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Exploring the Role of Unearned and Non-Wage Income on Regional Income Convergence

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Abstract: In the second half of the 20th century, regional income in the United States converged. Convergence was driven largely by neo-classical forces where capital flows from regions of high wages to regions of low wages in search of greater returns. The formal test for convergence, driven by the attractive and repulsive effects of wage levels, regresses changes in income against initial income levels. However, unearned and non-wage have become increasingly important components of income, yet their effects on the convergence process is largely unexplored. To add insight to their role in convergence, this paper deconstructs Per Capita Personal Income into its component parts – Wages and Supplements, Dividends, Interest and Rent, Transfer Payments, and Proprietor's Income – and tests for unconditional convergence among Metropolitan/Micropolitan areas across three time periods. Results suggest consistent convergence stemming from wages and significant, localized effects stemming from the unearned, non-wage income streams.

1. Introduction

Exogenous growth theory relates local economic growth to endowments and utilization of labor, capital, and an external technologic component (Solow, 1956; Swan, 1956). Assuming diminishing returns to capital and ubiquitous technology, the growth of regional economies will slow as they approach their steady state. With footloose, return-maximizing firms, there is an incentive for firms to relocate from regions approaching steady state levels to regions with greater potential for returns to investment. As firms (and capital) continue to relocate, levels of per capita income or output tend to converge across regions (Baumol, 1986; Barro and Sala-I-Martin, 1991; Islam, 2003). Convergence processes can be studied as *beta convergence*, where capital poor regions experience faster growth rates than capital rich regions, or *sigma convergence,* where there is a decrease in the standard deviation of per capita income or output over time. Further, *club convergence* occurs when differing convergence processes occur between regional economies grouped together based upon respective economic structures. Of these, beta convergence has been the most studied, with growing evidence of the theory (Galor, 1996; Drennan and Lobo, 1999). Convergence can further be framed as an *unconditional* process, where regional incomes or output convergence to a global mean regardless of local economic structure, or a *conditional* process, where differences in local economic structure are taken in to account and regional economies converge to their own steady state (Galor, 1996).

To test for unconditional convergence, initial income levels are typically regressed against income change (Sala-I-Martin, 1996). Inclusion of additional predictor variables turns the unconditional model into a conditional one (Galor, 1996). While there re-

mains an ongoing debate as to the mix and significance of conditioning variables, scant attention has been paid to the nuances of income itself (Austin and Schmidt, 1998; James and Campbell, 2014). As the key predictor variable in the convergence model income is implicitly tied to capital investment, and per capita income can be used as a measure of capital and labor productivity and utilization (Barro and Sala-I-Martin, 1991; Sala-I-Martin, 1996). More directly, as firms relocate or capital shifts from locations of capital surplus (and, in turn, high wages) to regions of capital deficit (and, in turn, low wages), the marginal product of labor increases, thereby inducing relatively fast rates of income growth. Therefore, a negative relationship between income levels and income growth rates is expected in converging economies (Barro and Sala-I-Martin, 1992; Sala I-Martin, 1996).

Income is comprised of earned and unearned, as well as wage and non-wage, components. Earned income typically takes the form of wages (W), supplements to wages (S), or non-wage proprietor's income (PI). Unearned income comes from sources such as Dividends, Interest, and Rents (DIR), and personal transfer payments (TP). While the wage components are most intuitively tied to convergence and exogenous growth, unearned and non-wage components of income can also significantly influence the growth rate of a region and operate with a different spatial pattern than earned, wage income (Austin and Schmidt, 1998; Campbell, 2003). The direct impact of unearned and non-wage income on the growth and convergence process has been relatively unexplored (Austin and Schmidt, 1998), though unearned and non-wage income has been included as an income component in a classical convergence analysis (e.g., Coughlin and Mandelbaum, 1988; Evans and Carras, 1996; Sherwood-Call, 1996; Austin and Schmidt, 1998; Rupasingha et al., 2002; Santopietro, 2002; Rapino et al., 2006; James and Moeller, 2013; James and Campbell, 2014) or excluded in part or whole (e.g., Barro and Sala-I-Martin, 1991; Sala-I-Martin, 1996; Austin and Schmidt, 1998; Higgins et al., 2002; Rapino et al., 2006). In the few studies that have examined unearned and non-wage income more closely (Austin and Schmidt, 1998; Rapino et al., 2006), their effects were never directly tested; rather convergence analyses were conducted including and excluding unearned income components from total income. These studies found that unearned income can influence the convergence process. However, the effects from the differing components of unearned income were never explicitly tested, nor were the analyses conducted at the national level. Meanwhile, even less attention has been paid to the role of non-wage proprietor's income, PI, in the convergence process. Clearly, a complete understanding of the impact of unearned and non-wage income on convergence and growth has yet to be rendered.

In order to more fully explore the role of earned and unearned, as well as wage and non-wage, income on regional income growth and convergence, this paper examines regional income convergence in the United States from 1970-2010 at the Metropolitan/Micropolitan Statistical Area level of spatial aggregation. Specifically, we address the following research questions: (1) Is unearned and non-wage income a significant factor in regional income growth and convergence? and (2) How do the factors of unearned and non-wage income influence income growth across (a) space, and (b) time? Per capita personal income (PCPI) is deconstructed into its component parts – wages and supplements (WS), DIR, TP, and PI – and unconditional convergence models are run for 1970-1990, 1990-2010, and 1970-2010. Initially we use global, Ordinary Least Squares (OLS) estimates to test for convergence of wages, the aggregate impacts of unearned income on growth, and spatial effects. Geographically Weighted Regression (GWR) is then applied to each time period to remedy spatial heterogeneity and identify the varying spatial relationships and significance of these factors.

This paper makes contributions to both the convergence and unearned, non-wage income literatures. An overarching contribution comes from the bridge between these literatures that this paper creates. While the impact of transfer payments on convergence is noted in a few convergence studies, the other components of non-wage and unearned income are not. This paper fills that gap by including all components of unearned, non-wage income in a convergence model. As such, identifying the impact of each income stream on the regional income convergence process is itself a novel contribution. Extending the contribution to the unearned, non-wage literature, the contribution originates from bringing these income streams in to the neo-classical framework at a national scale. Most studies examining these income streams are either descriptive (Manson and Groop, 1988; 1990; Debbage et al., 2014), region focused (Kendall and Pigozzi, 1994; Campbell, 2003; Rapino et al., 2006; Stevens and Partridge, 2011; Debbage et al., 2014), or couched in economic base theory (Forward, 1982; 1990; Nelson, 1997; Nelson and Beyers, 1998; Campbell, 2003). By studying the impacts of

unearned and non-wage income through convergence theory, the impact of these income streams can be understood through a neo-classical lens, which offers the strength of a unifying growth theory compared to the more locally descriptive economic base theory (Malizia and Feser, 1999). This paper, then, creates a more complete understanding of the regional growth and convergence process by incorporating previously excluded income streams and examining those income streams through the strength of the neo-classical theory of growth.

The rest of this paper is organized as follows: Section 2 provides more depth in the growth and convergence and unearned income literatures. Section 3 outlines and justifies the methodologies utilized to address the research questions, Section 4 examines results and provides discussion, while Section 5 offers concluding remarks and directions for future research.

2. Income and growth

2.1. Regional income growth and convergence

Regional income convergence is born out of exogenous growth theory where an external technological component, working with local endowments and utilization of capital and labor, dictates growth rates of a regional economy (Swan, 1956; Solow, 1956). In this process, high levels of per capita income or output are initially concentrated in regions with similarly high levels of capital and labor utilization. Assuming constant returns to scale and decreasing returns to investment, returns diminish as each additional of unit of capital and labor is utilized. Eventually, returns to investment equal cost, and the incentive for additional investment disappears. Then a regional economy enters the comparatively slow and stable steady-state growth rate (Malizia and Feser, 1999). When regional economies enter this steady state, relocation of capital to relatively capital-poor regions becomes attractive to the marginal or footloose firm. Assuming a globally fixed capital stock, a spatial version of Schumpeterian creative destruction (Schumpeter, 1942) occurs as investment moves from regions of capital wealth to those of comparative capital deficit. Utilizing the most productive units of capital and labor, as investment flows to regions of capital deficit, per capita output in the receiving region begins to grow at a relatively quick pace. Simultaneously, growth rates in regions of disinvestment slow. The result of these differences in growth rates is a narrowing of disparities between regional incomes or output (i.e., convergence). While increasing returns to capital associated with endogenous theory (Romer, 1986) would seem to reject convergence, it has been difficult to find empirical support for rejecting the convergence hypothesis. In fact, "most of the empirical work motivated by endogenous growth theory has actually tested implications of the Solow-style neoclassical model rather than endogenous growth theory itself" (Pack, 1994, p. 57).

Traditionally, the test for beta convergence begins in the unconditional framework, where initial per capita income or GDP levels serve as the key predictor variable against changes in per capita income or GDP (Baumol, 1986; Sala-I-Martin, 1996). Convergence is deemed present when the relationship is negative and significant and the intercept is the same across observations (Barro and Sala-I-Martin, 2004). This relationship captures the implied outcome of the neo-classical Solow-Swan model where regions with lower levels per capita capital investment experience faster growth rates, thereby allowing regions with lower capital-labor ratios to "catch up". Here, the expectation is that per capita GDP is the key variable as it measures the effective output per unit labor. Barro and Sala-I-Martin (1991; 2004) note that in practice there is no discernible difference when per capita personal income is used, particularly when studying convergence within a national economy. Given the ready availability of income data, it has been widely used in convergence studies. When extended to the conditional framework, initial income levels are augmented by the inclusion of control variables to recognize that differences in production process and product maturation affect firm locational needs (Hirsch, 1967; Helleiner, 1973; Park and Wheeler, 1973; Almor et al., 2006; James and Moeller, 2013), the role of governmental investment and subsidization (Smith, 1966; Lall and Yilmaz, 2000; Gertler, 2001; Rupasingha et al., 2002; James and Campbell, 2014; James and James, 2015), the role of innovative activity or human capital (Higgins et al., 2006; James and Sharp, forthcoming), and the impact of urbanization and localization benefits on growth (Nourse, 1968; Jacobs, 1969; Cho, 1994; Chen and Fleisher, 1996; Sala-I-Martin, 1996; Garofalo and Yarmik, 2002; Rupasingha et al., 2002; Choi, 2004; Higgins et al., 2006; James and Campbell, 2014; James and James, 2015). While the evidence of convergence remains persistent, the appropriate mix and impact of additional conditioning variables remains subject to debate (Galor, 1996; James and Campbell, 2014).

In the unconditional framework, the neo-classical assumptions regarding closed economies, uniform tastes, preferences, and productive capacities become problematic when considered at the international scale (Baumol, 1986; Baumol and Wolff, 1988; Barro and Sala-I-Martin, 2004). These differences are less problematic when applied to national economies, thereby suggesting an unconditional convergence framework to be appropriate when studying national economies (Barro and Sala-I-Martin, 2004). Conversely, within the United States, conditional studies dominate (see, for example, Barro and Sala-I Martin, 1991; Sala-I-Martin, 1996, Rupasingha and Freshwater, 2000; Higgins et al., 2006), though frequently reasons for the conditional framework come from research questions directly related to the impact of specific conditioning variables on growth. The application and significance of these conditional vectors may run contrary to the relatively homogenous steady state within national economies noted by Barro and Sala-I-Martin (2004), though James and Campbell (2013; 2014) argue that spatial aggregation can influence evidence of convergence, other things being equal. They note that when economies are grouped functionally evidence points towards unconditional convergence within the United States, while politically based levels of aggregation tend towards conditional convergence. In other words, functional economic units of spatial aggregation such as metropolitan areas or BEA Economic Areas appear to capture convergence in its most pure (unconditional) form.

Whether unconditional or conditional, the key convergence variables are initial income levels and income change. As defined and measured by the United States Bureau of Economic Analysis (BEA), income includes earned wages, earned non-wage proprietor's income, and several unearned, non-wage components. While wages comprise the majority of income, unearned and non-wage income comprise a growing portion of income (Campbell, 2003; Debbage et al., 2014). It is therefore increasingly important that unearned and non-wage income be systematically examined in the context of regional convergence. For example, while all components of income can be included (Coughlin and Mandelbaum, 1988; Evans and Carras, 1996; Sherwood-Call, 1996; Austin and Schmidt, 1998; Rupasingha et al., 2002; Santopietro, 2002; Rapino et al., 2006; James and Moeller, 2013; James and Campbell, 2014), some studies have excluded certain income components (Barro and Sala-I-Martin, 1991; Sala-I-Martin, 1996; Austin and Schmidt, 1998; Higgins et al., 2002; Rapino et al., 2006). Few have examined the impact of unearned income on growth and convergence. Those that have addressed the relationship typically compare *beta* estimates on models where unearned income is excluded versus models where it is included, and these analyses were conducted at the sub-national level (Austin and Schmidt, 1998; Rapino et al., 2006).

Emerging from these selected studies, initial evidence suggests that transfer payments can impact the convergence process by providing an "income floor", DIR only marginally affects convergence, while proprietor's income has been excluded from study. These results suggest that unearned and non-wage income can impact regional growth, though their omission from the neo-classical model means the precise relationship between unearned income and regional growth remains unexplored. Given the increasing importance of unearned and non-wage income, the lack of explicit testing of all aspects of income on convergence, and the potential for highly localized impacts of unearned and non-wage income (Campbell, 2003; Beyers and Lindahl, 1996), it is clear that more analysis on these topics is needed.

2.2. Unearned and non-wage income and regional growth

Income is comprised of both earned and unearned, wage and non-wage components. Earned income is comprised of wages and salaries as well as supplements to wages (such as insurance benefits) including the "monetary remuneration of employees…employee gains from stock options, distributions from non-qualified deferment plans, and an imputation for pay in kind" (BEA, 2005, II-I). PI, "the current production income of sole-proprietorships, partnerships, and tax exempt cooperatives," can also be included as earned income, though it is non-wage. Unearned income includes TP, the "benefits received by persons for which no current service is performed" (BEA, 2005, VI-1), and DIR, the "payments in cash or other assets…that corporations in the United States or abroad make to persons who are U.S. residents" (BEA, 2005, V-I), "interest income (monetary and imputed) from all sources…received by individuals, private and government employee retirement plans, nonprofit institutions, and by estates and trusts" (BEA, 2005, V-3), and "net rent and royalties received by individuals, the net rent and royalties received by private noninsured pension funds, the net rent and royalties received by nonprofit institutions, and the net rent and royalties retained by fiduciaries" (BEA, 2005, V-6). While wages are still the dominant component of income, the unearned and

non-wage components have been steadily increasing in their relative importance and currently comprise over one-third of total personal income (Campbell, 2003; Debbage et al., 2014).

In a convergence framework, the impact of income on regional growth is strongly tied to the wage component, as wages serve as a proxy for productivity. Even when conditioned by other predictor variables, direct measures of unearned and non-wage income are typically excluded from convergence models. This type of omission is troubling, since the ability of these components to affect regional growth has been known for some time (e.g., Wilson, 1955; Isard, 1960; Tiebout, 1962) and has recently been reinforced by Nesse (2014). Manson and Groop (1988; 1990) argue that their effects are strong enough to require inclusion as an income stream when regional economic analyses are conducted. When examined by comparing models that include and exclude components of unearned income (Austin and Schmidt, 1988; Rapino et al., 2006), evidence suggests that unearned income can influence growth rates (and in turn, convergence), though its direct impact remains unexplored.

That the impact of unearned and non-wage income has not been fully explored in the context of convergence should not be surprising. The existing body of knowledge on unearned and non-wage income is comparatively sparse and generally couched in economic base frameworks. There is clear evidence, however, that unearned and non-wage income influences regional growth. For example, building off of Isard (1960), Campbell (2003) found that DIR positively affects employment growth and can function in a manner similar to basic industries, albeit with a weaker impact, while a reliance on TP abjectly slows employment growth, results consistent with Vias (1996), Batey and Madden (1983), Nelson and Beyers (1998), Nesse (2014), and Mulligan and Vias (2006). These impacts stem from the fact that even though the wealth may be generated elsewhere, DIR and TP still get spent in the local economy (Kendall and Pigozzi, 1994). Forward (1990) further argued that concentrations of DIR capture the spillovers and vibrancy of an economy that allows for accumulated wealth. Nesse (2014), however, noted that the accumulated wealth is not always invested in the local economy. So while the returns of DIR serve to bring wealth in to the local economy and help sustain growth in already vibrant locations, DIR will produce weaker effects since the actual investment of the accumulated wealth may be in another location, a problem noted by Cebula and Feige (2012).

Beyers and Lindahl (1996) noted the importance of the relocation of PI to the rural west through their analysis of the export-oriented "Lone Eagles" and "High Flyers" in those physically remote, yet digitally connected economies. Nelson and Beyers (1998), however, found no significant positive relationship between PI and income growth. Given these findings, it appears that unearned, non-wage income can affect regional growth, yet those impacts are not uniform. DIR and PI can positively influence growth which can be tied to their measures of accumulated wealth within a region, a relocation of previously accumulated personal wealth, or a degree of private entrepreneurship, though at rates slower than basic employment (Campbell, 2003). TP, on the other hand, can be reflective of an overall lack of competitiveness of a regional economy or labor force, as the largest components of TP are governmental entitlements (BEA, 2005). While these growth impacts are inconsistent across unearned and non-wage components, there is also evidence that the multiplier effects of each component are sensitive to local economic structure (Nesse, 2014). Similarly, Mulligan (1987) noted that the exclusion of TP in an economic base model will artificially inflate basic multipliers. For convergence analysis, these impacts should influence the coefficient estimates when included in income. Perhaps more importantly it suggests that unearned income can condition growth rates.

It is important to note, however, that the impacts of unearned and non-wage income on regional economies are conservatively measured. Some streams of non-wage and unearned income have a propensity to be unreported or underreported in a unique fashion, due to less stringent reporting mechanisms, particularly with PI and DIR. For example, Alm and Yunus (2009) note that PI is most likely to be unreported. The impact of unreported PI can be significant. Choi and Johnson (2014) noted that the PI stemming from informal childcare has significant regional economic impacts, particularly in rural locations. This type of informal PI suggests that two types of PI can occur: the PI that stems in locations of comparative wealth, such as the Lone Eagle and High Flyer phenomena (Beyers and Lindahl, 1998), and the informal proprietorships that arise in recessionary periods when wage employment is unavailable (Stephens and Partridge, 2011; Choi and Johnson, 2014). With reported data, PI is more likely to be captured in wealthy locations and underestimated in more rural ones. Therefore, the significant effects stemming from proprietorships in the underground economy may be missed

in more rural locations or during times of recession (Choi and Johnson, 2014). Feige (2012) and Cebula and Feige (2012) also note that DIR can be under- or unreported. This income can stem from investments in tax havens, where reporting requirements simply do not exist (Feige, 2012). So, in locations with high concentrations of DIR, it is again likely that the impact of DIR on the regional economy is a conservative estimate since it stems from reported data.

Further compounding the relationship between unearned and non-wage income and growth is that unearned and non-wage income has a very uneven spatial distribution. While it has been noted that unearned and non-wage income can impact both metropolitan and non-metropolitan economies (Nelson, 1997; Nelson and Beyers, 1998; Nesse, 2014), concentrations and impacts are strongly tied to local economic structure and context (Nesse, 2014; Lawson et al., 2014). Generally, DIR is associated with locations where the socioeconomic conditions are conducive to growth, while TP and age-related payments are associated with slower rates of growth and locations with less conducive socioeconomic conditions (Lawson et al., 2014). Further, DIR tends to concentrate in urban locations where there is an educated, skilled workforce that has accumulated wealth, frequently from employment in skilled sectors. It also represents a smaller portion of overall income, thereby reflecting the comparatively higher wages and younger demographics in urban areas (Debbage et al., 2014). This relationship was noted by Forward (1982), who found DIR concentrates in growing cities. Though there is some evidence that DIR follows wealthy retirees (Campbell, 2003), the overall expectation is that DIR is associated with both high wages and regional growth, a relationship that is somewhat contradictory to exogenously driven convergence but finds some support in endogenous growth theory.

TP tends to be concentrated in more peripheral and largely rural locations, as well as those with populations aging in place (Forward, 1982; Manson and Groop, 1988; 1990). In locations where TP comprises a large portion of income, the population is not as active in the wage economy (Campbell, 2003). In effect, TP provides a price floor to income. Given the growth of TP, it might aid in the convergence process as the imposed price floor continues to rise (Austin and Schmidt, 1998), even though TP does not have the same spillover effects as export based production, or even DIR (Campbell, 2003). In less urbanized, amenity-rich locations, rental income and proprietor's income can have a positive relationship with growth stemming from tourism or from attracting footloose, wealthy sole proprietors (Beyers and Lindahl, 1996; Campbell, 2003).

Putting the convergence and unearned and non-wage income literatures together, it is clear that a complete understanding has yet to be reached. Though admittedly small, this body of work that finds a relationship between unearned and non-wage income regional growth has generally been confined to economic base theory and has yet to be incorporated into the neo-classical model. Given inconsistencies in the literature dealing with the impact of unearned and non-wage income on growth, their precise roles in the growth and convergence process remain unknown. It appears, then, that the manner in which these income streams condition growth rates requires further investigation. This paper helps address those uncertainties by answering the research questions outlined in Section 3.

3. Research questions and methods

There is an increasing body of literature addressing the convergence debate and a growing consensus on the significant negative relationship between initial income levels and income growth. However, surprisingly little literature has addressed the role of unearned and non-wage income as a component of personal income in the convergence model, or the ability of unearned income to influence regional growth and, in turn, convergence trajectories as individual predictors. To explore these deficiencies, this paper develops a quasi-conditional convergence model for U.S. Metropolitan/Micropolitan Statistical Areas where Per Capita Personal Income (*PCPI*) is decomposed into its earned and unearned component parts. The components of non-wage and unearned income thus serve as conditioning variables, though the model broadly remains unconditional since all variables add to *PCPI*. This deconstructed unconditional convergence model is then applied to *PCPI* growth for the 1970-1990, 1990-2010, and 1970- 2010 time periods utilizing both Ordinary Least Squares (OLS) regression and Geographically Weighted Regression (GWR) to inform the following research questions: (1) Is unearned and non-wage income a significant factor in regional income convergence? and (2) How do the factors of unearned and non-wage income influence income growth across (a) space, and (b) time?

To begin the analysis, the components of Metropolitan/Micropolitan *PCPI* for 1970, 1990, and 2010 were gathered from the Bureau of Economic Analysis Regional Economic Information System (BEA REIS).

Data were deflated to 1970 dollars using the Consumer Price Index (CPI) and joined to a shapefile of Metropolitan/Micropolitan Statistical Areas (current definition) provided by the National Historical Geographic Information System (NHGIS). Changes in *PCPI* (dependent variable) were calculated for total *PCPI* 1970-1990, 1990-2010, and 1970-2010. The rate of change in total *PCPI* is calculated as:

$$\Delta PCPI_i^{t,t+n} = PCPI_i^{t+n}/PCPI_i^t \quad (1)$$

where:

$\Delta PCPI_i^{t,t+n}$ is change in *PCPI* in area *i* from time period *t* to time period *t* + *n*

$PCPI_i^{t+n}$ is PCPI in area *i* in time period *t*+*n*,

and

$PCPI_i^t$ is PCPI in area *i* in time period *t*

Independent variables are constructed through the use of the components of Personal Income made available from the BEA REIS. Only available as aggregated measures, these variables were divided by base year population in order to achieve per capita measures. Initial components include per capita wages, supplements to wages, transfer payments, dividends, interest and rent, and proprietor's income. Pre-regression diagnostics indicated a strong colinearity between wages and supplements to wages. As a remedy, they were combined in to one variable, wages and supplements (*WS*). Remaining variables included *TP*, *DIR*, and *PI*. These variables were then entered as independent variables in OLS and GWR regressions for 1970-1990, 1990-2010, and 1970-2010. The OLS specification is as follows:

$$\Delta PCPI_i^{t,t+n} = \beta_0 + \beta_1 WS_i^t + \beta_2 DIR_i^t + \beta_3 TP_i^t + \beta_4 PI_i^t + \varepsilon \quad (2)$$

where:

β_0 is the intercept,

WS_i^t is per capita wages and supplements in area *i* at time period *t*,

DIR_i^t is per capita dividends, interest, and rent in area *i* at time period *t*,

TP_i^t is per capita transfer payments in area *i* at time period *t*,

PI_i^t is per capita proprietor's income in area *i* at time period *t*, and

ε is the assumed error, i.i.d.

The GWR is specified as:

$$\Delta PCPI_i(U) = \beta_{oi}(U) + \beta_{1i}(U)WS_i^t + \beta_{2i}(U)DIR_i^t + \beta_{3i}(U)TP_i^t + \beta_{4i}(U)PI_i^t + \varepsilon \quad (3)$$

where:

$\Delta PCPI_i(U)$ is PCPI change around location *U*,

$\beta_{oi}(U)$ is the intercept around location *U*,

$\beta_{1i}(U)PCPI_i^t$ is the parameter estimate for per capita dividends, interest, and rent around location *U* at time period *t*,

$\beta_{2i}(U)DIR_i^t$ is the parameter estimate for per capita dividends, interest, and rent around location *U* at time period *t*,

$\beta_{3i}(U)TP_i^t$ is the parameter estimate for per capita transfer payments around location *U* at time period *t*,

$\beta_{4i}(U)PI_i^t$ is the parameter estimate for per capita proprietors income around location *U* at time period *t*, and

ε = error assumed i.i.d.

The kernel defined as:

$$w_i(u) = (1 - (\frac{d_i(u)}{h})^2)^2 \quad (4)$$

where:

$w_i(u)$ = weight of the *i*th observation relative to location *u*, and

$d_i(u)$ = distance between the *i*th observation and location *u*.

Both models are run in ArcGIS 10.2. For the spatial OLS diagnostics an inverse distance weighting is utilized, a conceptualization of space that allows for influence from all observations, with greater weight for closer neighbors (Wong and Lee, 2005). This weighting scheme allows for the increasing interactions of urban economies in the national economy, which at times can run contrary to simply contiguity (Zhou, 2012). In the GWR, spatial influence is captured through an adaptive kernel with the corrected Akaike Information Criterion (AICc) (Hurvich et al., 1998) as the bandwith selection mechanism. Since MSAs are not uniformly spaced, this methodology is appropriate, as it gives the flexibility to account for the lack of a uniform distance between potential neighbors and selects a neighborhood that produces the best model fit (Charlton and Fotheringham, 2002).

When coupled together, these growth regressions will address the above research questions. The OLS model provides initial base results for explanatory power and model fit, residual diagnostics for normality (Jarque-Bera) and heteroscedasticity (Koenker Breusch-Pagan), beta convergence evidence, and strength and direction of the relationships between the unearned, non-wage income variables and income growth. These baselines provide initial evidence to answer Research Questions 1 and 2(b). Evidence for Research Question 1 comes from the strength and direction of unearned income variables on income change. Evidence informing Research Question 2(b) comes from a comparison of those relationships across time periods.

Answers to Research Question 2(a), as well as confirmation of Research Questions 1 and 2(b), come from the GWR. As opposed to traditional OLS, GWR is a local regression that allows for spatial variation in variable relationships by generating regression equations and associated diagnostics for each observation with each equation weighted by a defined neighborhood (Fotheringham et al., 2002). While GWR should not be a default test, it can be used when there is theoretical evidence to suggest spatial variation in predictor variables (James and Moeller, 2013), especially in the presence of significant regression diagnostics such as the Koenker Breusch-Pagan and Moran's I residual tests (Charlton and Fotheringham, 2009). Spatial variation in variable relationships is confirmed though the GWR output, where finding local coefficients that fall outside of the standard errors of the OLS estimated coefficient are considered to reflect spatial drift in variable relationships. Mapping the local t-statistics allows visualization of the hypothesis test that the true coefficient is zero in an observation (Fotheringham et al., 2002; Charlton and Fotheringham, 2009). In this case, given evidence of spatial heterogeneity in the convergence process (Le Gallo, 2011; Artelaries, 2014) and spatial variation of the impact of unearned and non-wage income (Beyers and Lindahl, 1996; Campbell, 2003; Forward, 1982; Debbage et al., 2014; Manson and Groop, 1988; 1990), an expectation of a spatially heterogeneous relationship between variables is not unreasonable. As such, the answer to question 2(a) will come from OLS evidence suggesting a need for GWR and be reinforced if spatial drift is detected in the GWR regression coefficients. Further, answers to Research Questions 1 and 2(b) will be reinforced and refined as the GWR will allow for the effect of the specific unearned income variables to be identified and compared at specific observations across time periods.

4. Results

4.1. OLS results

Results from the three OLS convergence models are displayed in Table 1. Across all models, model fit is marginal with R^2 values of 0.134, 0.227, and 0.223 for the 1970-1990, 1990-2010, and 1970-2010 regressions, respectively. This marginal model fit is similarly reflected in the AICc scores of 7013.4, 7484.0, and 8250.3. Alternatively, the F and Wald tests indicate overall model significance, with the Wald test being particularly important given the significant Breusch-Pagan. The marginal model fit countered by the significant F and Wald tests can be attributed to several causes, such as omitted variables or noise from spatial heterogeneity driving down the measures of model fit (Afifi et al., 2007; Charlton and Fotheringham, 2009). While James and Moeller (2013) noted the ability of the GWR to improve model fit in an unconditional convergence model, they also noted that such analysis needs further exploration in GWR. Additional diagnostics indicate non-normal residuals (Jarque-Bera) as well as heteroskedastic residuals (Breusch-Pagan). While normality is a goal, the significant results of the Jarque-Bera are not cause for alarm because the impact of non-normal residuals becomes less troubling as sample size increases (Deilman, 2004). Of more interest is the significant Breusch-Pagan, which suggests that the models are all candidates for GWR (Charlton and Fotheringham, 2009). While the unconditional OLS models offer explanatory power, their model fit and residual diagnostics leave much to be desired. Taken together, these factors all can arise when there is spatial heterogeneity in the variable relationships, a supposition that should be further explored with a GWR analysis.

Consistent with the expectation of convergence theory, the earned wage income variable was negative and significant at the 0.01 level in all models. Worth noting is that the magnitude of the earned wage income variable is strongest in the long run model, while the 1990-2010 result is noticeably larger than the 1970-1990 model. The comparatively large negative coefficient for the long run model makes sense when couched in terms of convergence theory, as it is a long run process of investment and disinvestment that manifests itself in the earned income of workers. More interesting is the comparative strength of the earned wage income variable in the 1990-2010 model when compared to the 1970-1990 model. While both are significant at the 0.01 level, the magnitude of the relationship with *PCPI* growth is

much stronger in the 1990-2010 regression. A possible explanation may come from the increased locational flexibility of skilled workers during this time period (Florida, 2002) leading to growth in amenity-rich, less urban locations (Beyers and Lindahl, 1996), as well as a movement of investment to more suburban locations during a similar time period (James and Sharp, 2015).

The effects of unearned or non-wage income on growth are generally consistent across regressions. Most of these variables exhibit a negative relationship with growth, with the only positive coefficients coming from *PI* in the 1990-2010 and 1970-2010 regressions. Given the different theorized effects of the unearned income variables, the interpretation of these results is not straightforward. *WS* is suggestive of income growth and convergence resulting from exogenous growth processes. The negative impact of *DIR* would seem to support the convergence hypothesis, as regions that had accumulated enough wealth to have investment income experienced slower growth. This result also suggests that accumulated wealth is not as tied to place as previously thought — the coefficients are similar for each of the sub-period regressions. Yet, the strongest evidence comes in the long run regression. Similar to the earned wage income variable, the process should quicken when *DIR* is included. Conversely, the negative effect of *TP* on income growth fits with the expectation, as high levels of *TP* are indicative of a struggling local economy, particularly as related to the disinvestment of wage employment. However, those struggles are not limited to the disinvestments associated with convergence but are suggestive of poverty in locations that were never as prosperous, suggesting that local context may be lost in the global model (Forward, 1982; 1990; Campbell, 2003). The magnitude and significance of the coefficient for the 1990-2010 regressions suggests that struggling economies were especially hard hit by the Great Recession, a finding consistent with Debbage et al. (2014).

As for *PI*, it is significant (and negative) only in the 1970-1990 period. Though positive in the other periods, it is not significant. We can infer that in the long run, the contribution of proprietor's income to total regional income changed, especially in the latter part of this study period. The 1990-2010 period contained three recessions, the most recent of which was especially severe. Apparently, PI becomes a more prominent form of income during recessionary periods. However, given the known increase in informal activity during recessions (Choi and Johnson, 2014), the coefficient on *PI* is most likely conservative. Alternatively, this could also be suggestive of a greater degree of entrepreneurship in some regions. The positive effect on growth might slow the estimated speed to convergence as it provides an alternative income source that contributes to *PCPI*.

Table 1: OLS Results

	1970-1990	1990-2010	1970-2010
R-Squared	0.134	0.227	0.233
AICc	7013.375	7483.991	8250.252
Jarque-Bera	12334.701***	310.466***	1011.975***
Koenker Breusch-Pagan	50.807***	16.879***	45.563***
F	33.206***	64.307***	66.351***
Wald	81.487***	65.560***	89.294***
Moran's I	0.191***	0.161***	0.148***
Intercept	158.295***	161.507***	210.506***
Wages and Supplements	-0.005 (0.001)***	-0.011 (0.002)***	-0.016 (0.006)***
DIR	-0.005 (0.004)	-0.004 (0.002)	-0.027 (0.011)**
TP	-0.002 (0.012)	-0.014 (0.005)***	-0.004 (0.844)
Proprietors Income	-0.016 (0.003)***	0.004 (0.004)	0.001 (0.008)

Notes: Standard Errors in Parentheses. *, **, and *** indicate significance at the 0.1, 0.05, and 0.01 levels, respectively.

With some of the diagnostic problems noted above, additional insight to the nature of the model shortcomings can be gained through an exploration of LISA cluster maps of regression residuals. These are displayed in Figure 1, with (a) representing 1970-1990, (b) 1990-2010, and (c) representing 1970-2010.

In each there is a noticeable spatial pattern of model error, though the pattern is not consistent across time periods. Starting with the LISA clusters for 1970-1990, the model tended to under-predict in the Boston-New York agglomeration, along the Piedmont Megapolitan Cluster, and in coastal Florida. It tended to over-predict in California and the southwestern states. These clusters were more fragmented than those of under-prediction, possibly due to the fragmentation of population and large county sizes in those areas. Of particular interest are areas of under-prediction. It appears that earned and unearned income might have played regionally differentiated roles. The Piedmont Cluster contains the large urban agglomerations of the South (e.g., Atlanta, Charlotte, and Raleigh-Durham) where there was particularly strong growth from 1970-1990, reflecting bottom-up income convergence (James, 2010). While growth was widespread in the Southeast, growth of urban centers was especially pronounced, which might not have been captured in the unconditional, global model. Under-prediction in New York-Boston could be a sign of increasing returns to investment and endogenous growth, as the concentration of skilled labor in these locations facilitated innovation and knowledge spillovers (Romer, 1986; Lucas 1988) which are thus subject to highly localized growth variable relationships. In Florida, as both a retirement and vacation destination there are areas where we might expect an increased importance of all three types of unearned or non-wage income, which are not subject to the global effects of the model. The clustering of over-prediction in the southwest and inland California is not surprising. These somewhat less urban locations should be attractive to growth due to their lower wages and previously slower growth rates, perhaps indicative of their more peripheral role in the larger economy (James and James, 2015).

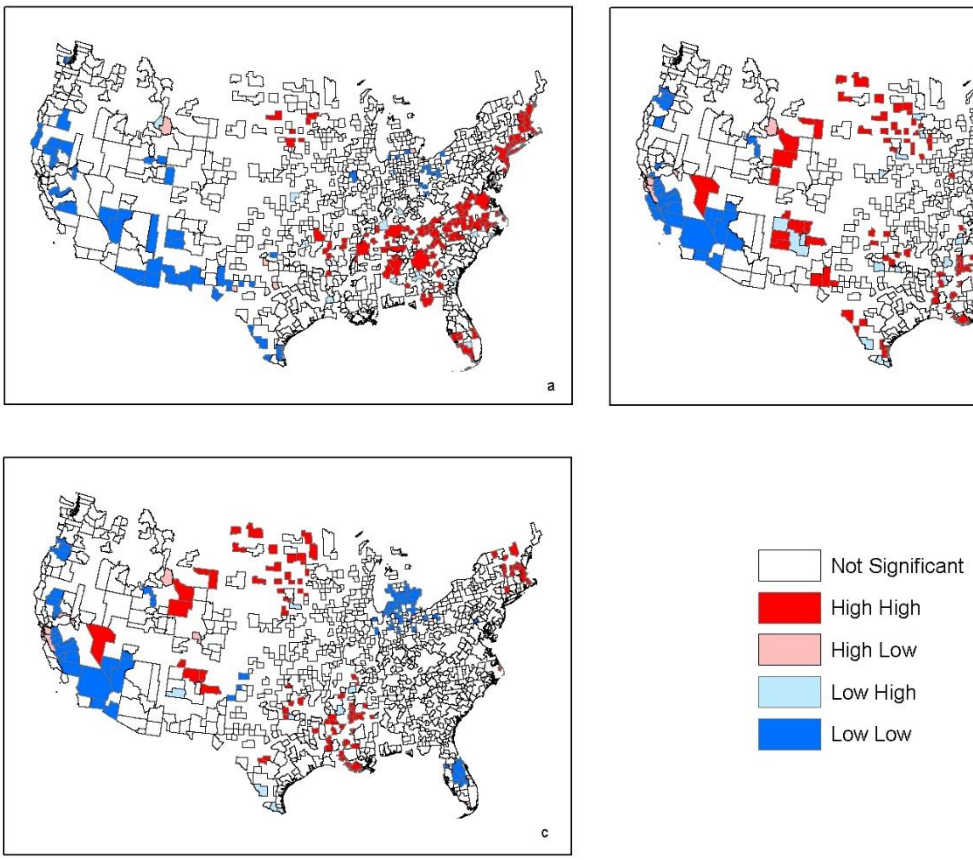

Figure 1: OLS Residual LISA Clusters.

Moving to the 1990-2010 and the 1970-2010 regressions, a new pattern of over- and under-prediction emerges. First, the swath of under-prediction in the Southeast disappears. This can suggest that by 2010 the Southeast had largely completed its bottom-up convergence. Secondly, under-prediction remains in the Southwest, reinforcing the unique, external processes of those economies. Finally, in both regressions pockets of under-prediction appear in the Upper Great Plains and Mountain regions. These can be reflective of the presence of the High-Fliers and Lone Eagles, as well as the effects of the energy boom, both of which are unique local factors that would not be captured in a global model.

Putting the results from the OLS analysis together, a few things become apparent. First, in addressing Research Question 1, the persistent significance of at least one unearned or non-wage income component in each regression suggests that these factors are relevant to the income convergence process. Secondly, in addressing Research Questions 2 (a) and (b), additional evidence suggests that the impact of these unearned and non-wage factors is not consistent over time and space as (a) the significant predictor, and in some cases relationship, of the unearned and non-wage variables changes across the regressions, and (b) model diagnostics and background literature indicate the model to be a candidate for a GWR. Clearly then, unearned and non-wage income are relevant factors in the convergence process, but their impact is notably more nuanced and localized.

4.2. GWR results

GWR results are displayed in Table 2. Of immediate note is the improvement in model explanatory power that comes from the local model. Each regression more than doubles its R^2 values, and AICc values all moved closer to zero. GWR results suggest earned and unearned, wage and non-wage income affect regional growth differently across space, thereby creating a comparatively poor model fit in the global OLS regression. This suspicion can be further explored by looking at spatial drift of the individual regression variables. Additionally, the neighborhoods defined by the regression are relatively large, ranging from 185-318 out of 861 total observations, suggesting the processes at work are, in fact, regional though still affected by local economic structure.

Table 2: GWR Results.

	1970-1990	1990-2010	1970-2010
R-Squared	0.474	0.401	0.507
AICc	6617.95	7286.09	7907.78
Neighbors	185	318	185
Sigma	11.003	16.383	23.272
Intercept Min	82.653	133.593	104.104
Intercept Mean	137.023	154.307	223.414
Intercept Max	159.933	184.625	327.531
Wages and Supplements Min	-0.017	-0.022	-0.047
Wages and Supplements Mean	-0.005	-0.012	-0.024
Wages and Supplements Max	0.011	-0.004	0.012
DIR Min	-0.08	-0.021	-0.094
DIR Mean	-0.01	-0.001	-0.016
DIR Max	0.026	0.028	0.053
TP Min	-0.083	-0.035	-0.151
TP Mean	-0.017	-0.004	0.002
TP Max	0.145	0.021	0.236
Proprietors Income Min	-0.037	-0.02	-0.069
Proprietors Income Mean	-0.01	0.003	-0.007
Proprietors Income Max	0.032	0.034	0.067

Note: Red text indicates spatial drift of variable.

Individual predictors provide strong evidence of local variation in variable relationships, as nearly all of the minimum and maximum coefficient values fall outside the tolerable range for a spatially homogeneous process. For example, across all regressions *WS* reflects spatial drift consistent with the growing literature supporting local variation of regression coefficients in convergence models (e.g., Le Gallo et al., 2011; James and Moeller, 2013; Artelarias, 2014), as well as the spatial heterogeneity of barriers to market entry (Krmenec and Esparza, 1999) which violates the convergence assumption of unfettered capital movement (Barro and Sala-I-Martin, 2004). However, in the 1970-1990 and 1970-2010 regressions the maximum values were positive. These positive values operate in contrast to the expectations of convergence, and might suggest the increasing returns to capital of endogenous growth theory or the spatial implications of the Product Life Cycle (PLC). In the 1990-2010 regression, *WS* is negative in all observations but still reflects spatially heterogeneous relations. Consequently, even in a time period with several recessions and where no economy experienced increasing returns, the degree of decreasing returns was not consistent across space. Such heterogeneity is similar to that noted by James and Moeller (2013), who found spatial heterogeneity in the impact of income levels on growth. Our current results differ from their results in that increasing returns to income are not found in the 1990-2010 period. It is possible that this inconsistency stems from differences in spatial aggregation or that the increasing returns found by James and Moeller (2013) were not the result of wages, but rather from positive effects stemming from unearned or non-wage income, a supposition that can be furthered by examining the directionality of the unearned or non-wage variable relationship to growth.

Given these conflicting results, greater examination of local context through mapping of local coefficients and t-statistics is warranted. All of the unearned and non-wage variables had negative minimum values and positive maximum values, lending credence to the idea that the impact of unearned and non-wage income on growth is a highly localized process. An unearned or non-wage income component that might operate as basic to one local economy and generate significant multiplier effects might not in another. This finding is consistent with that of Campbell (2003), who noted the potential for this heterogeneous impact driven by local economic structure. For convergence, and growth models in general, this local variation of influence and significance can be lost as the positive and negative effects could offset each other in the global model or in an aggregate measure of income, relegating the influence of those variables to the error term.

Local variation of these processes is illustrated by mapping local coefficients and t-values for each of the predictor variables. These maps are presented in Figure 2 (*WS*), Figure 3 (*DIR*), Figure 4 (*TP*), and Figure 5 (*PI*), with panel (a) representing 1970-1990 results, (b) representing 1990-2010 results, and (c) representing 1970-2010 results. Examination of Figure 2 reveals specific patterns with respect to *WS*. First and foremost, instances of increasing returns found in Table 2 for 1970-1990 and 1970-2010 were few, confined primarily to the southwest with strong t-values. These regions generally had low initial incomes, attractive to investment associated with convergence, so one should expect a negative sign. However, these areas remained on the periphery, suggesting a lack of inclusion in the larger national economy (see James and James, 2015, for an example). In peripheral economies, any earnings can play a significant role in growth given their overall condition.

The negative returns in the large urban agglomerations such as New York run contrary to increasing returns associated with endogenous growth (James and Moeller, 2013). Additionally, *WS* tended to have strong t-statistics across observations and time periods, with a consistent, significant, negative effect from *WS* on income change, regardless of time period. This would suggest that the functionality of the Baumol-inspired test for beta convergence captures that process, even at a local scale; i.e., there is a negative effect of wages on growth rates. At times the relationship does not hold at the local level, such as the Rust Belt failing to register a significant relationship in the 1970-1990 regression or the southwestern increasing returns. In the long run, the relationship between *WS* and growth holds across most locations. In other words, there is evidence of earned, wage income convergence in the larger economy, but exceptions appear due to localized, temporally fluid reasons.

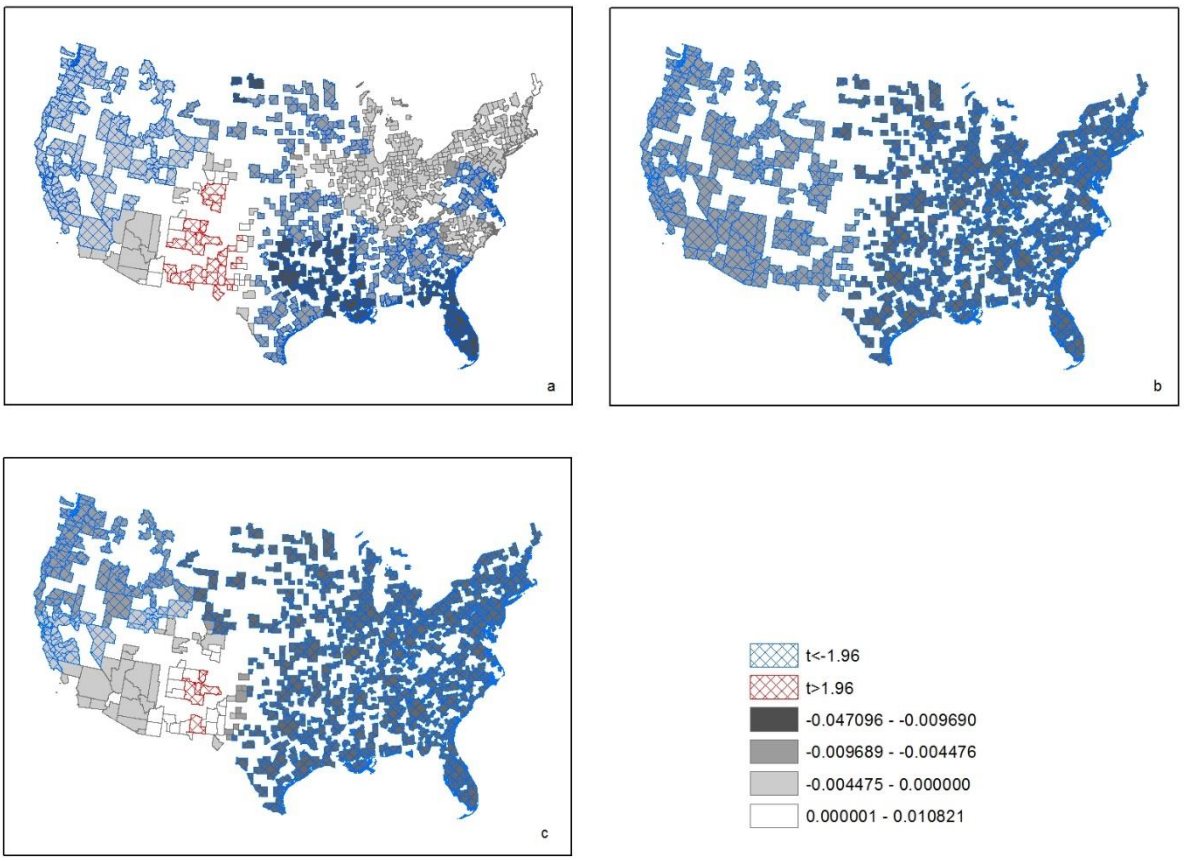

Figure 2: WS GWR results.

Examination of local coefficients on *DIR* in Figure 3 also supports the spatial heterogeneity noted in the discussion of Table 2. *DIR* crosses zero in all time periods, with each regression having regions of positive and negative local significance. In the global regression *DIR* was consistently negative across time periods, yet only significant over the 1970-2010 period. Globally, the negative coefficient should be expected, given that is it is a measure of accumulated wealth and therefore tied to the slower growth rates in regions of wealth. Yet the local results indicate this process is not spatially uniform, leading to noise in *DIR* in the OLS. A persistent concentration of positive growth effects in all regressions is clustered around New York City, an unsurprising result given the unique urban agglomerative effects in the region (Chinitz, 1961; Gottmann, 1957). While more compact in the 1990-2010 regression, a concentration of positive *DIR* effects covers most of New England in the 1970-1990 and 1970-2010 regressions.

The persistence of positive *DIR* effects in New England, in combination with the negative coefficient on *WS*, offers a particularly important observation for theory: increasing returns can result from accumulated wealth. Since skilled labor should receive higher wages, thereby increasing the capacity to invest, growth need not come solely from wages, but rather from how those wages are utilized. So, while skilled labor is associated with a tempering of the convergence process, it appears to increase the capacity of skilled labor to use their higher wages to invest and generate further wealth — something akin to an accelerator effect — which is a more nuanced interpretation, to be sure. A second possible explanation relates to the demographic and urban structure of the region: with both an aging population and strong markets (housing, machinery, etc.) there would be both sufficient population with the time to accumulate and utilize *DIR* and market demand for assets that generate rental income.

Additional positive *DIR* impacts, tied to place- and time-specific processes, can be found in the western United States, Florida, and the Upper Plains. Florida and the western U.S. (1970-1990) most likely

witnessed DIR growth from retirees and High Fliers and Lone Eagles (Campbell, 2003; Beyers and Lindahl, 1996). In the Upper Plains, the 1990-2010 time period intersects with the energy boom and the associated demands for housing and rental equipment, a finding largely consistent with Deller (2014). The lack of persistence of these factors in the long run regression is suggestive of their time-specific sensitivity that does not shield them from the long run convergence process.

Significant negative *DIR* effects tended to concentrate in the Midwestern Rust Belt, the southeast, and portions of the southwest from New Mexico though Oklahoma. The negative effect in the Rust Belt could be attributed to disinvestment of capital in this once capital rich region. However, given its role as an assembly, as opposed to an innovation, center, there was not the skilled labor to retain and reinvest high wages. Thus, *DIR* did not shield this portion of the Rust Belt from the global convergence process as it did in New England. In the southern and western regions that began as relatively poor locations, any gains would have been as a result of wages, not investments. Locations with enough wealth to accumulate *DIR* in these locations would not be as attractive to the footloose capital in the convergence framework. Contrary to the positive effects in the Northeast, the comparative poverty of some southern and western regions might dampen local savings and investment and possibly depress local housing markets reflective of a challenging economic structure, thereby exerting a negative effect on growth. Further, running counter to the positive effects during the 1970-1990 period, northern Florida and Arizona exhibit negative effects in the long run regression. This conflict of results can be traced to several sources, such as an overly optimistic boom period in the first regression, strong impacts of the Great Recession, or simply that any gains from retirement relocations were not sufficiently large to temper the long run convergence process.

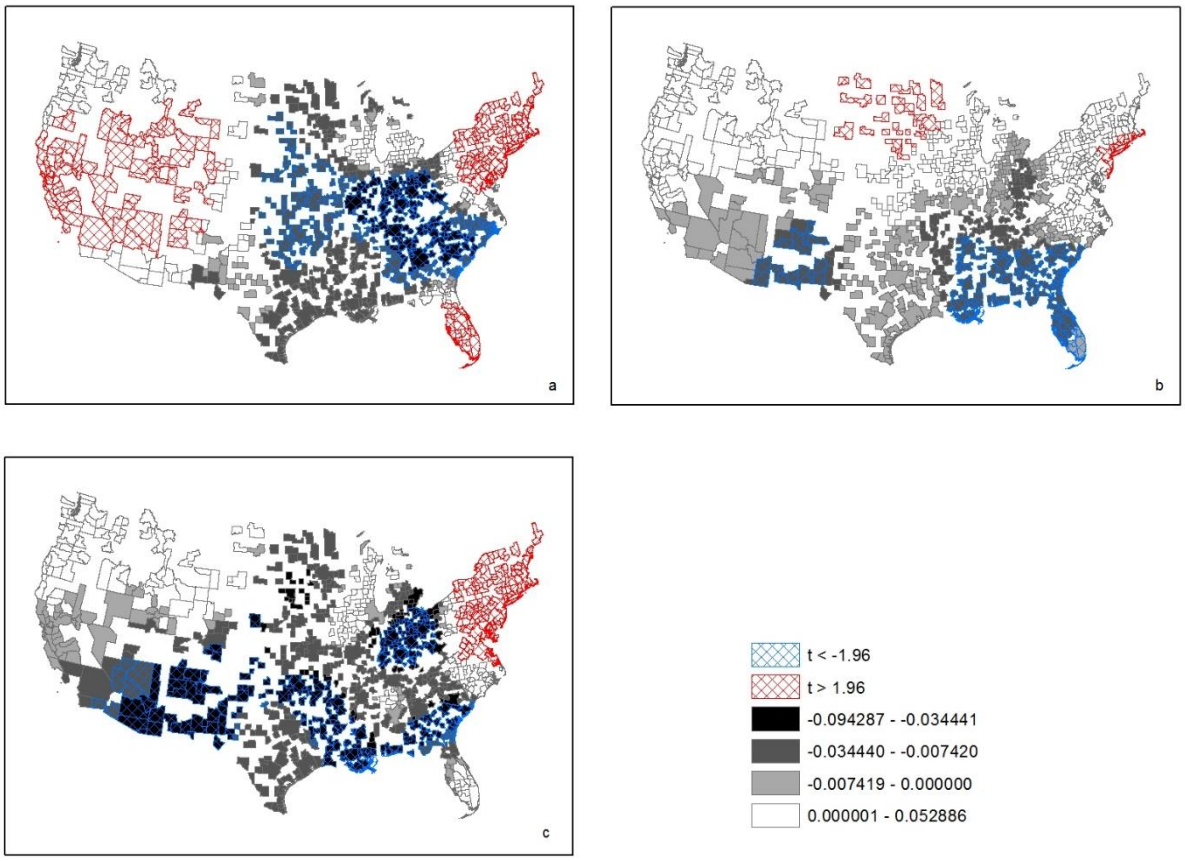

Figure 3: DIR GWR results.

Figure 4 displays results for the *TP* coefficients. The spatial drift of variable relationships shown in Table 2 is clearly apparent. All regressions have coefficient ranges that cross zero, and the 1970-1990 and 1970-2010 periods have significant positive and negative effects. The local significance of *TP* in those regressions is important because it was not always a significant predictor in the global model. Similar to *DIR*, it reinforces the strong local nature of unearned and non-wage income's influence on regional economies. Further, the strong effects of this variable on both sides of zero may cancel each other out in the global model, thereby masking its true, localized impact on growth and, in turn, convergence. Therefore, the importance of *TP* in shaping the convergence process could be understated if OLS result alone were relied upon. If *TP* is included as income in an OLS model, its inclusion could lead to changes in the estimated coefficient values.

Meanwhile, the significance of *TP* in the 1990-2010 OLS appears to be driven by a particularly strong negative relationship between *TP* and growth in the western United States and Florida, while it had little influence otherwise. In the west, the negative impact might be tied to the findings of Nelson and Beyers (1998), who noted a particular growth of TP as a component of income in western states leading up to this time period. As such, given the weak impact of *TP* in producing growth (Campbell, 2003), the negative effect of these concentrations should have been picked up in the regression. Additionally, the significance in these western and Florida locations overlap with locations where *DIR* lost a positive effect in the same time period. This seems to suggest that the unique socio-demographic factors, such as age, leading to the positive effects for *DIR* in the previous time period might have led to the negative effects in the later regression. For example, while comparatively wealthy retirees may take their *DIR* with them, they also receive *TP*. As the national economy slowed during the later time period and the aggregate impact of *DIR* diminished, those relying on unearned income might become more reliant on *TP*, which is known to generate some of the weakest multiplier effects of income components (Campbell, 2003). If so, locations in regions with previously high concentrations of *TP* were at greater risk for slow growth once the offsetting effects of *DIR* were lost. Additionally, the entire lack of significant, positive effects would lead to a significant, negative coefficient in the global regression.

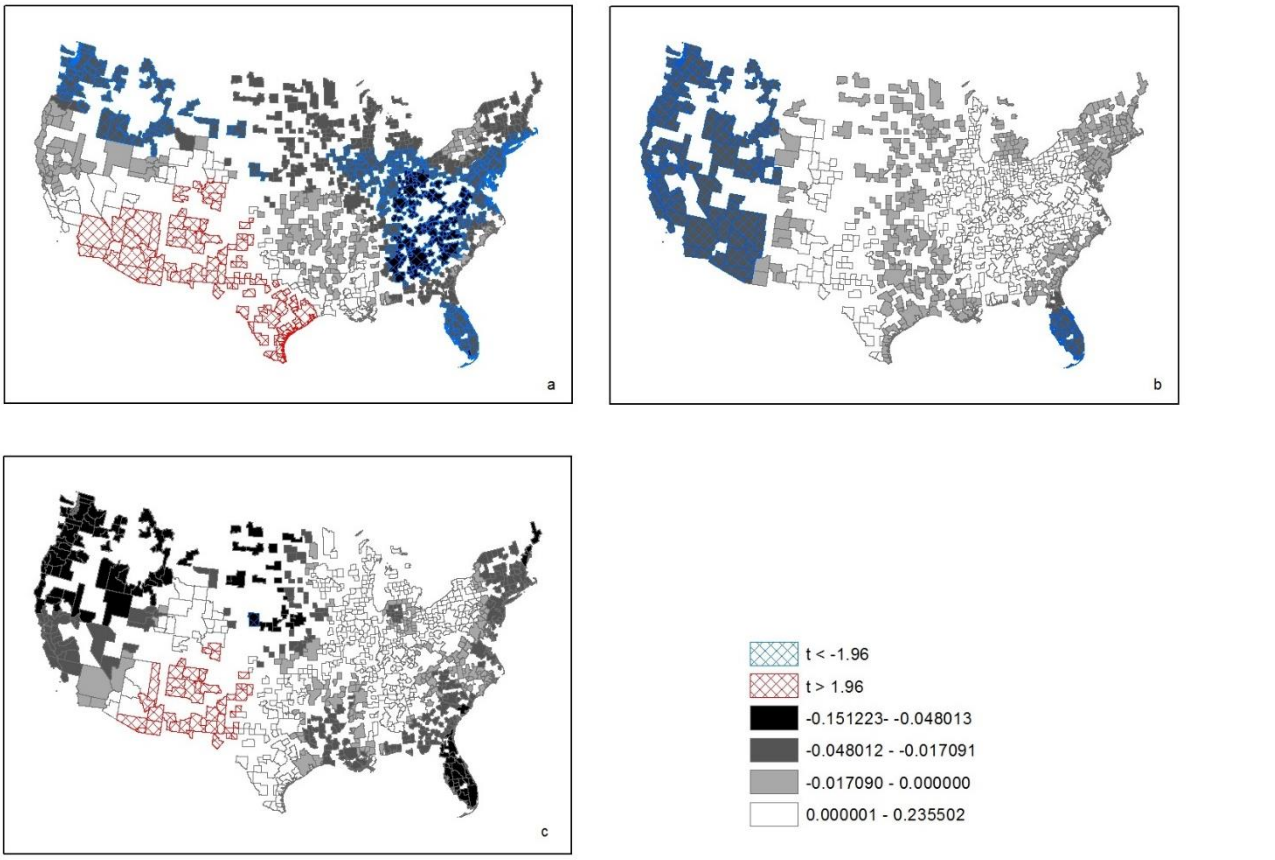

Figure 4: TP GWR results.

In the 1970-1990 and 1970-2010 regressions, the local coefficients add additional layers to the *TP* picture. For example, *TP*'s persistently negative effect in Florida reinforces the difficulty aging communities face in their reliance on *TP* as basic income (Forward, 1982). Similarly, the negative impact of *TP* during the 1970-1990 period in the Rust Belt and Appalachia might be related to local economic conditions and their relationship to the broader national economy occurring at the time (Moore, 1998). High levels of *TP* in the Rust Belt would be suggestive of economies facing structural changes at the beginning of the deindustrialization process, where a full conversion to a post-industrial economy had yet to be complete by 1990 (Hayter, 1997).

In Appalachia, the negative effect of *TP* may be capturing persistent unemployment caused by the peripheral relationship of the regional economy to the nation in the early time period. Of particular note is the fact that this negative relationship appears to reflect a failure of *TP* to stabilize struggling economies, and it might further suggest that the Appalachian periphery was driven by factors outside of a simple lack of available capital. However, between 1990 and 2010 the Appalachian economy became more integrated in to the national, neo-classical economic process (James and James, 2015), thereby removing the reliance on *TP* as a source of income. Conversely, in the same time periods *TP* positively impacted growth in the peripheral southwest. This might be suggestive of two peripheral processes occurring in the national economy — one where *TP* had the desired effect to help stabilize struggling economies, in turn speeding convergence, and another where *TP* appears to have done more harm than good by potentially offering a disincentive to engage active employment. Clearly, this discord helps reinforce the strong regional context that relates to the impact of unearned income on regional growth.

Local coefficients and significant t-values for *PI* are mapped in Figure 5. Across the three regressions, changes in the role of *PI* noted in the OLS results hold. First, the coefficient for *PI* is negative and significant in the 1970-1990 OLS, a result reinforced by the GWR. In 5(a), even though the coefficient displays spatial drift, large portions of the country still have a significant, negative relationship between income growth and initial *PI* levels, consistent with the OLS results. Worth noting is that the negative influence is heavily concentrated westward, beginning along the Mississippi River. Negative effects are also found in southern Florida and parts of Appalachia, while a few positive effects are found in eastern North Carolina and Virginia. The concentrations of negative effects in the west run counter to the Lone Eagle and High Flier hypothesis, suggesting the basic impacts were not felt yet. The lack of significance in some parts of the eastern U.S. runs counter to the notion that *PI* should become a more prominent income source in depressed areas with little wage employment (Stephens and Partridge, 2011). In the eastern states, lack of *PI* significance could be due to *PI*-like income derived from unreported sources (Choi and Johnson, 2014). As shown, a few pockets in Appalachia were significant and negative, fitting with the peripheral relationship in that time period as *PI* was likely in low skill sectors driven by a lack of wage employment rather than from skilled labor entrepreneurship. However, in eastern North Carolina, the results returned positive. This might point to the combined influence of tourism and a relatively large agricultural sector in that area of the state (Furuseth, 1997), as *PI* includes income to farm owners.

In the 1970-2010 and 1990-2010 regressions, the results are geographically similar. The presence of significant positive and negative effects reinforces the spatial heterogeneity outlined in Table 2; the larger reduction of significance also mirrors the lack of significance in the OLS regressions for these time periods. However, the areas of significance that remain tell an interesting story of economic transition in the United States. To begin, the significant negative effect of *PI* in Appalachia disappears, suggesting that proprietorships are no longer significantly influencing income growth in the region, contrary to Stephens and Partridge (2011) but consistent the integration suggested by James and James (2015). Additionally, the western concentration of significance decreased in size in the 1990-2010 and 1970-2010 regressions. In 1990-2010, the negative effect was largely concentrated in the southwest, stretching from Texas to California, while in the long run it was largely confined to central and southern locations, reflective of a peripheral role of these locations in the national economy. These MSAs with large rural territories experienced some of the slower growth in the long run time period. In the long run, regression negative effects of *PI* remain in southern Florida, which might be suggestive of poor diversification in the wage economy, making it overly reliant on income from tourism and agriculture which declined dramatically during the Great Recession (Ritchie et al., 2010).

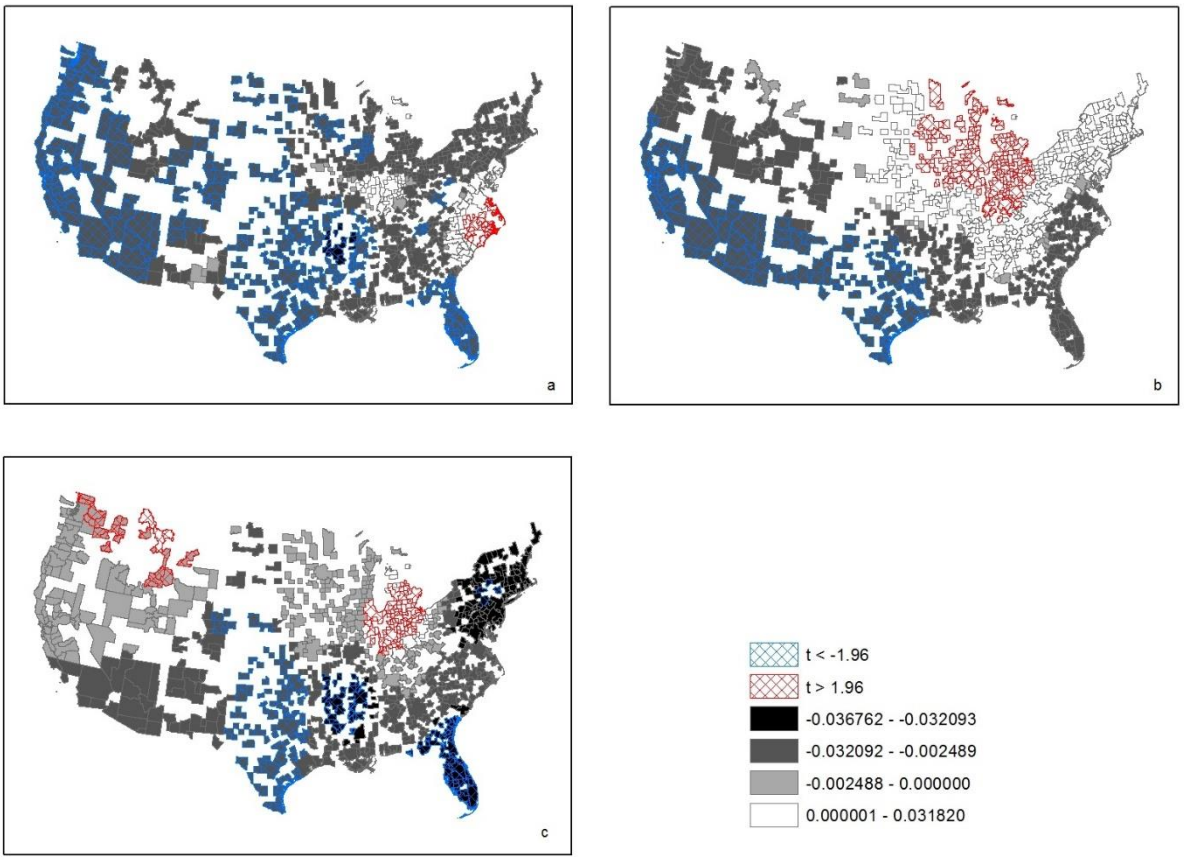

Figure 5: PI GWR results.

Conversely, *PI* exerted positive effects in the Rust Belt from 1970-2010 and 1990-2010; in the Pacific Northwest and Mountain States positive effects of *PI* were strictly long run (1970-2010). These differences are very likely regional in context. The Rust Belt deindustrialized during the long run regression. While *TP* was not significant in the long run model, it was significant during the 1970-1990 period. The transition alluded to by the loss of *TP* significance might be captured here, as the lack of wage employment may have led to an increase in *PI*. In the Pacific Northwest, *PI* patterns might be capturing the Lone Eagle and High Flier phenomenon missing in the 1970-1990 regression. Because they are few in number, it is possible that more time was required for *PI* from Lone Eagles and High Fliers to influence growth rates in their home economies.

Taken together, the GWR analysis sheds additional light on the role of unearned and non-wage income components in the regional income convergence process. In addressing the specific research questions, it is clear that unearned and non-wage income is a significant factor in regional growth and income convergence. While the global OLS models tended to return one of the unearned or non-wage variables as significant, thereby suggesting that unearned and non-wage income can be a significant predictor, the significant predictor changed over time. The GWR results indicate that all aspects of unearned and non-wage income can significantly influence regional income convergence, in both positive and negative directions at the local level. These conflicting effects inform Research Question (2), where (a) the significance of unearned and non-wage variables are not uniform across space, as each had a significant positive, a significant negative, or non-significant effect in the regressions; and (b) the local influence of the predictors are not spatially stable over time. In other words, unearned and non-wage income are significant factors in the regional income growth and convergence process, yet the relationship is highly localized and sensitive to the time period in which growth is examined. The findings of these regressions fit with the existing body of knowledge on the

strong local effects of unearned income (Campbell, 2003; Debbage et al., 2014; Forward, 1982; Kendall and Pigozzi, 1994; Lawson et. al, 2014; Nesse, 2014) and extend this knowledge to the relatively unexplored influence of unearned and non-wage income on the regional income convergence process.

5. Conclusions

In this paper the role of unearned and non-wage income on the regional income convergence process was explored. Specifically, a quasi-conditional convergence model was deconstructed to include the individual per capita measurements of Wages and Supplements, Dividends, Interest, and Rent, Transfer Payments, and Proprietors Income as conditioning variables against the growth rate in per capita income. These models were applied to Metropolitan/Micropolitan Statistical Area economies for 1970-1990, 1990-2010, and 1970-2010 time periods in order to address the following research questions: (1) Is unearned and non-wage income a significant factor in regional income growth and convergence? and (2) How do the factors of unearned and non-wage income influence income growth across (a) space, and (b) time? Results indicate that while earned, wage income tends to be uniformly strong in influencing regional income growth and convergence, the effects of the unearned and non-wage components are significant but highly dependent on local context and time period.

In and of themselves, the answers to the research questions are informative in helping to understand the complexity, nuance, and local variability of regional income growth and convergence. The results also help connect convergence theory to other competing theories of regional development, especially those that help explain the local context driving significance of the unearned and non-wage income variables. For example, the increasing returns of *DIR* in the New England region, when coupled with the negative influence of earned income, suggest that increasing returns to labor productivity, spatial implications associated with product life cycles, and endogenous growth theory are actually captured in measures of accumulated wealth. In other words, high wages associated with these locations play a role in the sustained growth of the regional economies, but only in so far that they produce enough earned income to generate *DIR*, a measure of accumulated wealth. Similarly, the significant impact of *TP* in peripheral regions of the national economy (Appalachia and the Southwest) is suggestive of their relative lack of inclusion in the larger, neo-classical process, thereby implying a core-periphery relationship. However, as *TP* had differing effects on these regional economies — effects that were not constant over time — it is possible that there are multiple peripheral processes at work in the United States economy. Further, the diminishing role of *PI* in the Appalachian economy suggests movement away from the strict core-periphery relationship to a more inclusionary role in the national economy.

These results add to several literatures and present several additional avenues for future research. The immediate contribution to the convergence literature comes from answers to the research questions. Nationally, convergence is influenced by unearned and non-wage income. Therefore, the strictest test for the exogenous convergence process needs to exclude the unearned and non-wage income components. In the construction of conditional models, these components should be included as predictor variables since they can be significant and therefore can influence local growth rates. However, given the highly localized results, a further implication is that local and regional methods of analysis might be more appropriate for the exploration of convergence (James and Moeller, 2013; Artelaris, 2014). In the Appalachian literature specifically, this extends previous studies of the dynamics of growth in the region presented by Stephens and Partridge (2011) and James and James (2015) and adds additional evidence that the historically peripheral role of the region is changing.

One finding of this paper relates to the use of the local regression (GWR) in broad economic analysis. While others note the implications of these types of local models in the convergence case specifically (James and Moeller, 2013; Artelaris, 2014), the findings of this paper regarding spatial drift in non-wage income and wage income can be translated to other models of economic growth as well. For example, OLS regression is a common technique for calculating economic base multipliers, and the application of GWR would facilitate the calculation of spatially varied multipliers and allow for a more nuanced interpretation of multiplier effects.

An important caveat, however, needs to be noted. The convergence process modeled here included 861 individual economies that were distributed across the entire United States. While intra-national convergence studies have the advantage of a constant currency and regulatory structure that helps facilitate interregional capital flows (Barro and Sala-I-Martin, 2004), there is a line of research that acknowledges regional variation in prices and cost of living within

national economies (e.g. Rabianski, 1971). These differences can significantly impact regional phenomena such as migration (Gatons and Cebula, 1972; Cebula, 1980; Renas 1978, 1980, 1983; Cebula and Toma, 2008; Cebula and Alexander, 2006). Interregional price/cost variations can influence the interpretation of convergence results, as intuitively one dollar of investment moved from a high-cost to low-cost region will not be a one-to-one transfer of wealth and investment. Rather, the dollar has potential to be a more productive investment in the region with a lower cost of living, as per-unit wage rates and input costs should be comparatively lower. In fact, James (2013) found cost of living and personal income to be converging, but at different rates, within the United States. However, the standard cost of living index (CPI) is only released at the urban level for 26 MSAs, while the BEA Regional Price Parity Index is not available for the time period covered in this study. Alternative measures, such as the cost of living index available through the Statistical Abstract of the United States or through the Council for Community and Economic Research (C2ER), either exclude Micropolitan Areas or are measured at the urbanized area level, both of which would limit data completeness and compatibility to the income data and the nuances of location in unearned, non-wage income. As such, deflating income into a true regionalized measure of wealth was not possible given the requirements of GWR. With a complete set of regional price deflators observations could fully represent the nuances of convergence in the distribution of unearned, non-wage income. Therefore, a degree of caution must be exercised when drawing conclusions about regional relationships. It is likely that direction and significance of predictor variables would hold, but the units of measurement are spatially heterogeneous in value.

Moving forward, key areas for future research include extending this analysis to smaller levels of spatial aggregation to examine the impact of unearned income at a finer level contiguous across the United States (such as counties). Additionally, a closer examination of the dynamics of the competing peripheral economies and the influence of Transfer Payments, Proprietors Income, and earnings in those challenged economies remains an area warranting further investigation. As noted in the caveat above, additional work examining the effect of regional price levels and cost of living differences in the income convergence process is needed.

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