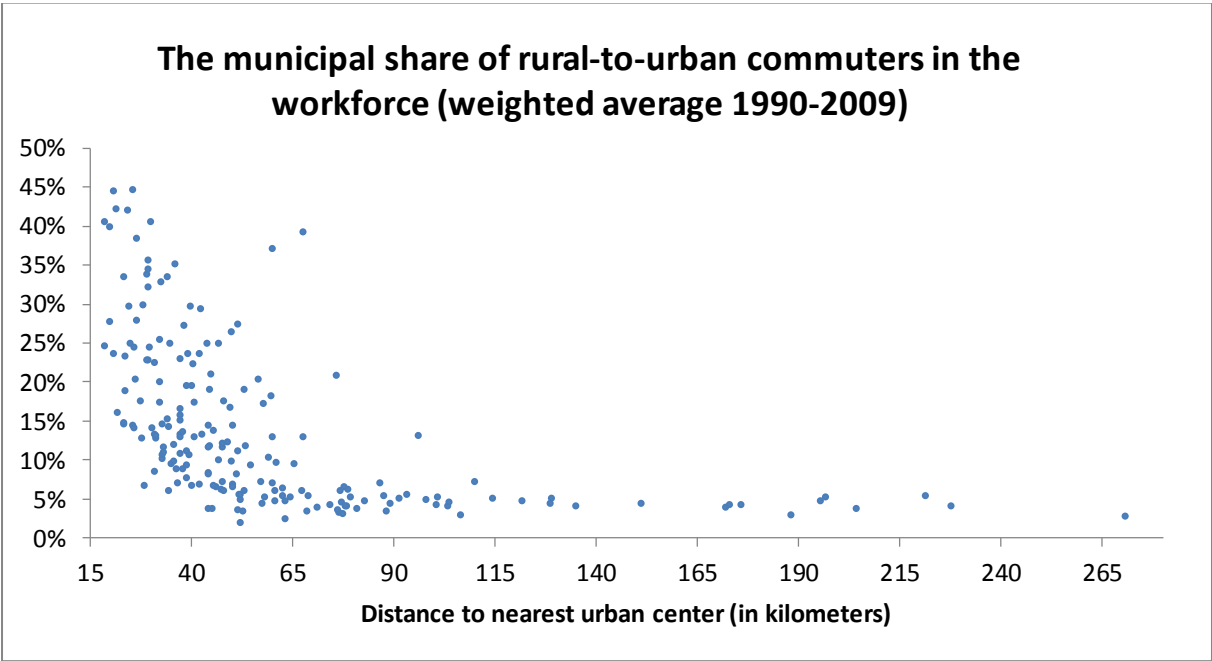


Figure 1: The share of rural workers commuting to urban areas, weighted average 1990-2009. Each dot in the diagram corresponds to a Swedish rural municipality.

Earlier research and empirical observations show that rural regions close to urban areas experience high growth rates in population and employment due to agglomeration economies in cities and metropolitans. In Figure 2, growth rates between 2003 and 2009 are shown for population (all ages) and employment (individuals in working age, 25-64 years old). In Figure 2 red dots represents municipalities that are classified as urban according to the definition used in the paper, while green figures represent municipalities classified as rural by definition. In Sweden, there are 290 municipalities which of 197 are classified as rural and 93 as urban (of which 39 are excluded in Figure 2 due to that these comprise the urban centers considered). The general pattern, with respect to population as well as employment growth is that rural regions have experienced lower growth rates during 2003-2009.

Municipalities close to urban centers often have performed well in terms of both population and employment growth during the examined period of time. Few urban municipalities have experienced negative population growth, while the opposite is true for municipalities classified as rural. In fact, in 2009, most rural municipalities experienced a loss in population compared with 2003. Interesting, but not very surprising, is the decay in population growth the more remote a municipality is from an urban center. This reflects that closeness to an urban center may be advantageous for municipalities due to agglomeration economies and urban deconcentration. Without drawing any conclusion or involve any causal interpretations, population increases in urban-adjacent rural municipalities could be due to people moving to the countryside from the city. When scrutinizing the employment growth in Figure 2, a similar pattern is seen as in the population development: some rural regions exhibit high growth rates in employment growth between 2003-2009 even though these are remote from dense urban centers. One plausible explanation could be that these municipalities which stand out rely on the local economy to a larger extent (i.e. rural restructuring) than rural regions that are worse of in terms of employment growth. For instance, it could be that some certain municipality has a strong industry where locals work. One such example is strong tourism activities.

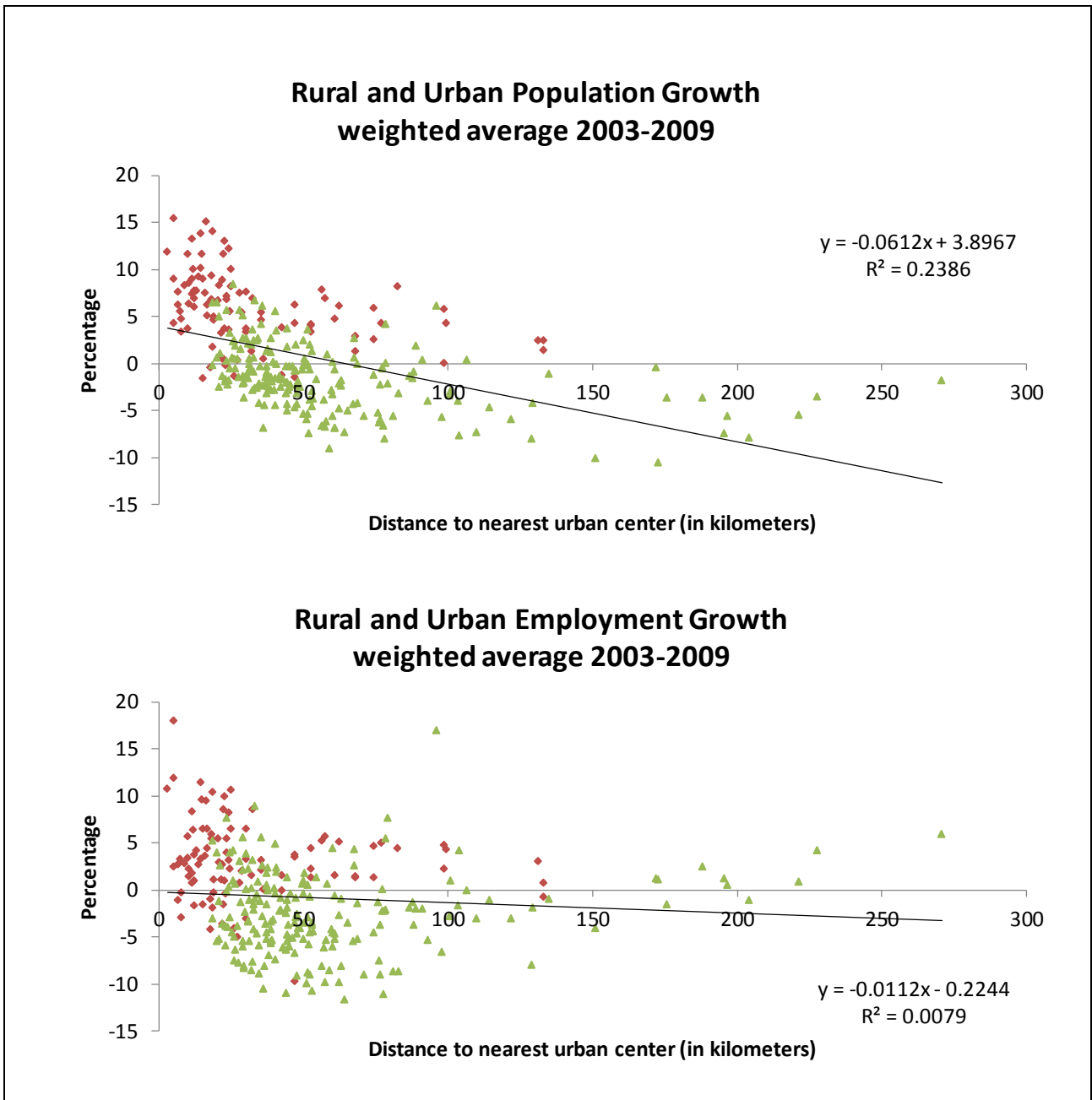


Figure 2: Growth rates by distance in (a) Population and (b) Employment during 2003-2009. Red dots represent urban municipalities while the green figures represent rural municipalities according to the definition used in the paper.

The upper part of Figure 3 depicts ratios between high and low educated individuals in rural regions by distance. Municipalities close to urban centers in general have higher ratios of high and low educated workers. In the “best-performing” municipality, which is urban by the definition used in the paper, there are 1.8 highly educated workers by each low educated worker. In fact, in several urban regions the ratios are larger than or close to a one-to-one relationship even though most observations are found around 1:2. This is certainly not the

case for rural municipalities, the relationship is clearly different. Most of the rural municipalities almost have a 1:3 relationship, i.e. one highly educated worker for each three low educated. In fact, on average, the ratio of high educated workers by each low educated worker is 0.289 (i.e. selecting 1000 rural workers, on average 289 have high education while the others are low educated). The corresponding figure for urban municipalities is 0.56 which is almost twice the rural ratio.

The lower part of Figure 3 shows ratios with respect to occupation rather than education. Similar patterns as for education can be discerned. Some municipalities have high ratios of workers in knowledge intense occupations while the opposite is true for other occupations. Urban municipalities in general score higher in both education and occupation ratios than rural municipalities. The average ratio for urban municipalities is 1.073 and 0.494 for rural. The intuitive explanation is that education and more qualified occupations are correlated. Higher occupations often require higher degree of education, even if this not necessarily is the case. Moreover, the ratios in Figure 3 decrease with distance. This is expected since universities, qualified occupations and other elements that attract highly educated and qualified workers are found in cities and metropolitans. Hence, such individuals are more likely to be dwelling and working in or close to urban centers.

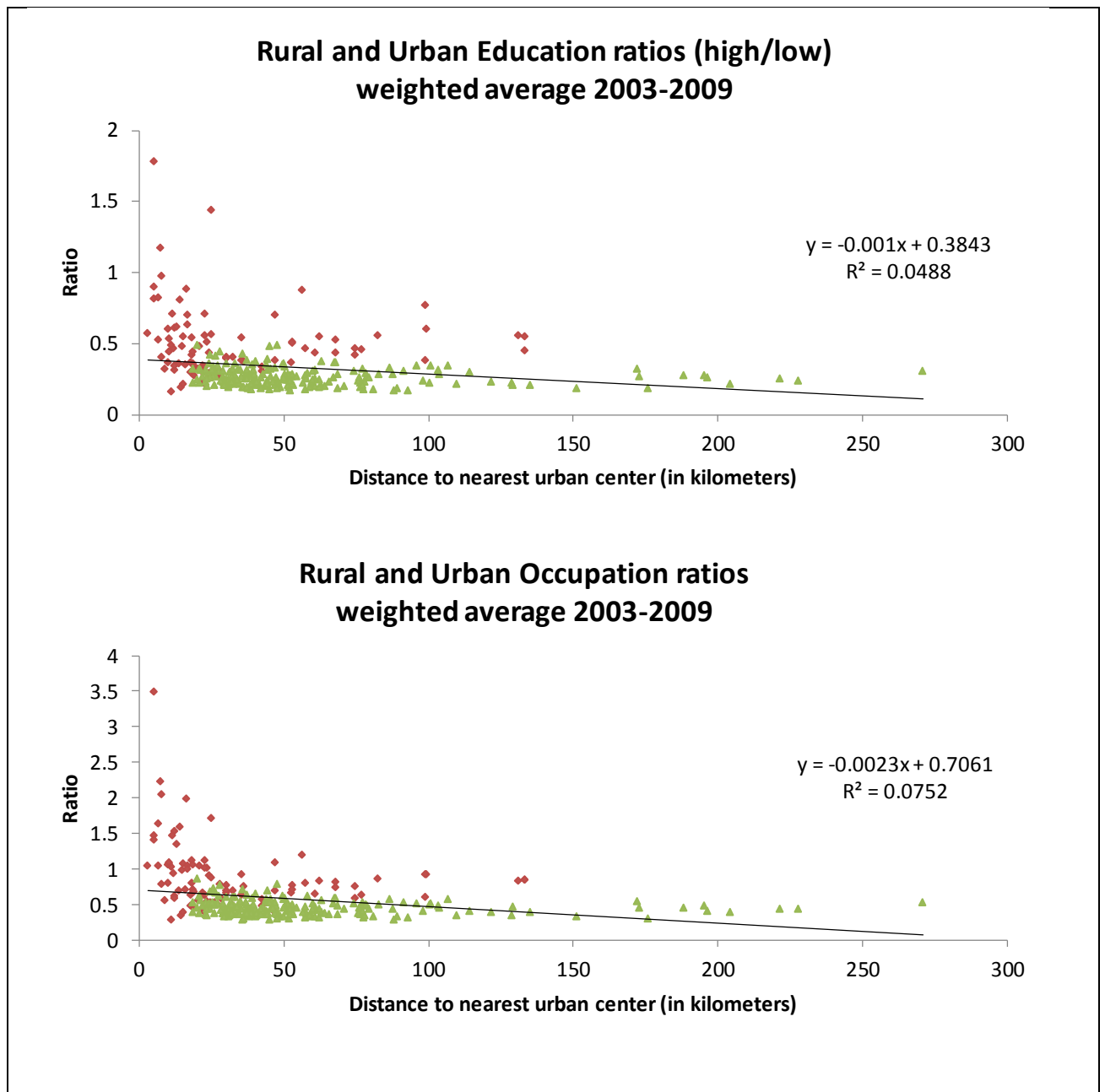


Figure 3: Ratios of (a) high and low educated workers and (b) workers in knowledge intensive (i.e. requires special competence or higher education) occupations against those with occupations with lower requirements. Red dots represent urban municipalities while the green figures represent rural municipalities according to the definition used in the paper.

7. EMPIRICAL ANALYSIS

7.1 Commuting as a way to increase regional job growth?

The job-growth regressions are reported in Table 1. The main conclusion is that there exist a positive relationship between past out-commuting rates and future job growth. In other words, out-commuting in 2003 seems to have a positive impact on future job growth in rural regions, thus, indicating that rural-to-urban commuting can work as a tool for rural development. These results hold irrespective of distance measure used.

TABLE 1: Rural job-growth regression

Dependent variable (Rural job growth, 2003-2009)		
VARIABLES	Distance (Kilometers)	Time (Minutes)
Distance to nearest UC	0.0266 (0.0283)	0.0896*** (0.0179)
Squared distance to nearest UC	3.23e-05 (0.000108)	-0.000197*** (4.69e-05)
Incremental distance to nearest large UC	0.00334 (0.00221)	0.00320 (0.00240)
Share of population, age 20-64 (2003)	0.288 (0.267)	0.420* (0.238)
Population (2003)	0.108*** (0.0336)	0.108*** (0.0333)
Population growth in nearest UC (2003-2006)	-0.138 (0.346)	-0.00218 (0.361)
Out-commuting (2003)	0.159*** (0.0325)	0.183*** (0.0301)
Constant	-24.68 (15.33)	-34.72*** (13.13)
Observations	197	197
R-squared	0.288	0.294

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Distance to nearest urban center is insignificant when considering estimates when distance measured in kilometers is used. However, when considering distance measured in minutes, there is a positive relationship between rural job growth and distance to nearest urban center. On average, regions located 10 minutes far away from an urban center experience an approximate 1 % increase in job growth (0.896%). It is fairly reasonable that distance to nearest urban center has a significantly positive effect on job-growth in rural regions since rural municipalities, adjacent to urban regions, may experience a loss of workers to cities; the more adjacent a region is, the higher the loss of labor. Or the other way around, the more remote a rural region is, less is the loss of labor to urban regions. Moreover, the positive sign

of distance to nearest urban center can be said to capture a potential bedroom community effect¹. Another possibility is that other effects that promote rural job growth, e.g. closeness to prosperous rural surroundings (in terms of job opportunities) may positively influence the local economy.

Though, the essence from the job-growth regressions is that out-commuting to urban regions has positive effects on rural job growth. An increase with 1% in past out-commuting (2003) increases the local job growth during 2003-2009 with 1.59-1.83% (depending of which distance measure that is used). Rural regions with an additional 1000 individuals in 2003 experienced a 0.11% higher growth in employment during 2003-2009. Moreover, according to the estimates in Table 1, a higher share of population in working age (20-64) was beneficial when considering rural job growth. Overall, the results in the commuting regressions are robust. The coefficients and signs do not differ to any larger extent depending on which distance measure that is used. Different specifications of the model have been tested with no significant differences influencing the conclusions above.

7.2 Deconcentration of urban activities to rural regions or rural restructuring as the main driver of rural-to-urban commuting?

Next, regressions of rural-to-urban commuting on the variables introduced in the method part are discussed. Regressions for all workers are performed, as well as divided upon type of education and occupation, separately. These are named by number and letters where the letter represents whether distance by kilometers (a) are used or distance measured in time (b). For instance, in Table 2, regression (1a) corresponds to the sample where all workers are included and distance in kilometers are used while regression (1b) also includes all workers in the municipality but with distance measured in time instead. Accordingly, regressions (2a)-(2b) include highly educated workers from the municipalities with distance in centroid (a) and time (b), respectively. Regression (3a)-(3b) include low educated workers only. The same structure follows for subsequent regressions on individuals by occupations in Table 3.

¹ Bedroom communities comprise areas where people choose to reside in order to work in larger cities or metropolitans.

TABLE 2: Commuter regressions – All and by education type						
Dependent variable (rural-to-urban commuting share in 2009)						
VARIABLES	<i>Distance (Kilometers)</i>			<i>Time (Minutes)</i>		
	<i>All</i>	<i>High education</i>	<i>Low education</i>	<i>All</i>	<i>High education</i>	<i>Low education</i>
	<i>(1a)</i>	<i>(2a)</i>	<i>(3a)</i>	<i>(1b)</i>	<i>(2b)</i>	<i>(3b)</i>
Population growth (2003-2006)	2.601*** (0.734)	2.975*** (0.788)	2.389*** (0.702)	3.687*** (0.715)	4.295*** (0.735)	3.385*** (0.681)
Local job growth (2003-2006)	0.0511 (0.231)	-0.140 (0.158)	0.135 (0.211)	0.0570 (0.240)	-0.0607 (0.164)	0.112 (0.220)
Distance to nearest UC	-0.450*** (0.0466)	-0.569*** (0.0540)	-0.411*** (0.0445)	-0.503*** (0.0509)	-0.619*** (0.0567)	-0.462*** (0.0475)
Squared distance to nearest UC	0.00114*** (0.000174)	0.00153*** (0.000221)	0.00102*** (0.000164)	0.00112*** (0.000129)	0.00140*** (0.000148)	0.00103*** (0.000121)
Interaction term	-0.0300*** (0.00784)	-0.0267*** (0.00875)	-0.0297*** (0.00772)	-0.0463*** (0.00786)	-0.0488*** (0.00859)	-0.0440*** (0.00769)
Incremental distance to nearest large UC	0.00794 (0.00494)	0.00864 (0.00542)	0.00729 (0.00462)	0.0132** (0.00598)	0.0151** (0.00663)	0.0122** (0.00555)
Share of population, age 20-64 (2003)	0.372 (0.488)	-0.0103 (0.519)	0.525 (0.487)	0.159 (0.476)	-0.161 (0.518)	0.291 (0.472)
Population (2003)	-0.140* (0.0788)	-0.183** (0.0851)	-0.121 (0.0777)	-0.180** (0.0859)	-0.237** (0.0923)	-0.156* (0.0844)
Share of higher educated (2003)	0.766** (0.316)	0.919*** (0.341)	0.531* (0.310)	0.598* (0.315)	0.738** (0.343)	0.376 (0.308)
Population growth in nearest UC (2003-2006)	0.166 (0.797)	-0.321 (0.886)	0.365 (0.773)	-0.0351 (0.746)	-0.448 (0.815)	0.151 (0.728)
Constant	6.767 (27.09)	38.88 (29.11)	-2.560 (27.01)	23.22 (26.66)	51.40* (29.13)	14.73 (26.44)
Observations	197	197	197	197	197	197
R-squared	0.520	0.574	0.479	0.521	0.577	0.479

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

In Table 2, the share of rural-to-urban commuters in 2009 is regressed on a set of explanatory variables. In regression (1a) and (1b) all rural-to-urban commuters are included. For the sake of this paper, the coefficients for population growth, local job growth and those related to the distance measures are of most importance. In both (1a) and (1b) there is a strong tendency of urban depopulation effects on rural economies. The coefficients for population growth is 2.601 and 3.687; this indicates that regions with 1% higher population growth during 2003-2006 experience 2.601% and 3.687% increase in the share of rural-to-urban commuters in 2009. Thus, there is a tendency that urban inhabitants move to rural surroundings, thereby contributing to rural population growth. At the same time, these “new” rural dwellers keep working in the city and thus need to commute. There are however no signs of rural restructuring effects since the coefficients for rural job growth is statistically insignificant in all of the regressions in Table 2. When considering distance variables some interesting, but not surprising results are learnt. As distance to nearest urban center increase the share of individuals commuting to urban areas decrease. This negative relationship between out-commuting and spatial location of rural regions reflect that efforts for commuting are hampered with longer travelling distances to work, thus individuals choose to commute less. This is in accordance with theory presented in Section 5 and confirms what is found in other studies; see e.g. Partridge *et al* (2010) and Renkow and Hoover (2000). The positive sign of the squared distance variable however indicates that this relationship attenuates with distance. Moreover, the interaction term between distance to nearest urban center and rural population growth over 2003-2006 intend to capture the trade-off between distance and population related growth. Additionally, it reveals how rapidly population growth effects, on rural-to-urban commuting, diminish. The negative and significant association between the interaction term and the share of rural-to-urban commuters show that the degree of urban deconcentration is reduced with distance. The declining effect is somewhat stronger when distance is measured in minutes rather than in kilometers (compare -0.0300 and -0.0463). This indicates that distance in minutes probably is more important for commuters than the actual travelling distance in kilometers. For instance, having 100 kilometers to work but with a travelling time of 30 minutes is clearly more preferable (on average) than having 30 kilometers to work and a commuting time of 100 minutes.

The distance variable that reflects the position of the rural municipality in the urban hierarchy is positively significant (when considering distance measured in minutes; see Incremental distance to nearest large UC in Table 2). Larger cities and urban areas should exert more impact

on its surroundings than medium sized urban centers (according to the engine of growth model). However, the positive sign in regression (1b) indicate that this not seems to be the case. Rural-to-urban commuting appears to increase with additional distance (in minutes) from medium to large urban centers, which appears contradictory to theory. One explanation of this phenomenon might be that there exists a substitution effect. At some certain point, when distance to a large urban center becomes ‘too far away’, individuals that face commuting options to a large urban center may reconsider and instead deliberate commute to another but smaller urban place. Simply, it is no option to travel to work in larger urban centers after a certain distance. In fact, in that case, the variable captures effects of out-commuting to medium-sized urban center. Being too remote from a large city possible increase urban spread effects from medium-sized urban regions instead. When comparing the estimate of incremental distance to a large urban center with distance to any urban center, it becomes obvious that the substitution effect is relatively small. In sheer numbers, the negative effect of being remote from an urban center is almost 38 times stronger (the absolute value of $-0.503/0.0132$) than effects related to substitution from large to medium-sized urban centers.

Population growth in nearest urban center is considered to capture potential effects for a rural municipality to being adjacent to a well-growing urban region. Table 2 reveals that no such effect exists, neither when distance is measured in kilometers, nor in minutes. However, when turning to variables tied to the local economy in the past, i.e. population in 2003, share of highly educated individuals and individuals in working age (20-64), only the latter is insignificant (the share of working individuals in the past does have an impact on future commuting rates and potential spread effects from urban centers). Regions with an additional 1000 individuals in population in 2003, experience lower commuting shares in 2009 and therefore a larger population in the past hampers urban spread effects reaching the rural economy. One reason is that larger rural regions likely are more self-sufficient in terms of job opportunities et cetera. Hence, commuting to urban centers is not as important for more remote and possibly lagging rural municipalities. The opposite is true when share of highly educated individuals is considered; having an educated population in the past seems to be beneficial for rural regions. Highly educated individuals face at least two options how to participate on the labor market; (i) either to move to an urban region to find a job or (ii) begin to commute from a rural region to an urban workplace. According to the estimates, it is likely educated individuals necessarily commute in order to find a job. In other words, there is a need for accessing urban labor markets for individuals in such regions.

Turning to regression 2a-b and 3a-b in Table 2, where focus is on urban deconcentration derived from workers of different levels of education, similar conclusions as above are drawn but with slightly different interpretations. The estimates are of relatively similar size and it is the same coefficients of the most important variables that are significant as in the more general case (regression 1a and 1b). Urban spread effects brought to rural regions in terms of population growth are stronger when highly educated individuals commute in comparison with rural regions with low educated workers (compare $2.975 > 2.389$ and $4.295 > 3.385$ in regression 2a/3a and 2b/3b). In terms of distance, irrespective which measured that is used; regions with highly educated individuals suffer more from being remote to an urban center than regions comprised of low educated workers. In rural regions with highly educated individuals, an additional 10 kilometers from an urban center decreases the rural to urban commuting with 5.69%. The corresponding figure in regions with less educated workers is 4.11%. In minutes, an additional 10 minutes travelling time decreases the rural-to-urban commuting with 6.19 % and 4.62 % respectively. To summarize, highly educated individuals are more sensitive to constraints in distance than workers with lower education. The squared distance term(s) also reveals that distance influence out-commuting rates at a decreasing rate of change. Thus, the farther away from an urban center a rural region is, the less is the negative effects of remoteness in distance. For rural regions characterized by a low educated labor pool, the decreasing rate of distance on out-commuting is not as large (it comprise about 2/3 of the effect in more educated regions) as for regions comprising a highly educated labor force. Again, this is an indication of that highly educated individuals are more sensitive concerning commuting distances.

The interaction term between distance to nearest urban center and rural population growth is negative in regression 2a-b and 3a-b. When distance in kilometers is used (regression 2a and 3a), the declining impact of population growth on rural-to-urban commuting is stronger in regions comprising low educated workers compared to those with more educated workers. However, when considering estimates based on distance in minutes (regression 2b and 3b) the opposite is true. This reflects that highly educated individuals are more sensitive to travelling time in minutes in comparison with less educated workers (compare a decrease of 0.0488 with 0.0440 in out-commuting for each extra commuting minute). Therefore, the decline in urban deconcentration is more rapidly pronounced when highly educated individuals face additional commuting time to work than it is for less educated individuals. Additionally, both low and high educated individuals rather travel long distances in kilometers than spend more

commuting time (which was concluded above). However, for highly educated individuals, traveling 10 additional kilometers in front of 10 extra minutes yield a loss of rural-to-urban commuting of 0.221% $(-0.0488+0.0267)$. The corresponding figure for low educated individuals is 0.143% $(-0.044+0.0297)$.

The incremental distance to a large urban center is significant in the regressions where time distance is used as explanatory variable (regression 2b and 3b). The sign is positive, as in the general case of all individuals considered earlier, but the net effect is larger for regions with highly educated individuals. This suggests that the substitution effect from travelling to large urban centers to medium-sized urban centers instead is higher for educated individuals. Hence, in cases where commuting to a medium-sized urban region is more favorable than commuting to a large urban area such as Stockholm, Gothenburg and Malmö, highly educated individuals are more prone to choose the former alternative, possibly due to saving time et cetera.

In Table 3, a similar exercise as in Table 2 (regressions 2a-b and 3a-b) is performed but by occupation instead of educational level. Occupations are divided into two crude groups named (i) *knowledge occupations* and (ii) *other occupations*. As previously, regressions are performed with distance measured in time as well as in kilometers (compare regressions 4a-4b and 5a-5b in Table 3). According to Table 3, population growth has a strong impact on rural-to-urban commuting, demonstrating that urban deconcentration dominates the rural growth process. Moreover, it seems that urban deconcentration effects are stronger in regions with high shares of skilled workers (in knowledge occupations). Just as for all individuals and these divided by education, there seems to be no effect of rural restructuring since local job growth is insignificant. Distance to nearest urban center is insignificant when distance in minutes is considered. But when distance is measured in kilometers there are some signals that regions with knowledge workers experience a comparatively strong decline in out-commuting with increased distance. As distance increase, fewer skilled workers commute. This effect is smaller for individuals in other occupations. One hypothesis is that workers in knowledge occupations to a higher degree can choose to commute (otherwise, job opportunities exist elsewhere) while those working in other occupations to some extent are forced to do so (in order to have a job due to less opportunities to change job).

TABLE 3: Commuter regressions – By occupation				
Dependent variable (rural-to-urban commuting share in 2009)				
VARIABLES	Distance (Kilometers)		Time (Minutes)	
	Knowledge-based occupations	Other occupations	Knowledge-based occupations	Other occupations
	4a	5a	4b	5b
Population growth (2003-2006)	10.01*** (2.626)	4.689*** (1.344)	12.06*** (3.038)	5.919*** (1.558)
Local job growth (2003-2006)	0.352 (0.420)	0.210 (0.297)	14.89 (45.40)	-9.636 (34.71)
Distance to nearest UC	-1.436*** (0.156)	-0.670*** (0.0797)	-0.351 (0.261)	-0.159 (0.124)
Squared distance to nearest UC	0.00359*** (0.000544)	0.00167*** (0.000277)	-0.000467 (0.000727)	-0.000234 (0.000332)
Interaction term	-0.112*** (0.0281)	-0.0548*** (0.0147)	-0.112*** (0.0403)	-0.0540*** (0.0191)
Incremental distance to nearest large UC	0.0120 (0.0148)	0.0109 (0.00830)	-0.0141 (0.0186)	0.00385 (0.0104)
Share of population, age 20-64 (2003)	2.459* (1.466)	1.295 (0.933)	3.101* (1.701)	1.421 (1.021)
Population (2003)	-0.961*** (0.259)	-0.332** (0.134)	-1.116*** (0.278)	-0.395*** (0.143)
Share of higher educated (2003)	2.720** (1.070)	0.624 (0.557)	3.315*** (1.240)	0.908 (0.631)
Population growth in nearest UC (2003-2006)	1.680 (2.496)	1.162 (1.351)	3.578 (2.942)	1.724 (1.458)
Constant	-50.28 (81.42)	-27.49 (51.44)	-130.7 (97.35)	-55.05 (57.43)
Observations	197	197	197	197
R-squared	0.548	0.451	0.412	0.319

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The interaction between distance and population growth is significant in Table 3, irrespective of which distance measure that is used. The coefficients are almost identical in regression 4a-4b and 5a-5b. Thus, a 1 minute change has the same impact as a change by 1 kilometer. Increased geographical distance for regions with knowledge workers experience a more rapid decrease in population growth effects on rural-to-urban commuting, than regions with other workers. The rate of decrease is almost twice as fast for regions with knowledge based workers. One implication of this result is that knowledge workers possibly avoid long travelling distances (either in kilometers or in minutes).

7.3 Critical distances and boundaries of urban spread effects

In Table 4, critical distances where urban spread effects level off for different types of rural regions are calculated. The calculations are based on the partial derivatives of estimates in Table 2 (for all individuals and individuals by education) and Table 3 (for workers divided into two types of occupational groups).

TABLE 4: CRITICAL DISTANCES (in kilometers and minutes)

	Distance (kms)	Time (minutes)
All individuals	86,70	79,63
Individuals with higher education	111,42	88,01
Individuals with low education	80,44	76,93
Knowledge occupations	89,38	107,68
Other occupations	85,57	109,61

Table 4 reveals that there exist different types of rurality in Sweden. When consider rural regions as a homogenous group, without taking education structure or occupational composition in consideration, urban spread effects on average, reaches 86.7 kilometers from the population centroid of rural regions. However, when dividing rural municipalities by education, regions with highly educated individuals tend to experience spread effects for longer distances in comparison with regions characterized by low educated labor. Therefore, the extent to which rural regions experience spread effects depends on the composition of the working population. Two rural regions located at the same distance from an urban center not necessarily get urban based growth. For instance, a prerequisite to get urban spread effects for rural regions located beyond 86.70 kilometers (or 79.63 minutes), is that it is characterized by a well-educated workforce. Moreover, regions beyond 111.42 kilometers, or 88.01 minutes, not experience positive impacts of urban deconcentration. Likely, this is due to the fact that at

this point commuting is not a realistic alternative for many workers. The fraction of workers travelling longer distances probably are few and also exert small impact on the local economy in their dwelling municipality.

8. CONCLUDING REMARKS

The result in this paper shows that out-commuting from rural regions to urban places has a positive and significant impact on rural job growth. This suggests that rural-to-urban commuting may be one way in which rural communities can experience urban-based growth. Hence, the importance of a well-functioning commuting system is emphasized. Access to labor markets in cities and access to higher-ordered goods and services in urban economies are enabled for rural residents as well. It is however shown that distance (in minutes) to urban regions matters when it comes to rural job growth. There is a positive relation between rural job growth and changes in travelling time to urban places – as time distance to a city increases, the stronger the rural job growth. This finding suggests that more remote rural regions are more reliant on the local rural economy than on employment opportunities found in cities. This is partly strengthened by the fact that earlier population numbers in rural regions have a positive impact on rural job growth. Such result may also indicate that there is a loss of labor to cities and metropolitans over time for rural regions in immediate urban proximity. Urban adjacent rural communities may also serve as bedroom communities for cities and metropolitans and that such phenomenon decreases with distance to cities. Anyhow it is concluded that rural regions can benefit from rural-to-urban commuting and urban proximity. Once this was established, it was examined what factors that drive rural-to-urban commuting. The two contending hypotheses tested in the paper is that it either is (1) rural restructuring or (2) urban deconcentration that drive rural-to-urban commuting.

Strong evidence in this paper points to the direction that deconcentration of urban activities is a (or rather the) key determinant of rural-to-urban commuting. Thus, it is population movements from urban regions to its rural surroundings that increases rural-to-urban commuting. The underlying assumption in this paper is that individuals move from cities to adjacent rural regions, keep their work in cities and begin to commute. The results in the paper shows no tendencies of rural restructuring as a determinant of rural-to-urban commuting and it therefore not seems to be spatial changes in rural job opportunities that impact commuting from rural regions. For instance, if job opportunities “at home” arise for rural residents, individuals likely refrain from commuting and rather engage in an

employment in their dwelling municipality. The result of urban deconcentration as the main driver of rural out-commuting holds when any type of workers in the labor force are considered. Moreover, highly educated individuals and workers in knowledge occupations have larger impact on rural-to-urban commuting than their counterparts, low educated workers and individuals in other work, respectively.

When the estimates of the distance measures are taken into account several interesting results was found. The most obvious and least surprising result was that commuting to cities and metropolitans decreases the farther away potential commuters dwell. This reflects that the efforts and possibilities to commute are hampered with distance. This however occurs with a decreasing rate, i.e. rural regions more remote than others suffer less from the negative distance effect (even though this effect is negligible). Moreover, it is found that traveling time (in minutes) are more important than the actual traveling distance (in kilometers) in individuals' commuting patterns. This is particularly true for high skilled individuals and workers in knowledge occupations. The maybe most interesting finding in the paper is the existence of a substitution effect between working in a medium or large urban center (even though such effect in comparison is fairly small). The engine of growth model states that large cities should have a larger impact on its surroundings than their medium counterparts. However, no such results is found in this paper. It is however concluded that as distance to large urban centers become unmanageably long, people rather switch and commute to a smaller urban region. Thus, the conclusion in this paper is that cities in general, rather than large metropolitans, positively impact rural economies.

Last in the paper, critical distances of urban deconcentration for different parts of the working population are calculated. These represent the distances in kilometers and minutes where the spread from urban regions end, or equivalently, this corresponds to the commuting belt for different parts of the labor force. The results show that individuals with high education tend to travel for longer distances to work, possible due to incitements that low educated individuals lack; e.g. high wages, possibilities to work during commuting to work et cetera. Unfortunately, it is not possible to distinguish how often individuals travel to work from the data. For instance, highly educated workers may have the possibility to work from home and travel to work more seldom than low educated workers. In that case, the aggregate commuting time (over e.g. a work week) for highly educated rural-to-urban commuters are lower than for their low educated counterparts. Moreover, it is not possible to determine what means of

transportation that is used. It could be the case that the commuting belt for highly educated individuals reaches further because of more convenient ways of transportation. Interesting to note, when considering workers in different types of occupations, is that the commuting belt is not as widespread for individuals within knowledge occupations. A somewhat more reasonable result would be that the same relationship between knowledge workers and other workers holds as for high and low educated individuals. The main reason is since knowledge workers and highly educated individuals coincides well (i.e. these variables are likely highly correlated); workers in knowledge occupations often have high education while the opposite is true for workers in other occupations.

This paper implicitly assumes that there is a relationship between population growth and rural development and if population growth drives out-commuting this means that such growth can be derived from proximity to a surrounding city. However, there are some topics for further investigation. In fact, population increases that influence rural-to-urban commuting may be derived from many sources. In this paper, as well as in Partridge *et al* (2010) and Renkow and Hoover (2000), the population growth is not divided into different parts. One suggestion in order to trace and establish what part of the population that exactly drives rural-to-urban commuting would be to decompose the population into several parts (for instance by different age cohorts, occupations et cetera). For instance, it could be that most of the out-commuting from rural regions to urban regions is driven by the population comprised of younger children and individuals in childbearing age, which directs towards that the “new” rural-to-urban commuters comprise people who leave the city because of having children. With this approach, it is possible to derive where spread effects stem from.

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