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## **Revisiting Convergence: A case study form American States**

Ray, Rita

Gustavus Adolphus College

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# Revisiting Convergence: A case study form American States

Rita Ray\*

This paper investigates the convergence of wage and salary disbursements per job and compensation of employees per job for fifty one states in the United States for the period 1990 and 2010. Additionally, this paper examines the relationship between the wage and salary disbursements per job and compensation of employees per job at 1990 and their respective annual growth rates between 1990 and 2010 for four regions in the United States. This paper finds that the American States are diverging with respect to wage and salary disbursements per job and compensation per job for the last twenty years. This paper also finds that the wage and salary disbursements per job and compensation of employees per job are converging in the 'Mid-West' and in the 'West', whereas they are diverging in the 'North-East' and in the 'South'.

**Keywords:** Convergence, Growth, Region, United States

JEL Classification: O47, O51

## 1. Introduction

The concept of 'convergence' and its empirical examination is an important area of study in economics. The concept of 'convergence' is divided into two parts: absolute convergence and conditional convergence. In absolute convergence the growth rate of poor countries is higher than the rich countries and the poor countries will catch up with the rich countries over-time. Conditional convergence describes a negative relationship between initial income and its long run growth rate. Conditional convergence also describes that the growth rate of income falls as the economy moves to its own steady state income. Empirical studies on 'convergence' examine the relationship between initial income and the long run growth rate of income among regions or states or countries. Income is measured by either per-capita personal income or per-capita real GDP.

I investigate the convergence of wage and salary disbursements per job and compensation of employees per job for fifty one states in the United States between 1990 and 2010. I use wage and salary disbursements and

\* Dr. Rita Ray, Assistant Professor, Department of Economics and Management, Gustavus Adolphus College, St Peter, MN. Email: [r-ray@gustavus.edu](mailto:r-ray@gustavus.edu).

compensation of employees for two reasons. First, wage and salary disbursements comprise minimum fifty two percent and maximum fifty six percent of personal income between the period 1990 and 2010. These percentages are sixty four and sixty eight respectively for compensation of employees between the period 1990 and 2010. Second, wage rate is a proxy of per capita income. I examine whether convergence of personal income automatically ensures the convergence of its two largest components and convergence of income of the labor. Additionally, I investigate the convergence of wage and salary disbursements per job and compensation of employees per job for four US regions between the period 1990 and 2010.

The organization of this paper is as follows. Section 2 provides a review of literature. Section 3 discusses the data sources and the methodology to examine the convergence of wage and salary disbursements per job and compensation of employees per job for fifty one states in the United States between 1990 and 2010. Section 4 discusses the results. Section 5 concludes.

## **2. Literature Review**

Regional growth and its convergence have been discussed extensively in economic literature. The theoretical background of convergence lies in the assumption of law of diminishing returns to capital of neoclassical growth model. The pioneer work of empirical research to examine the evidence of convergence among counties and regions has been done by Barro and Sala-i-Martin (1991, 1992).

In their paper, Barro and Sala-i-Martin (1991) examine the relationship between per-capita personal income and its annual growth between 1880 and 1988 for forty eight American states. They also investigate the relationship between per-capita Gross State Product and its annual growth between 1963 and 1986 for forty eight American states. They extend their analysis on Gross Domestic Product and its annual growth rate for seventy three regions of Western Europe between 1950 and 1985. They find the evidence of convergence among American states and the regions of Western Europe. Barro and Sala-i-Martin's 1992 (I) paper describe the convergence of per-capita personal income and per-capita Gross State Product of forty eight American states

between 1880 – 1988 and 1963 – 1986 respectively. The paper additionally examines the relationship between per-capita GDP and its annual growth for ninety eight countries between 1960 and 1985. They find the evidence of divergence across countries. However, when they hold primary and secondary school enrollment rates and the average ratio of government consumption expenditure to GDP as constants, they find the evidence of convergence. Barro and Sala-i-Martin (1992, II) find the evidence of convergence of per-capita income for forty seven Japanese prefectures between the period 1930 and 1990.

Coulombe and Lee (1995) investigate the evidence of convergence using a variety of measures of per-capita income and output for Canadian provinces between 1961 and 1991. They find the evidence of convergence among Canadian provinces and the speed of convergence is same as American States, European regions and Japanese prefectures. They also find that the favorable changes in terms of trade and government transfers and taxes help the process of convergence. Convergence of income is investigated for Australasia (Cashin, 1995), Bangladesh (Hossain, 2000), Greece (Petraikos and Saratsis, 2000), Sweden (Persson, 1997).

The empirical literature on evidence of regional convergence in Indian states is highly controversial topic. Cashin and Sahay (1995) find the evidence of regional convergence of per-capita net state domestic product among Indian states. Nagaraj, Varoudakis and Veganzoes (1997) also find the similar result as Cashin and Sahay, however they acknowledge the evidence of growing income inequality among Indian states. However, Marjit and Mitra (1996) and Ghosh, Margit and Neogi (1998) find the evidence of divergence of per-capita net state domestic product among Indian states. Yao and Weeks (2000) examine the income convergence in China between the time period 1953 and 1997. They find the evidence of divergence of income between coastal provinces and interior provinces of China between 1978 and 1997 due to the technological growth rate disparity. Gezici and Hewings (2001) find the regional growth rate of per-capita GDP in Turkey is highly dependent on the neighboring region. Additionally, they find a growing disparity between the eastern and western region of Turkey. O’Leary finds the evidence of convergence of living standards between different planning regions of Ireland between 1960 and 1979 but he also finds the evidence of weak divergence between 1979 and 1990.

### **3. Data and Methodology**

### 3.1 Data Sources

I collect the data on state nominal total wage and salary disbursements, state nominal total average compensation per job and state nominal compensation of employees from the Bureau of Economic Analysis. I collect the data on regional annual consumer price index for all urban consumers from the Bureau of Labor Statistics. I deflate the state nominal total wage and salary disbursements, state nominal total average compensation per job and state nominal compensation of employees by regional consumer price index to get state real total wage and salary disbursements, state real compensation per job and state real compensation of employees respectively. I divide state real compensation of employees with state real compensation per job to get state employment. I divide state real total wage and salary disbursements with state employment to get state real wage and salary disbursements per job.

### 3.2 Methodology

To investigate the convergence of state real wage and salary disbursements per job and state real compensation per job, I use the following model:

$$y_{it} = \alpha + \beta y_{it-1} + \varepsilon_{it} \quad (1)$$

$$\text{and, } \varepsilon_{it} = \theta_i + \mu_{it}$$

I subtract  $y_{it-1}$  from equation (1) and get equation (2).

$$y_{it} - y_{it-1} = \alpha + (\beta - 1)y_{it-1} + \varepsilon_{it}$$

$$g_{it} = \alpha + (\beta - 1)y_{it-1} + \varepsilon_{it} \quad (2)$$

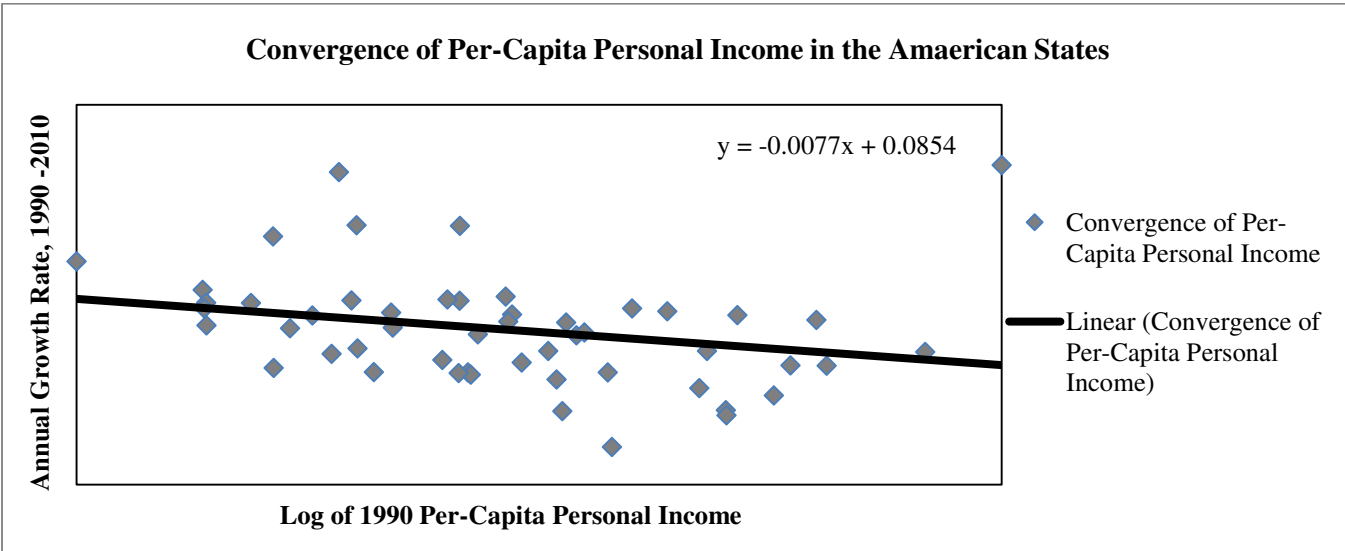
$y_{it}$  is the real wage and salary disbursements per job in state  $i$  at year  $t$ .  $y_{it}$  also represents the real compensation per job in state  $i$  at year  $t$ .  $\theta_i \sim IID(0, \sigma_\theta^2)$  and  $\mu_{it} \sim IID(0, \sigma_\mu^2)$  are independent of each other and among themselves.  $g_{it-1}$  is the annual growth rate of real wage and salary disbursements per job and annual growth rate of real compensation per job in state  $i$  at year  $t$  respectively.  $\beta < 1$  represents convergence.

I use the GMM estimator for dynamic panel data model proposed by Holtz-Eakin, Newey and Rosen (1988) and Arellano and Bond (1991) to estimate equation (1). The lagged dependent variable on the right hand side makes the regressors endogenous (since  $y_{it}$  is a function of  $\theta_i$ , so  $y_{it-1}$  is also correlated with  $\theta_i$ ). State-

specific omitted variables also make the regressors endogenous. The GMM estimator takes the regressors as endogenous and generates additional instruments by utilizing the orthogonality condition between the lagged values of the regressors and the disturbance term  $\varepsilon_{it}$ .

**4. Result**

First, I examine whether the convergence of real per-capita personal income automatically ensures the convergence of wage and salary disbursements per job and compensation per job. Next, I investigate the regional pattern of convergence of real wage and salary disbursements per job and real compensation per job between 1990 and 2010.

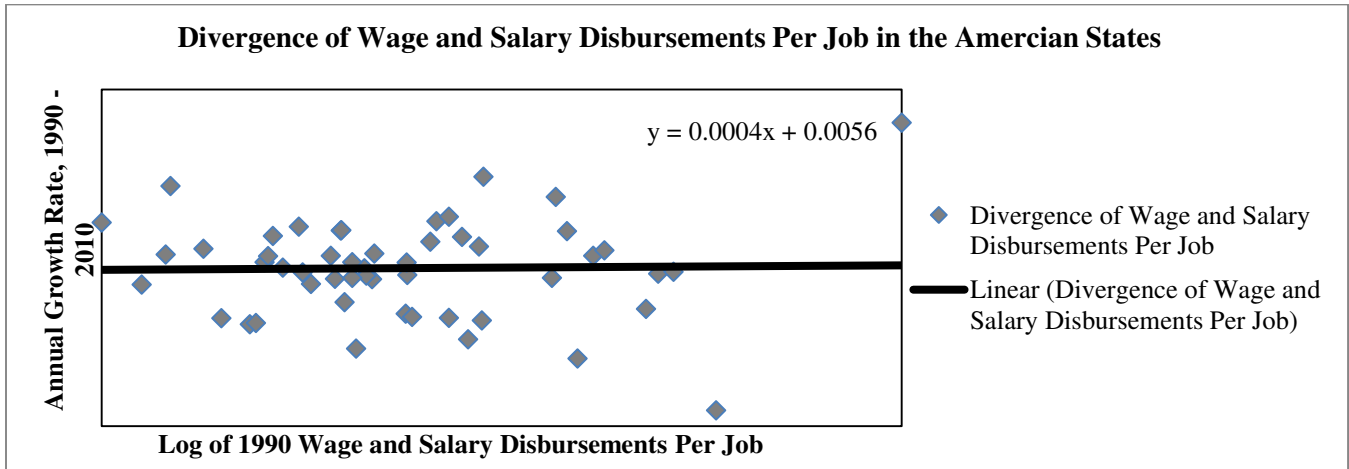


**Diagram 1: Convergence of Per-Capita Personal Income in the American States**

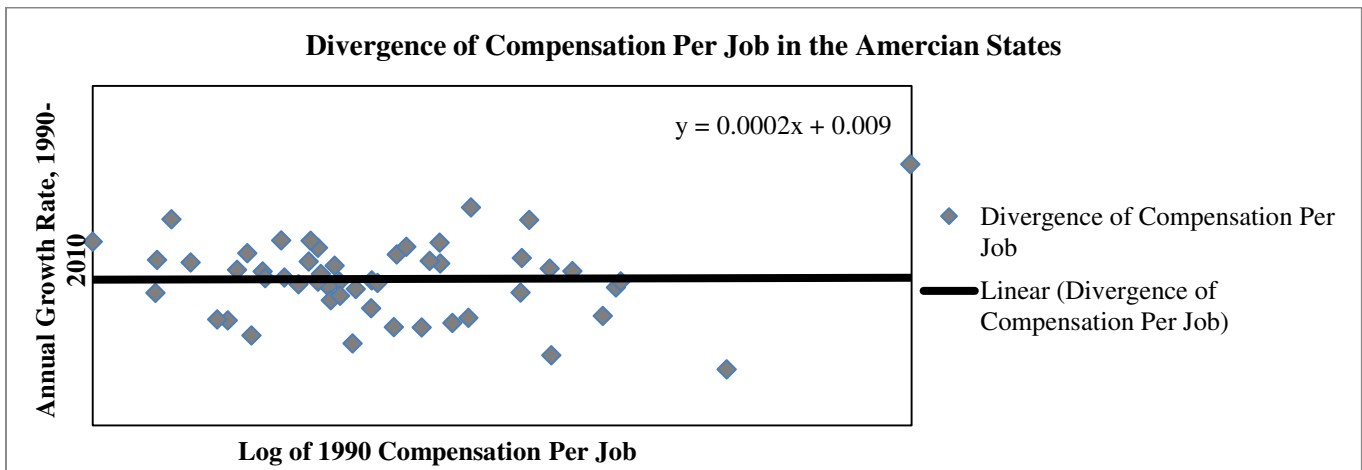
Diagram 1 shows the relationship between log of real per-capita personal income at 1990 and the annual growth rate of real per-capita personal income between the period 1990 and 2010. Negative slope (-0.0077) of the fitted line verifies the convergence of real per-capita personal income between the year 1990 and 2010.

Diagram 2 represents the relationship between the log of real wage and salary disbursements per job at 1990 and the annual growth rate of real wage and salary disbursements per job between the period 1990 and 2010. The fitted line has a positive slope (0.0002). This means that states with high real wage and salary disbursements

per job at 1990 is growing at a higher rate. This result verifies the divergence of American states with respect to real wage and salary disbursements per job between 1990 and 2010.

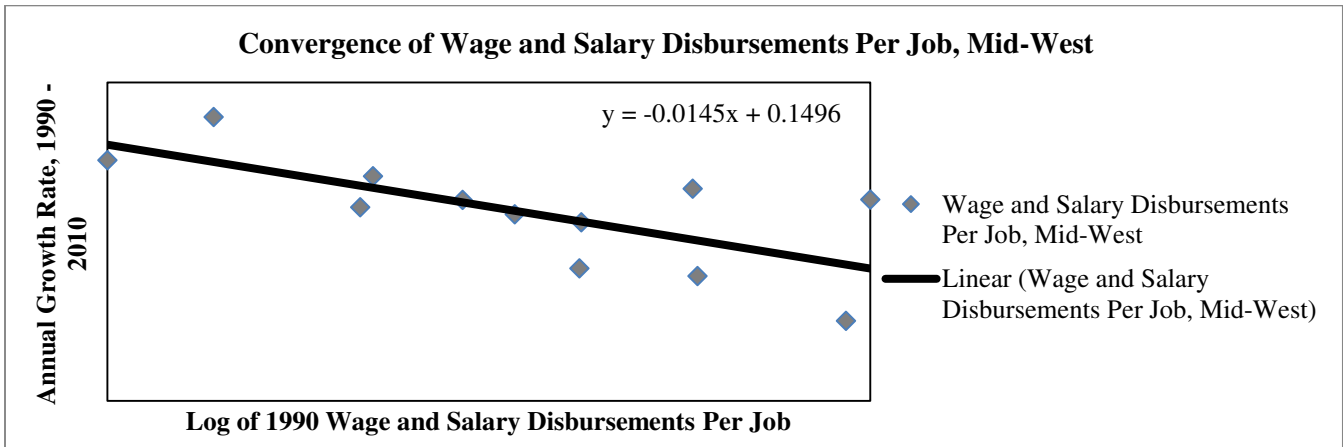


**Diagram 2: Divergence of Wage and Salary Disbursements Per Job in the American States**

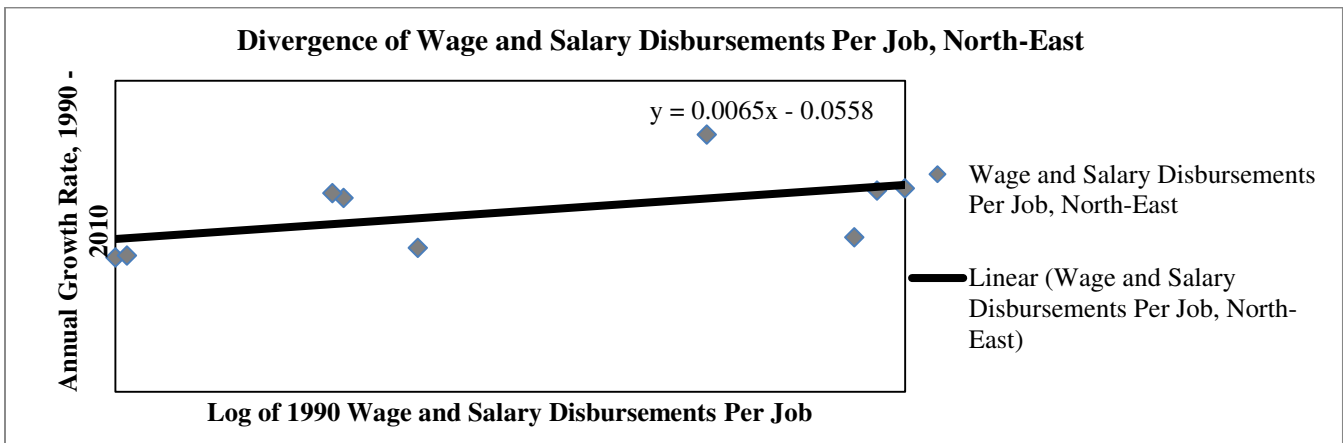


**Diagram 3: Divergence of Compensation Per Job in the American States**

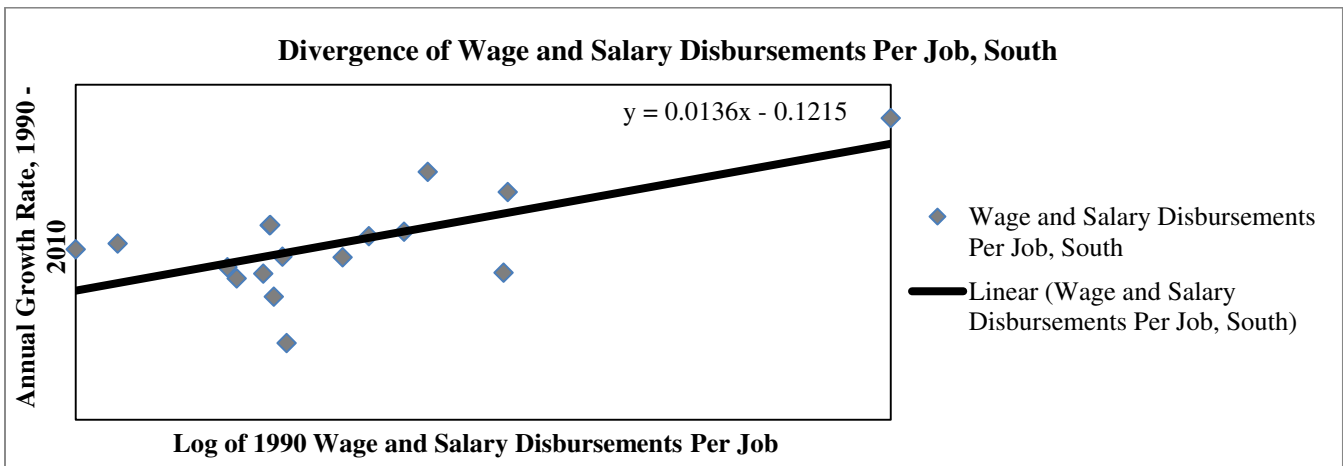
I find the similar result of real compensation per job for US states between 1990 and 2010. Diagram 3 presents the relationship between log of real compensation per job at 1990 and the annual growth rate of real compensation per job between the period 1990 and 2010. The fitted line has a positive slope (0.0004). This result confirms the divergence of US states with respect to real compensation per job between 1990 and 2010.



**Diagram 4: Convergence of Wage and Salary Disbursements Per Job, Mid-West**

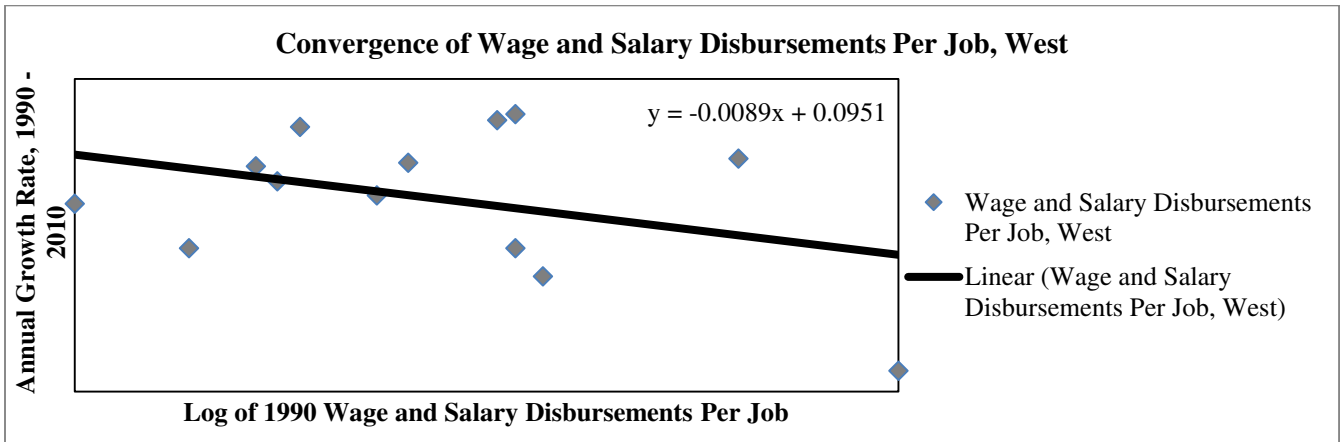


**Diagram 5: Divergence of Wage and Salary Disbursements Per Job, North-East**

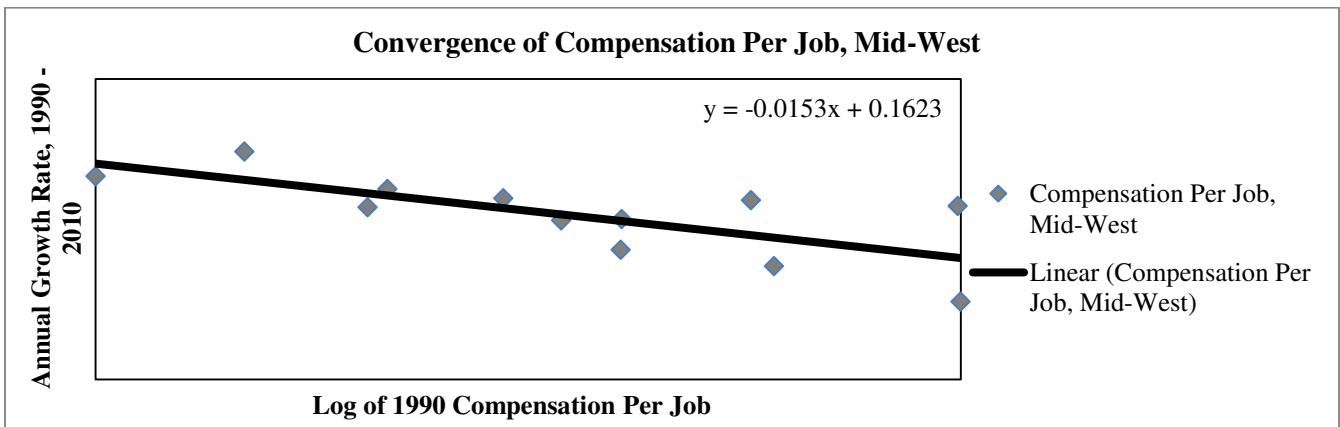


**Diagram 6: Divergence of Wage and Salary Disbursements Per Job, South**

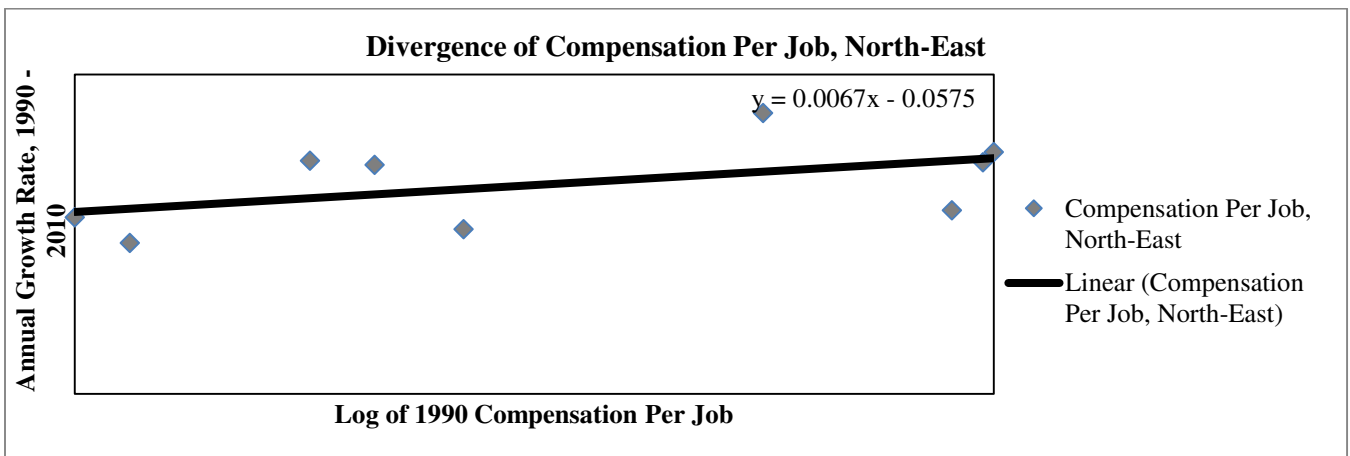




**Diagram 7: Convergence of Wage and Salary Disbursements Per Job, West**

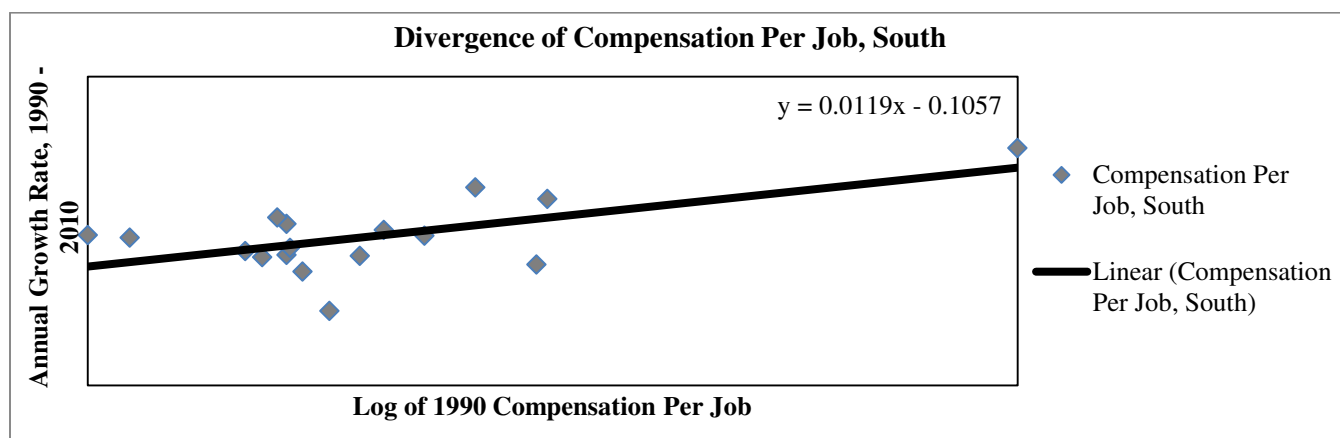


**Diagram 8: Convergence of Compensation Per Job, Mid-West**



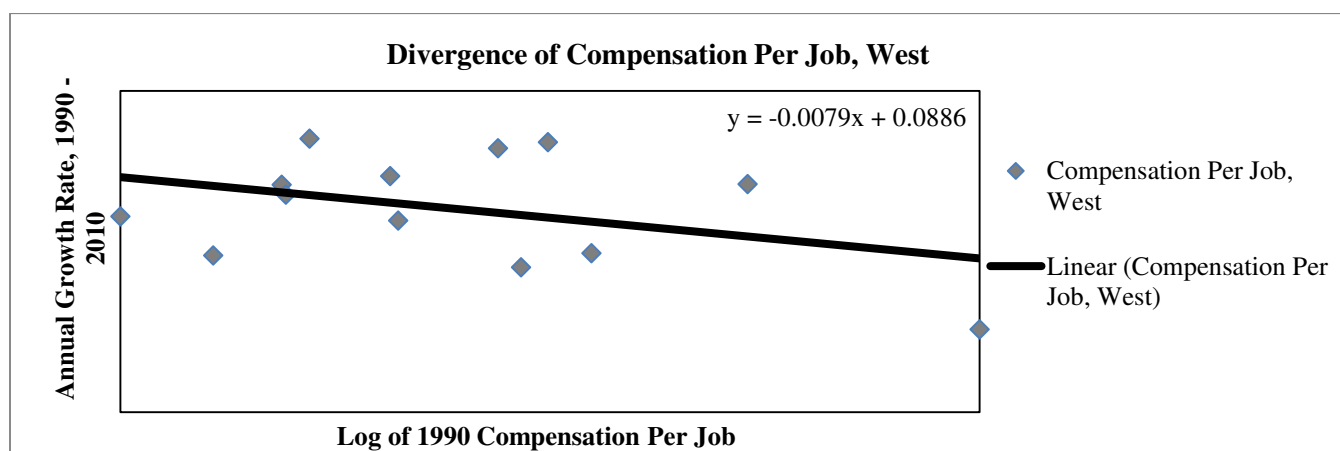
**Diagram 9: Divergence of Compensation Per Job, North-East**

Diagram 4, 5, 6 and 7 represent the relationship between the real wage and salary disbursements per job at 1990 and its annual growth rate between 1990 and 2010 for the 'Mid-West', 'North-East', 'South' and 'West' of United States. I find the evidence of convergence of real wage and salary disbursements per job in the US 'Mid-West' and 'West' between 1990 and 2010. However, the US 'North-East' and 'South' exhibit the sign of divergence of real wage and salary disbursements per job between 1990 and 2010.



**Diagram 10: Divergence of Compensation Per Job, South**

Diagram 8, 9, 10 and 11 present the regional pattern of convergence or divergence of real compensation per job between 1990 and 2010. US 'Mid-West' and 'West' show the sign of convergence and US 'North-East' and 'South' demonstrate the sign of divergence of real compensation per job between 1990 and 2010.



**Diagram 11: Convergence of Compensation Per Job, West**

Table 1 shows the estimation result of equation (2) for real wage and salary disbursements per job between 1990 and 2010. The value of  $\hat{\beta}$  is equal to 1.0001 for fifty one states in the United States between 1990 and 2010 and it is statistically significant. This result signifies that wage and salary disbursement per job is diverging in the United States over the period 1990 and 2010. Next, I divide the fifty one states into two groups based on graphical relationship between wage and salary disbursements per job at 1990 and its annual growth rate between 1990 and 2010. The first group has twenty six states (nine states from ‘North-East’ and seventeen states from ‘South’). The second group has twenty five states (twelve states from ‘Mid-West’ and thirteen states from ‘West’). The value of  $\hat{\beta}$  is equal to 1.0059 for the first group and it is statistically significant. This result indicates the evidence of divergence for the states in the US ‘North-East’ and ‘South’. The value of  $\hat{\beta}$  is equal to 0.9875 for the second group and it is statistically significant. This result indicates the evidence of convergence for the states in the US ‘Mid-West and ‘West’.

<b>Table 1: Regression on Real Wage and Salary Disbursements Per Job</b>	
Dependent Variable: Growth of real wage and salary disbursements per job	
Variable	$\hat{\beta}$
Initial real wage and salary disbursements per job (All American States)	1.0001*** (3.62e-07)
No of obs.	1020
Initial real wage and salary disbursements per job (States of North-East and South)	1.0059*** (0.0006)
No of obs.	520
Initial real wage and salary disbursements per job (States of Mid-West and West)	0.9875*** (0.0040)
No of obs.	500

Table 2 presents the estimation result of equation (2) for real compensation between 1990 and 2010. The value of  $\hat{\beta}$  is equal to 1.0011 for fifty one states in the United States between 1990 and 2010 and it is statistically significant. This result signifies that r real compensation is diverging in the United States over the period 1990 and 2010. The value of  $\hat{\beta}$  is equal to 1.0065 for the twenty six states in the US ‘North-East’ and ‘South’ and it is statistically significant. This result indicates the evidence of divergence of real compensation for the states in the US ‘North-East’ and ‘South’. The value of  $\hat{\beta}$  is equal to 0.9919 for the twenty five states in the US ‘Mid-West and ‘West’ and it is statistically significant. This result indicates the evidence of convergence for the states in the US ‘Mid-West and ‘West’.

<b>Table 2: Regression on Real Compensation Per Job</b>	
Dependent Variable: Growth of real Compensation per job	
Variable	$\hat{\beta}$
Initial real compensation per job (All American States)	1.0011*** (1.46e-09)
No of obs.	1020
Initial real compensation per job (States of North-East and South)	1.0065*** (0.0012)
No of obs.	520
Initial real compensation per job (States of Mid-West and West)	0.9919*** (0.0034)
No of obs.	500

## 5. Conclusion

I examine the convergence of wage and salary disbursements per job and compensation of employees per job for fifty one states in the United States between 1990 and 2010. I use wage and salary disbursement and compensation of employees for two reasons. First, wage and salary disbursements comprise minimum fifty two

percent and maximum fifty six percent of personal income between the period 1990 and 2010. These percentages are sixty four and sixty eight respectively for compensation of employees between the period 1990 and 2010. Second, wage rate is a proxy of per capita income. I examine whether convergence of personal income automatically ensures the convergence of its two largest components. Additionally, I investigate the pattern of convergence of wage and salary disbursements per job and compensation per job for four US regions.

I find negative relationship between log of real per-capita personal income at 1990 and the annual growth rate of real per-capita personal income between 1990 and 2010. This result verifies the convergence of real per-capita personal income between the year 1990 and 2010. However, this relationship is not true for real wage and salary disbursements per job and real compensation per job. I find statistically significant positive relationship between real wage and salary disbursements per job and its annual growth rate and real compensation per job and its growth rate. These results prove the divergence of real wage and salary disbursements per job and real compensation per job between 1990 and 2010.

I examine the evidence of convergence or divergence of real wage and salary disbursements per job and real compensation of employees per job for four US regions. I find that real wage and salary disbursements per job and real compensation per job for the 'Mid-West' and the 'West' are converging, whereas they are diverging for the 'North-East' and the 'South'. I divide the fifty one states into two groups: the first group consists of twenty five states of the 'Mid-West' and the 'West' and the second group consists of twenty six states of the 'North-East' and the 'South'. I find the statistically significant evidence of convergence for twenty five states in the 'Mid-West' and the 'West' and statistically significant evidence of divergence for twenty six states in the 'North-East' and the 'South' for wage and salary disbursements per job and compensation of employees per job between 1990 and 2010.

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