Explaining Labor Share Movements: A Regional Analysis*

What drives labor share of income across regions in Korea?

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This study investigates the explanatory forces behind changes in labor shares over 2000-2014 in Korea. Unlike previous studies focused on cross-national differences in labor shares, our focus is on the changes in labor shares across regions within Korea. Although the labor share of Korea's national income has been relatively stable over time, the labor shares at the regional level have shown very diverse trends across 16 metropolitan areas and provinces, varying from a 9.7% point increase to a 5.6 % point decrease over the sample period. In this paper, we examine why labor shares vary widely across regions even though they share common economic environments such as trade liberalization, tax system and minimum wage law. By estimating an array of cross-regional models, we find that the concentration of manufacturing industry, the share of university-educated workers, and the average age of firms are important factors affecting labor shares in regional income. Furthermore, we employ the panel VAR model to estimate dynamic responses of the labor shares while allowing for regional heterogeneities. Our results show that shocks to capital-output ratio, total factor productivity and the concentration of both manufacturing and services industries all lead to a decline labor shares over time. We also show that the concentration of manufacturing and service industries are more important in metropolitan cities than in provincial areas. Our results demonstrate that heterogeneities in product and labor markets should be taken into account to understand the changes in labor shares in regional income. Policies aimed at raising labor income would need to take a regional approach.

Keywords: labor share, Herfindahl-Hirschman index, dynamic panel model, panel VAR, regional analysis

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1. Introduction

The labor share in national income has been one of the crude measures of income distribution. It indicates a division of income between workers and capital owners, and possibly shows the position of workers relative to that of capitalists in a society. As Kuznets (1933) pointed out, there are serious political and social conflicts about the relative size of labor income. Governments as well as workers and capitalists are very much concerned with the changes in the labor share, and those changes in the labor share are sometimes the results of class struggle and class compromise, which in turn shapes governments' social policies (Kristal 2013).

Recently, a number of studies have observed and documented a declining trend of labor share in national income among developed and developing countries, especially in 2000s (Rodriguez and Jayadev, 2010; OECD, 2012; Dunhaupt, 2013; Karabarbounis and Neiman, 2014; van Treeck and Wacker, 2017; Autor et al, 2017). This observation sparked considerable debate on why the decline has occurred. Proposed causes are such as capital accumulation and skill-biased technical changes (Bentolila and Saint-Paul, 2003; Driver and Muñoz-Bugarín, 2010; Hutchinson and Persyn, 2012), an increase in import competition and offshoring (Harrison, 2002; Elsby et al, 2013), financial globalization and FDI (Bassanini and Manfredi, 2014; Decreuse and Maarek, 2015; van Treeck and Wacker, 2017), market structure and product market competition (Blanchard and Giavazzi, 2003; Jaimovich and Floetotto, 2008), union density and bargaining power of workers (Bentolila and Saint-Paul, 2003; OECD 2015), and minimum wage and employment protection legislation (IMF, 2007; European Commission, 2007; ILO, 2012; OECD, 2012).

Although the decline of the labor share in national income informs us that the relative income position of an *average* worker in a country deteriorates over time, it by no means indicates that the relative incomes of *all workers* in a country have worsened. By the same token, even if the aggregate labor share is stable over time, it is possible that labor shares in some sectors decline substantially, affecting workers adversely in those sectors. This aspect is also well expressed by Elsby et al (2013) who show that the stable aggregate labor share prior to the 1980s in the US in fact disguised substantial movements, though offsetting each other, in labor shares at the industry level. Accordingly, the changes in the aggregate labor share sometimes do not provide adequate information about how workers are affected differently by those changes, so we need to look at the changes in the labor share at more disaggregate levels.

In this paper, we examine the changes in the labor share at regional level. Previously, many studies have looked at the changes in the labor share at the country level. Therefore, proposed causes for the decline in the labor share in many countries are found on the basis of cross-country differences. However, country-based causes such as globalization, import-competition and minimum wage laws cannot explain the different trends of labor shares across regions in a country since those factors are

mostly constant for all regions in a country.[1] Therefore, one must investigate other factors that are more specific to regions to explain the different movement of labor shares across regions.

If the trend of the aggregate labor share is similar to those of regional labor shares, studying the causes for changes in the labor share at the regional level may not be so interesting. However, as we will see below, the trend of the aggregate labor share in Korea is very different from those of the regional labor shares, which makes our case study of Korea more interesting. The examination of the changes in the labor share at the regional level also reveals that welfares of workers in different regions are affected differently under the same aggregate economic changes.

Because we attempt to explain the differences in changes of the labor share across regions, we need to utilize information at the regional level. One of the important contributions of our paper is that our explanatory variables are constructed directly from the information on firms and individuals at the regional level. For example, we use the Census of Establishments, which contains information on all firms in Korea, to construct is the Herfindahl-Hirschman (HH) index at the regional level. We also use the Economically Active Population Survey to construct the share of temporary workers and the share of university graduates at the regional level. Therefore, we are able to link the activities of firms and individuals at a region to the changes of the labor share at that region.

In addition to the Herfindahl-Hirschman (HH) index and the shares of temporary workers and university graduates, we also allow the labor share to respond to changes in region-specific conditions such as local market structure, the share of employment utilized in the four largest firms, the average tenure of firms, and union density. The share of employment utilized in the four largest firms to test the "the superstar firm hypothesis" suggested by Autor et al (2017). The union density is supposed to measure bargaining power of workers and unions. In Korea, large corporations such as Samsung and Hyundai are located in certain provinces and those large firms are highly unionized. Therefore, the union density can be an important factor to explain the difference in the labor shares across regions.

The average tenure of firms is an additional variable we propose in the model that the previous studies have not considered. As the tenure of a firm increases, it is more likely that the firm has a greater marker power since the longer tenure implies longer survival in the market. We expect that the average tenure of firms has a negative impact on the labor share in the regional income in addition to the negative effects of the HH index.

Using 16 metropolitan and provincial data from 2000 to 2014 in Korea, we estimate a dynamic panel model where the current labor share is dependent on previous labor shares. This state dependence is supposed to capture the difference in initial levels of the labor share stemming from heterogeneities in production or market structure across regions. Our empirical results suggest that the

[1] Minimum wage laws can be different across regions in some countries. However, Korea, which is our basis of analysis, has a national minimum wage law that applies to all regions in Korea.

difference in labor shares across regions can be largely explained by difference in regional industry structure, the concentration of manufacturing (service) industry, the share of university graduates, the union density and the average tenure of firms.

This paper is structured as follows. Section 2 describes how the labor share in income is defined in our study, and presents the trend of the labor shares in national and regional income in Korea. Section 3 presents the econometric models and estimation procedures. Section 4 explains the data and describes how the variables in the model are constructed. Section 5 presents estimation results obtained from dynamic panel models and panel VAR models. Section 6 summarizes the main findings of this study and suggests implications of our results on the increasing disparity across regions in Korea.

2. The Changes of Labor Shares in Korea

The labor share normally refers to the fraction of national income that belongs to labor. When income is distributed to factors of production, the labor share is then the compensation of employees as a share of GDP or value-added (Dühaupt, 2013). However, the consumption of fixed capital is a part of capital income (profits), so we can define the labor share as

$$(1)\quad LS_t = \frac{CE_t}{CE_t + PR_t + CFC_t}$$

where CE_t denotes the compensation of employees, PR_t profits, and CFC_t the consumption of fixed capital. The denominator of (1) is equivalent to the gross value added (GVA) net of other taxes on production less subsidies (Kim, 2016). Gollin (2002) shows that large differences between labor shares of rich and poor countries disappear when the earnings of self-employed are corrected. There are several ways to adjust for the labor income of self-employed. We follow Gollin's third suggestion that the self-employed earn the same wage as employees. This kind of adjustment was commonly adopted by many studies (Hutchinson and Persyn, 2012; Kim, 2016; van Treeck and Wacker, 2017). Therefore, the adjusted labor share is defined as

$$(2)\quad LS_t = \frac{CE_t}{CE_t + PR_t + CFC_t} \times \frac{N_t}{N_t - N_t^{self}}$$

where N_t denotes total number of workers and N_t^{self} the number of self-employed. Figure 1 shows the trends of unadjusted and adjusted labor shares in national income in Korea. The self-employment

adjusted labor share is about 15% point higher than the unadjusted labor share. This conspicuous difference comes from the large share of self-employment in Korea.[2]

Figure 1 The Trend of the Labor Share in National Income

The national labor share (self-employment adjusted) in Korea increased from 59.2% in 2000 to 61.7% in 2006 and then decreased to 59.5% in 2014. The pattern is quite consistent with the findings of Kim (2014) although his time span is much longer than ours.[3]

Although the labor share in national income is fairly stable in 2000s, the labor shares across regions present quite a different picture. Table 1 shows the labor shares of 16 metropolitan cities and provinces in Korea during the period 2000-2014. From the table, we can observe two important things. First, the levels of the labor shares are quite different across regions. This implies that there may be intrinsic differences in market structures and production technologies as well as labor market characteristics. Second, the movements of the labor shares over time are also varying across regions. Out of 16 metropolitan cities and provinces, 6 of them experienced an increase in the labor share during that period while 10 experienced a decrease. The largest increase in the labor share occurred in Ulsan where many Hyundai companies are located in and the largest decrease happened in Busan although the level of the labor share in Busan is much larger than that of Ulsan (Appendix Figure 1).

Table 1 The Labor Shares in Metropolitan Cities and Provinces in Korea, 2000-2014

Figure 2 presents correlations between the labor share in Korea as a whole and the labor share of each city and province. All correlations are positive, indicating that the trend of the labor share in national income generally moves in the same direction with that of the labor shares in the regions. However, the magnitude of the correlations ranges from 0.36 with Geoungbuk to 0.82 with Chungbuk. The movement of the labor share in national income, therefore, cannot fully explain the changes of the labor share in all regions. In order to understand the changes of the labor shares at the regional level, one has to explain why different regions have different movements of labor shares even in the same aggregate economic conditions. To answer this question, one needs to exploit reasons that are more regional-based.

Figure 2 Correlations between Regional Labor Share and National Labor Share

[2] In 2014, the share of self-employed workers in total employment in Korea is 26.8%, whereas the average share for the OECD member countries in that year is 15.4%.

[3] The time span of our analysis is limited to 2000 to 2014 because regional data on income accounts are only available after 2000 in Korea.

3. Models and Estimating Techniques

1) Theoretical Backgrounds

When product and labor markets are competitive and the production function is Cobb-Douglas, $Q_t = AL_t^{\alpha}K_t^{1-\alpha}$, it can be easily shown that the labor share in total income is represented by the parameter of the labor input (α) which is a constant. When the product market is not competitive, firms enjoy some markups and hence the labor share depends on the markup as well as the parameter of the labor input. Specifically, if the production function is of a CES form, $Q_t = [(A_tK_t)^{\varepsilon} + (B_tL_t)^{\varepsilon}]^{1/\varepsilon}$, then the labor share becomes:

$$(3)\quad LS_t = \frac{\eta_w}{\mu}$$

where μ is the markup and η_w is the elasticity of the capital-labor ratio with respect to wage, holding capital constant. Bentolila and Saint-Paul (2003) shows that the elasticity of substitution between K and L (σ_{LK}) is related to η_w, together with the capital-labor ratio and the elasticity of the labor share with respect to the capital-labor ratio. It is known that if σ_{LK} is smaller than one in absolute value, an increase in the capital-labor ratio lead to a decline in the labor share (Bentolila and Saint-Paul, 2003; Dühaupt, 2013).[4]

Equation (3) indicates that the labor share is inversely related to the markup. As the markup tends to increase when the product market is more concentrated, we expect the labor share in income to decrease as the measures of market concentration such as the Herfindahl-Hirschman (HH) index or the market share of a small number of firms increase.

The bargaining power of labor can also influence the labor share in income. Using the "efficient bargaining model" where unions and firms bargain over wage and employment, Bentolila and Saint-Paul (2003) show that when there is an increase in workers' bargaining power, the labor share increases given the capital-output ratio.[5] Hutchinson and Persyn (2012) also consider the efficient bargaining model when firms can relocate their plants in a foreign country as an outside option. Their theoretical model shows that the labor share depends on the union's bargaining power, but the direction of the effect is ambiguous. Kim (2012) constructs a theoretical model where the product

[4] On the other hand, Karabarbounis and Neiman (2014) estimated the capital-labor elasticity of substitution to be greater than unity so that a decrease in the relative prices of capital goods actually leads to a decline in the labor share.

[5] However, their empirical results do not strongly support the theoretical prediction. They used the number of labor-management conflicts as a proxy for the union power, but the effects of the variable on the labor share are negative and sometimes statistically insignificant.

market is imperfectly competitive and unions and firms jointly determine wages and employment. The labor share is then derived as:

(4) $LS_t = \frac{\eta_L}{\mu} k + \gamma(1 - \frac{1}{\mu})$

where μ is the markup, η_L the elasticity of output with respect to labor, k the capital-labor ratio measured in efficiency units, and γ the bargaining power of unions. From equation (4), it is easily seen that an increase in the markup (μ) lowers the labor share as long as η_L is larger than the bargaining power (γ), and an increase in the bargaining power (γ) raises the labor share because μ>1.

As discussed briefly in the introduction, our purpose is to empirically explain the differences in changes of the labor share at the *regional level* rather than at the national level. Therefore, we construct measures for markup and workers' bargaining power for each of 16 metropolitan cities and provinces in Korea. We also consider other factors that can influence labor shares in regions such as the share of temporary workers, the share of university-educated workers, and the average age of firms. We do not consider such factors as trade liberalization, tax system, and minimum wage law because they are relatively common to all regions in Korea.

2) Dynamic Panel Models

Previous studies on the decline of the labor share address the role of capital accumulation and capital-augmenting technical change. These studies include Bentolila and Saint-Paul(2003), Arpaia et al.(2009), Driver and Muñoz-Bugarin(2010), Raurich et al.(2012) and Hutchinson and Persyn(2012). Unfortunately, data on capital stock at the Korean regional level are not available. Thus, we are also unable to estimate total factor productivities at regions precisely. Instead, we use per capita GDP and depreciation of capital as the proxy variable for technological change and capital accumulation.

Based on the discussion from theoretical models above, our basic specification of the empirical model is as follows:

(5) $LS_t = F(LS_{t-1}, lnGDPPerCapita_t, HHM_t, HHS_t, Tenure_t, Manu_t, Service_t, Univ_t, Unionden, Temprate, Indep\_capital)$

where

LS_t= adjusted labor share

LS_{t-1}= one period lagged adjusted labor share (expected sign: +)

$lnGDPPerCapita_t$= log of real GDP per capita (expected sign: -)

HHM_t= Herfindahl-Hirschman index for manufacturing sector (expected sign: -)

HHS_t= Herfindahl-Hirschman index for service sector (expected sign: -)

$Tenure_t$,= Average age of firms (expected sign: -)

$Manu_t$= The share of manufacturing sector (expected sign: +)

$Service_t$= The share of service sector (expected sign: +)

$Univ_t$= The share of university graduates in the workforce (expected sign: +)

$Unionden$= The density of Union

$Temprate$= The ratio of temporary workers

$Indep\_capital$= the depreciation of capital

Equation (5) is panel regression with a lagged dependent variable on the right-hand side. It is important to ascertain the serial correlation properties of the disturbances in our model, which are crucial for the formation of an appropriate estimation procedure.

Following Arellano and Bover (1995) and Bludell and Bond (1998), we employ the system GMM estimator. This involves the estimation of a system of two simultaneous equations, one in levels (with lagged levels of the regressors as instruments) and the other in first differences (with lagged first differences as instruments). In addition, we include the region fixed effects and the time fixed effects to control the unobserved regional characteristics and the common shocks for all regions.

3) The panel VAR

In recent years, the vector autoregressive (VAR) model, a well-understood empirical tool in macroeconomic time series, has been extended to incorporate panel data settings. The advantage of the panel VAR is that it allows summarizing dynamics of data while allowing for cross-sectional heterogeneities. Moreover, it is the impulse response and variance decomposition analysis that comes with a VAR setting and applying this to a panel data framework has the potential to enrich an empirical analysis in many applications.

Following Canova and Ciccarelli (2013), consider the following panel VAR model. Let y_{it} be a vector of G variables for each cross-sectional unit i = 1, …., N for each time unit t = 1, …., T, and X_t is a set of M exogenous variables. For simplicity of exposition, assume that there are G=4 variables, N=4 cross-sectional units[6], and 2 weakly exogenous variables forming the vector of exogenous variables $X_t = [X_{1t}, X_{2t}]'$. Since the exogenous variables can be incorporated, the representation is the panel VARX model.

[6] Our number of cross-sectional units is much larger, N=16, rather than N=4.

$$y_{1t} = A_{11}(L)y_{1t-1} + A_{12}(L)y_{2t-1} + A_{13}(L)y_{3t-1} + A_{14}(L)y_{4t-1} + F_1(L)X_t + u_{1t}$$
$$y_{2t} = A_{21}(L)y_{1t-1} + A_{22}(L)y_{2t-1} + A_{23}(L)y_{3t-1} + A_{24}(L)y_{4t-1} + F_2(L)X_t + u_{2t}$$
$$y_{3t} = A_{31}(L)y_{1t-1} + A_{32}(L)y_{2t-1} + A_{33}(L)y_{3t-1} + A_{34}(L)y_{4t-1} + F_3(L)X_t + u_{3t}$$
$$y_{4t} = A_{41}(L)y_{1t-1} + A_{42}(L)y_{2t-1} + A_{43}(L)y_{3t-1} + A_{44}(L)y_{4t-1} + F_4(L)X_t + u_{4t}$$

where $u_t = [u_{1t}, u_{2t}, ..., u_{Nt}]' \square\ iid(0, \Sigma), A_{ih}(L)$ is the lag polynomials in matrices for *j* lags. Note that $E(u_t u_t') \equiv \Sigma_u = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} & \sigma_{14} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} & \sigma_{24} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} & \sigma_{34} \\ \sigma_{41} & \sigma_{42} & \sigma_{43} & \sigma_{44} \end{bmatrix}$ is a full matrix where σ_{ij} are 6×6 matrices for *i*, *j* = 1, .. 4, since the *G* (2 in the above model) variables are the same for each unit. The model allows dynamic interdependencies, static interdependencies and cross-sectional heterogeneities.

In our application, dynamic cross-sectional differences are likely to be important because you use a panel dataset consisting of heterogeneous regions in terms of demography, industry structure and regional policies. We aim to use the panel VAR framework to add a different but complementary dimension to the empirical framework adopted in the previous section. In particular, we follow the production function based approach explored by Bentolila and Saint-Paul (2003) and employed by Hutchinson and Persyn (2012).

Consider a production function, $Q = F(K, BL) = Kf(l)$, where *K* is capital, *L* is labor and *B* is the labor augmenting technology. Note that *f*(*l*) is the output-capital ratio, where $l \equiv BL/K$. It can then be shown that the labor share in competitive factor markets is a function of the capital-output ratio.

$$LS(k) = g(k)\, f'(g(k))k$$

where $k = 1/f(l)$, $l = g(k) = f^{-1}(k)$. After including total factor productivity variable *Z*, this implies that the labor share *LS* can be written as,

$$\log LS_{it} = \beta_0 + \beta_1 \log(K_{it}/Y_{it}) + \beta_2 \log Z_t + \varepsilon_{it}$$

This specification is similar to that of Hutchinson and Persyn, with the exception that we also incorporate total factor productivity. However, unlike their empirical strategy only allowing the labor

share to be endogenous, we allow all the variables to be endogenous, and hence the panel VAR provides a natural framework. After including per capita income in each region, our panel VAR model comprises the following endogenous variables: $y_{it} = [LS_{it}, K_{it} / Y_{it}, Y_{it} / POP_{it}, Z_t]'$ plus a set of two weakly and contemporaneously exogenous variables $X_t = [X_{1t}, X_{2t}]'$ to be selected from a set of economy-wide and region specific institutional variables ranging across trade liberalization, economic growth, union density and educational attainment etc. We allow for cross-sectional heterogeneity in our panel VAR model, and report the impulse response function and variance decomposition of the labor share. We check for the sensitivity of the estimation results to different choice of lags and the vector of exogenous variables.

Estimating a panel VAR model requires a different strategy from a time series VAR or standard panel data model. We follow the estimation strategy of Arellano and Bover (1995), which is to transform variables using forward orthogonal deviation, allowing past realization as valid instruments. We estimate the entire model by a system GMM approach.[7]

4. Data and Descriptive Statistics

1) Data Sources and Variables

Our data for the labor shares come from regional income accounts provided by the Korean Statistical Information Service (KOSIS). Even though some public data on national income accounts are available from 1975, public data on regional income accounts are available only from 2000. For this reason, our analysis is limited to the period 2000-2014. There are 7 metropolitan areas and 9 provinces in Korea, so our full sample consists of 240 region-year observations. From the KOSIS, we also obtain information on the real GDP per capita and capital stock by region.

We use the microdata of the Census of Establishments, which contains information on all firms in Korea, to construct the Herfindahl-Hirschman (HH) index, the market share of top 4 firms, the average ages of firms, and shares of manufacturing and service sectors. The Herfindahl-Hirschman (HH) index and the market share of top 4 firms are assumed to be positively related to the markup and these measures are calculated at region-industry level. The average ages of firms can also measure market power of firms and they are calculated using the information on founding years of firms provided by the Census of Establishments. The shares of manufacturing and service sectors are obtained by using the number of workers employed in each sector at regional level.

[7] We estimated our panel VAR using the Stata procedures originally written and implemeted by Love and Zicchino (2006).

For shares of temporary workers and university-educated workers at regional level, we utilize the Economically Active Population Survey (EAPS). Temporary workers are defined as those whose length of contract is less than one year. University educated workers are those who have at least two-year college degrees.

We try two measures (the number of strikes and union density) for workers' bargaining power. Data on the number of strikes by region are available for 2006-2014 while data on union density are available for 2000-2010. Therefore, in order to test the effects of workers' bargaining power on the labor shares in regional incomes, we are forced to limit our sample to those sub-periods. Data on the number of strikes and union density are obtained from the surveys on union activities at regional level conducted by the ministry of labor in Korea.

For the panel VAR section, the key variable of interest is the capital output ratio as outlined in Section 3. In general, capital stock series is not available except for the annual series at the aggregate level. Even the annual or quarterly aggregate capital stock series are all computed based on a set of assumption of depreciation rates, capital accumulation dynamics and interpolation. Our strategy for computing capital stock series at the regional level is as follows. First, we obtained the data on consumption of fixed capital and the investment series at the regional level. While this allows us to estimate the net change in capital stock, we need the initial capital stock in order to use the capital accumulation equation, $K_{t+1} = (1 - \delta)K_t + I_t$. The initial capital stock could then be calculated using the aggregate capital stock at the beginning of our sample by assuming that the investment to capital at the regional level is constant at the aggregate level. We also estimate the total factor productivity at the regional level using the Malmquist method, and use the estimated regional TFP series for both dynamic panel and panel VAR estimation.

2) Descriptive Statistics

Table 2 presents sample means of the variables that are used in the empirical models for selected years. The average adjusted labor share increased from 62.7% in 2000 to 67.6% in 2005 and then gradually decreased to 62.2% in 2014. The average regional real GDP per capita has increased over time while the growth rate has been decelerating in recent years. The HH indices indicate that the market concentration in the manufacturing industry has decreased while that in the service sector increased and these patterns are consistent with those reflected in the shares of top four firms in markets. The average tenure of firms has increased from 6.1 years in 2000 to 8.7 years in 2014. We calculated the proportions of firms by tenure and found that the proportion of firm whose age is less than 3 years decreased from 0.439 to 0.341 in 2014 while the proportion of firm whose age is greater than 20 years increased from 0.064 to 0.118 in 2014. Therefore, regional markets in Korea have been

increasingly dominated by mature firms that are likely to have a greater market power.

Table 2 Summary Statistics for Variables

As expected, the share of manufacturing sector has been decreasing while that of service sector has been increasing. The share of university-educated workers has been steadily increasing and this is well anticipated given that the university attainment rate in Korea has also been increasing. The proportion of temporary workers whose contract is less than one year has increased until 2010 and then slightly decreased afterwards. Strike rates, measured by the number of strikes divided by employment, have decreased since 2005 and the union density decreased since 2005. It is interesting that strike rates reached a peak when the union density is high. The real GDP per capital

Table 3 presents correlations between variables in the model and the labor share by region. The correlation between the log of real GDP per capital and the labor share is negative in most regions although there are some regions with positive but insignificant correlations. The changes in the log of GDP per capita measures the growth rate and so the negative correlation may imply that regional economic growth is accompanied with capital-augmenting technology, reducing the labor share in regional income. The HH indices and market shares of top four firms in manufacturing and service sectors are generally negatively correlated with the labor shares in regions, even though the correlations with market shares of top four firms in manufacturing are found to be positive for some provinces such as Gangwon, Chungbuk, Chunbuk and Chunnam. These provinces are, however, relatively agriculture-based regions, so the top four firms in the manufacturing industry are not likely to be capital- intensive firms. For provinces like Incheon and Geyounggi whose major industries are manufacturing, the correlations with the market shares of top four firms are significantly negative. The average tenure of firms is also negatively correlated with the labor share, indicating a decrease in the labor share as firms get mature in the market.

Table 3 Correlations between Variables and the Labor Share by Region

As the manufacturing and service sectors increase relative to the agricultural sector, the labor shares in regional income are likely to decline. However, for Ulsan, which is called “Hyundai City”, the share of the manufacturing sector is strongly positively correlated with the labor share. This seems to be surprising because Hyundai companies are relatively capital-intensive ones compared to other manufacturing firms. The reasons for this phenomenon may be related to union strikes or union density. Given that union activities are positively correlated with the labor share as we look at the last

two columns in Table 3, and given that Ulsan has a high level of strike activities and union density,[8] the positive correlation between the share of the manufacturing sector and the labor share may be derived from the union's strong bargaining power in Ulsan.

The correlations between the share of university-educated workers and the labor share are generally negative. As the share of workers with university degrees increases, the average income of workers will increase. However, it is not certain that it will lead to an increase in the share of labor in total income. If the reason for an increase in the share of university-educated workers is due to skill-biased technical changes and if the skill-biased technical changes are complementary with more use of capital goods, then an increase in the share of university-educated workers may imply a decrease in the amount of labor used in production despite an increase in the average income of workers. In such a case, we may observe a negative correlation between the share of workers with university degrees and the labor share.

In most regions, the correlations between the share of temporary workers and the labor share are negative, which is consistent with our prior expectations. As the share of temporary workers increases, the average income decreases. Furthermore, an increase in the share of temporary workers may indicate that production technology is less skill-biased and hence the average quality of workers is lower. Finally, as discussed earlier, strike rates and union density are positively correlated with the labor share in most regions. It shows that changes in the labor share in some regions can be significantly affected by the changes in union's bargaining power in those regions.

5. Empirical Results

1) Estimation Results of Dynamic Panel Models

Table 4 shows the estimation results of Equation (5), which are obtained from dynamic panel models. All specifications include region and time fixed effects to account for unobservable characteristics of regions and the common time shocks for all regions. Per capita GDP, total factor productivity and the markup variables are treated as endogenous.

Columns (1) and (3) include per capita GDP as the proxy variable for technology advancement, while columns (2) and (4) instead include total factor productivity that is computed by approximating the weighted sum of the inputs (labor and depreciation of capital) from the OLS estimation of Cobb-Douglas production function.

[8] See Appendix Figure 2 for the strike rates and union densities for 16 provinces and metropolitan cities.

Table 4 Estimates of Dynamic Panel Models

The estimates of per capita GDP are negative and statistically significant at the 1 % level in column (1) and (3), implying that technological change results in the decline of the labor share across regions in Korea. However, the coefficients of total factor productivity in columns (2) and (4) are not significantly different from zero. Furthermore, the coefficients of the capital depreciation also are negative and highly significant in all empirical models. It means that capital accumulation has a negative impact on the labor share.

The effects of the markup on the labor share show the mixed results. Although the coefficient of Herfindahl-Hirschman (HH) index for services sector is negative and statistically significant in column (1), but it loses significance in column (2). In addition, the estimates the market share of top 4 firms, the alternative proxy variable for the markup, are not significant in column (3) and (4). Moreover, the estimates of tenure are negative and significant at the 1% level, implying that the age of firms is associated with the decline of the labor share. Finally, the coefficient of Univ is positive and significant, except column (1). It means that the share of university graduates in the workforce has a positive influence on the labor share.

2) Estimation Results of Panel VAR

We estimated a panel VAR model for the whole region, cities and provinces. This is to examine if the city areas show any different responses from the provincial areas in understanding the labor share dynamics. The lag length tests suggest 3 lags for the whole sample and 2 lags for the sub-samples. We initially included the exogenous variables such as GDP per capita and the openness index, but they were not significant and dropped. Since we already included per capita output (income) among the endogenous variables, this does not pose a significant issue. Since the main purpose of using the panel VAR is to summarize the dynamic interactions allowing for cross-sectional heterogeneities, we report the impulse response functions and interpret our results from this section. To identify shocks, we use a recursive scheme based on the following Cholesky ordering: TFP, K/Y ratio, income and labor share. This implies that income and labor shares cannot contemporaneously affect TFP and K/Y ratio while K/Y ratio cannot contemporaneously affect TFP. The ordering between income and labor share is less clear but the ordering is robust between income and labor share.

Figure 3.1 shows the impulse responses to own labor share shocks across the whole regions, cities (metropolitan areas) and provinces. It is notable that provincial areas show larger and more persistent

labor shares than city areas.[9] Even after six years, the labor share remains significant at above 25 percent of the impact response. This indicates that raising or lowering labor share of income takes longer in provincial areas than in cities.

Figure 3.2 presents a simple way of verifying the theoretical prediction that a higher capital output ratio lowers the labor share. For all regions, the response is negative although it is not significant for city areas. For provincial areas, the response is quicker and more significant in the short run compared to the whole region and cities. This is not surprising given almost all of the large and capital-intensive industries are located in provincial areas in Korea. The labor share in the city area shows some negative response to a positive capital output shock but appears less significant compared to the provincial areas. This indicates that applying the theoretical approach suggested by Bentolila and Saint-Paul (2003) is sensitive to the choice of regions. In terms of the speed of response to the capital-output ratio shocks, cities and provincial areas also show heterogeneous responses. Firms in the provincial areas show a more speedy response to the shock, implying that they are more responsive to replacing labor with capital. On the other hand, city areas show a slower response in substituting capital for labor. The response for the whole sample shows that the impact on labor share is felt the most within three to four years.

Figure 3.3 depicts the response of labor share to regional TFP shocks. Unlike the previous impulse responses, the labor share shows the most varying responses to the TFP shocks. While the whole region shows that the labor share shows a significantly negative response to a positive TFP shock, the responses in the city and provincial areas are quite different in terms of the signs. The provincial areas show a negative response to TFP shocks while the city areas show a positive response. This implies that TFP tends to be complementary with respect to labor in cities while it leads to a downward movement in labor share in provincial areas, substituting capital for labor. This is consistent with the results shown in Figure 3.2, as the provincial areas are more responsive to the labor-capital mix in production. This difference in the response of labor share to cities versus provinces cannot be spotted in an aggregate labor share analysis.

Figure 3.4 displays the response of labor share to shocks to per capita income. All figures across different classification of regions show a negative response of labor share to an income shock, indicating that a positive income shock leads to a significant decrease in the labor share. This may reflect the trend that as a regional economy grows in per capita terms the labor share tends to decrease due to various reasons. A technological progress or a positive wealth shock may be a driving force, which in turn lowers the labor share, either due to a capital-labor substitution or an income effect that may reduce labor supply.

[9] Note that the terms city and metropolitan areas are used interchangeably.

We extend the panel VAR model further by incorporating the degree of market concentration in the presence of the capital-output ratio. The variables to be added in our analysis are the Herfindahl-Hirschman (HH) indices of the manufacturing and services sector. As discussed in Section 3, it can be hypothesized that an increase in mark-up as measured by the HH index leads to a decrease in labor share. In fact, both static and dynamic panel models we estimate show results consistent with this hypothesis. So, our vector of endogenous variables is now $y_{it} = [LS_{it}, K_{it} / Y_{it}, Z_t, HHM_{it}, HHS_{it}]'$, where *HHM* and *HHS* are the HH index for manufacturing and services sectors. To keep the model dimension manageable and preserve degrees of freedom, we deleted the income variable from the endogenous vector. Shcoks are now identified by a different Cholesky ordering, which is to put *HHM* and *HHS* ahead of other variables. This assumption is justifiable because the degree of market power is not contemporaneously affected by other variables including productivity and capital-output ratio. The assumption however allows that other variables are contemporaneously affected by the degree of markups or market concentration. One may argue whether the TFP variable should be the most exogenous of all but it is well established in the empirical macroeconomic literature that the measured TFP is unlikely to be exogenous.

Figure 4.1 shows the response of labor share to *HHM* and *HHS* shocks as well as K/Y and TFP shocks. The inclusion of *HHM* and *HHS* in our model does not alter or diminish the effects of K/Y and TFP shocks on the labor share. Consistent with the preceding Figures 3.1 and 3.2, the labor share shows a significant and persistent negative response to these shocks. The upper panel of Figure 4.1 illustrates that the labor share shows a significantly negative response to both *HHM* and *HHS* shocks. The negative responses are confirms our results from the static and dynamic panel analysis in the previous section. An increase in markup or market concentration in both manufacturing and services sectors leads to a decline in labor share. Furthermore, the panel VAR analysis shows that the response of labor share to these shocks is very persistent and even larger in size than the responses to K/Y and TFP shocks. In particular, a 1% increase in the shock to *HHM* leads to roughly the same percent decrease in labor share, making labor share fall quite persistently over five years.

Figure 4.2 shows the labor share response to the same shocks in cities versus provincial areas. Panels (a) and (b) show the response in city areas while (c) and (d) report the response in provincial areas. The responses displayed show some striking differences. The negative response of labor share to *HHM* and *HHS* is strong in city areas while the response is rather positive, although statistically insignificant, in provincial areas. It is clear then that the negative response of labor share for the whole regions reported in Figure 4.1 is dominated by the responses in city areas. This may indicate that in provincial areas, the degree of market concentration may already be large in provincial areas compared to city areas. It is common that one or two firms providing the bulk of employment in

provincial areas while firms are more likely to be competitive in city areas, making an increase in market power in city areas leads to a more significantly negative effect on labor share.

Our panel VAR analysis considered the dynamic responses of labor share to a set of variables that have been shown to drive labor share in economic theory. Our results confirm that the capital-output ratio and the market concentration are indeed the main drivers of labor share. The results also show some heterogeneities in the response of labor share across regions.

6. Conclusion

One of the most pressing issues in modern decades is probably the polarization of income distribution. There are at least two dimensions to it. First, the division of income between capital owners and workers has been observed to be unequal and widening in many countries over several decades. Second, income inequality among workers (skilled vs unskilled) has also increased in many developed countries.

This paper addresses the first aspect of income inequality, i.e., functional distribution, but not at the national level, but at the regional level. Previous studies focused on explaining the aggregate income division between capital owners and workers, ignoring the underlining structural changes at the disaggregate level. Korea shows that the aggregate labor share can be stable, even though it is not stable at the regional level. Hence, it is imperative to analyze changes in labor share at regional level first, in order to gain an insight into understanding the movements of the labor share at the national level. We explored a panel dataset spanning 16 regions over 14 years and employed an array of cross-regional dynamic panel and panel VAR models to examine the driving forces of labor shares across the regions.

We find that the concentration of manufacturing industry, the share of university-educated workers, and the average age of firms are important factors affecting labor shares in regional income. Our panel VAR results show that shocks to capital-output ratio, total factor productivity and the concentration of both manufacturing and services industries all lead to a decline labor shares over time. We also show that the concentration of manufacturing and service industries are more important in metropolitan cities than in provincial areas. Our results demonstrate that heterogeneities in product and labor markets need to be taken into account to understand the changes in labor shares in regional income. Policies aimed at raising labor income would need to take a regional approach, rather than taking a one-size-fits-all approach.

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Tables in Main Text

Table 1
The Labor Shares in 16 Metropolitan Cities and Provinces in Korea (2000-2014)

	2000	2005	2010	2014	2014-2000	Correlation
Seoul	53.5	54.7	51.6	54.4	0.9	0.56
Busan	75.5	80.8	73.1	69.9	-5.6	0.69
Daegue	76.5	83.8	76.7	73.0	-3.5	0.76
Incheon	69.1	70.1	65.7	66.0	-3.1	0.56
Guangju	76.7	83.8	75.3	72.1	-4.6	0.71
Daejeon	72.3	82.2	75.0	70.8	-1.5	0.69
Ulsan	55.6	62.9	55.8	65.3	9.7	0.68
Geounggi	56.2	63.8	59.6	59.2	3.0	0.59
Gangwon	71.9	76.3	69.2	66.9	-5.0	0.78
Chungbuk	60.2	65.9	59.5	58.8	-1.4	0.82
Chungnam	49.6	50.6	48.0	49.3	-0.3	0.60
Chunbuk	65.8	71.5	62.9	64.5	-1.3	0.81
Chunnam	54.3	56.9	49.2	54.0	-0.3	0.67
Geoungbuk	50.7	49.3	44.8	50.6	-0.1	0.36
Geoungnam	58.4	62.9	59.8	60.9	2.5	0.68
Jeju	57.6	66.2	60.4	59.5	1.9	0.74
Korea	59.2	62.9	57.6	59.5	0.3	1.00

Note. All labor shares are adjusted for national and regional self-employment. Correlations are calculated between Korea and each city and province.

Table 2
Means of Variables for Selected Years

	2000	2005	2010	2014	2000-2014
Labor share (adjusted) (%)	62.744	67.606	61.025	62.200	63.236
log(real per capita income)	2.957	3.150	3.298	3.356	3.190
HH index (manufacturing)	0.027	0.022	0.022	0.021	0.023
HH index (service)	0.0021	0.0021	0.0029	0.0026	0.0025
Top4share (manufacturing)	0.344	0.317	0.313	0.297	0.318
Top4share (service)	0.181	0.166	0.209	0.195	0.193
Avrage tenure (years)	6.100	6.937	8.233	8.703	7.504
Share of manufacturing (%)	18.575	17.031	16.381	16.969	17.025
Share of service (%)	66.506	71.219	73.663	74.325	71.630
Share of university-educated workers (%)	22.488	30.069	35.856	39.963	32.021
Share of temporary workers (%)	11.574	17.904	19.479	16.195	15.743
Strike rate (%)	n/a	0.012[a]	0.008	0.008	0.008[b]
Union density (%)	9.039	11.566	7.981	n/a	9.311[c]

Note. a: strike rate for 2006, b: the average for 2006-2014, c: the average for 2000-2010.

Table 3
Correlations between Variables and the Labor Share, by Region

	log(gdp per capita)	HH (manufacture)	HH (service)	top4share (manufacture)	top4share (service)	tenure
Seoul	0.197	0.163	0.097	0.063	0.211	0.316
Busan	-0.502	-0.160	-0.051	0.208	-0.602*	-0.572*
Daegue	-0.390	0.117	-0.371	-0.411	-0.638*	-0.405
Incheon	-0.420	-0.301	-0.495	-0.597*	-0.544*	-0.400
Guangju	-0.599*	-0.190	-0.738*	0.322	-0.380	-0.480
Daejeon	-0.055	-0.210	0.009	0.290	0.063	0.001
Ulsan	-0.269	0.184	-0.402	-0.010	-0.411	-0.179
Geounggi	-0.056	-0.293	-0.248	-0.786*	0.246	-0.015
Gangwon	-0.676*	0.472	-0.290	0.639*	-0.590*	-0.745*
Chungbuk	-0.600*	0.288	-0.092	0.579*	-0.406	-0.631*
Chungnam	-0.649*	-0.856*	-0.694*	0.200	-0.736*	-0.817*
Chunbuk	-0.572*	-0.308	-0.660*	0.551*	-0.849*	-0.594*
Chunnam	-0.688*	-0.318	-0.655*	0.557*	-0.477	-0.741*
Geoungbuk	-0.616*	0.340	-0.585*	0.319	-0.704*	-0.713*
Geoungnam	0.074	-0.352	-0.490	0.069	-0.286	-0.072
Jeju	-0.350	-0.545*	-0.386	-0.480	-0.320	-0.466
average	-0.197	-0.041	-0.247	0.057	-0.196	-0.189

Note. * indicates a significance at the 95% level

Table 3 (Continued)
Correlations between Variables and the Labor Share, by Region

	manufacture	service	university	temporary	strike rates	union density
Seoul	-0.218	0.217	0.294	0.116	0.626	-0.104
Busan	0.279	-0.362	-0.485	-0.140	0.302	0.661*
Daegue	-0.103	0.115	-0.473	0.027	0.587	0.055
Incheon	0.408	-0.415	-0.370	-0.346	-0.056	0.846*
Guangju	-0.538*	0.106	-0.439	0.380	0.180	0.300
Daejeon	-0.163	0.138	0.209	0.366	0.136	0.666*
Ulsan	0.688*	-0.581*	-0.100	-0.341	0.561	0.810*
Geounggi	-0.226	0.193	-0.010	0.415	0.734*	0.386
Gangwon	0.320	-0.641*	-0.674*	-0.624*	0.293	0.927*
Chungbuk	-0.666*	0.070	-0.611*	-0.200	-0.033	0.510
Chungnam	-0.543*	-0.638*	-0.580*	-0.446	0.500	-0.449
Chunbuk	0.179	-0.368	-0.512	-0.360	0.746*	0.700*
Chunnam	-0.236	-0.442	-0.626*	-0.713*	0.298	0.528
Geoungbuk	-0.008	-0.589*	-0.470	-0.776*	-0.414	0.278
Geoungnam	-0.157	0.199	0.320	0.132	-0.168	0.592
Jeju	-0.057	-0.237	-0.397	-0.172	0.523	0.141
average	0.002	-0.066	-0.203	-0.044	0.238	0.224

Note. * indicates a significance at the 95% level

Table 4 Estimates of the Dynamic Panel Models

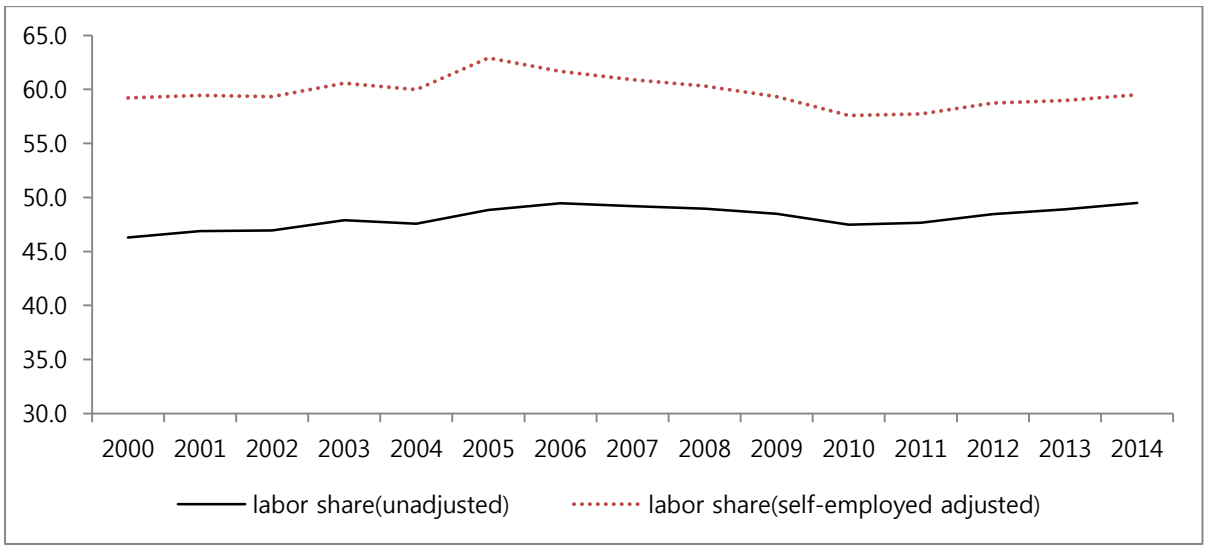
Dependent variable: Adjusted labor share in logarithm				
	(1)	(2)	(3)	(4)
Lagged labor share	0.27 (0.07)***	0.35 (0.07)***	0.30 (0.07)***	0.34 (0.07)***
Log(output percap)	-19.89 (4.47)***		-18.98 (4.51)***	
Log(tfp)		0.63 (0.70)		0.76 (0.66)
log(dep_capital)	-9.44 (2.50)***	-9.46 (2.53)***	-8.28 (2.38)***	-10.09 (2.40)***
HH_manu	56.10 (54.89)	57.03 (57.73)		
HH_serv	-645.82 (311.86)**	-346.49 (325.07)		
Top4share (manufacturing)			-1.61 (5.21)	1.43 (5.32)
Top4share (service)			-0.34 (13.31)	6.77 (13.73)
Tenure	-1.99 (0.82)***	-2.35 (0.88)***	-1.94 (0.86)**	-2.55 (0.88)**
Manu	0.09 (0.13)	-0.10 (0.14)	0.14 (0.13)	-0.97 (0.14)
Serv	0.07 (0.12)	-0.05 (0.12)	0.10 (0.12)	-0.06 (0.12)
Univ	0.17 (0.12)	0.28 (0.11)***	0.23 (0.11)**	0.30 (0.11)***
Unionden	0.05 (0.04)	0.07 (0.04)*	0.07 (0.04)	0.09 (0.05)**
Temprate	-6.38 (9.65)	-2.42 (9.80)	-6.69 (9.51)	-5.78 (9.47)
Region FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
No. obs	160	160	160	160
Sargan test	0.53	0.38	0.57	0.36

Note: Robust standard errors are in parentheses. Intercept, year and region dummies are included but not reported. *, ** and *** indicate that the estimated coefficients are statistically significant at 10, 5 and 1%, respectively. The Sargan tests do not reject the null hypothesis that the over-identifying restriction is valid.

Figures in Main Text

Figure 1

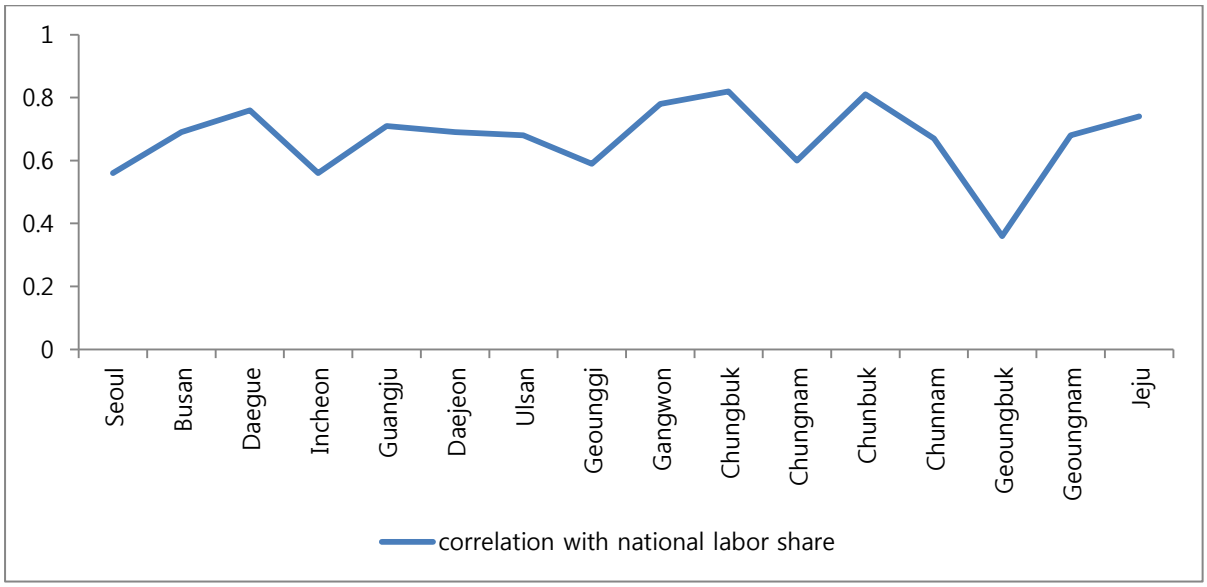
The Trend of the Labor Share in National Income (2000-2014)



Note. The shares are based on equations (1) and (2) in Section 2. The data on the compensation of employees, profits, the consumption of fixed capital, and the share of self-employed are mainly obtained from the KOSIS (Korean statistical information service).

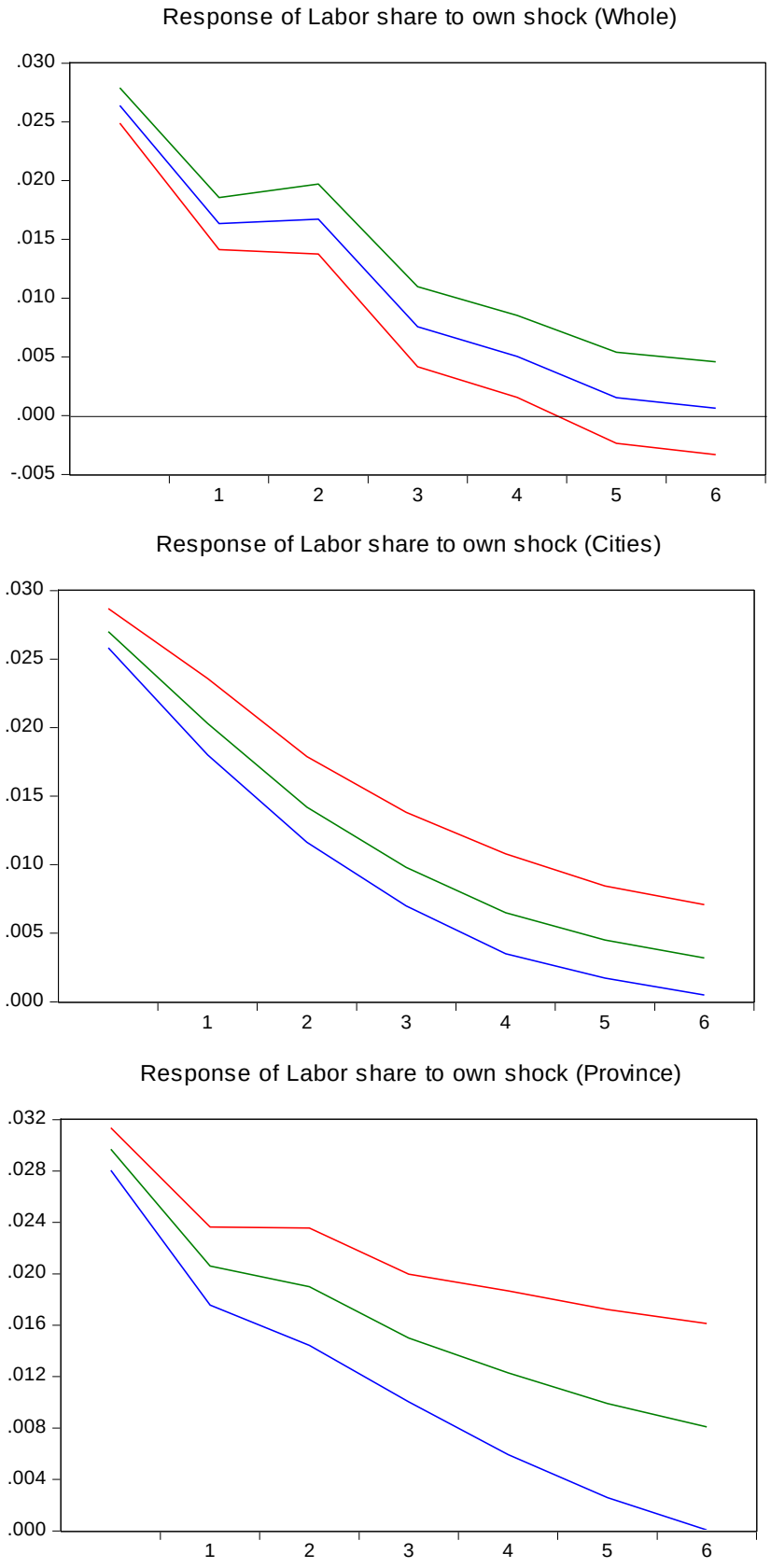
Figure 2

Correlations between Regional Labor Share and National Labor Share (2000-2014)



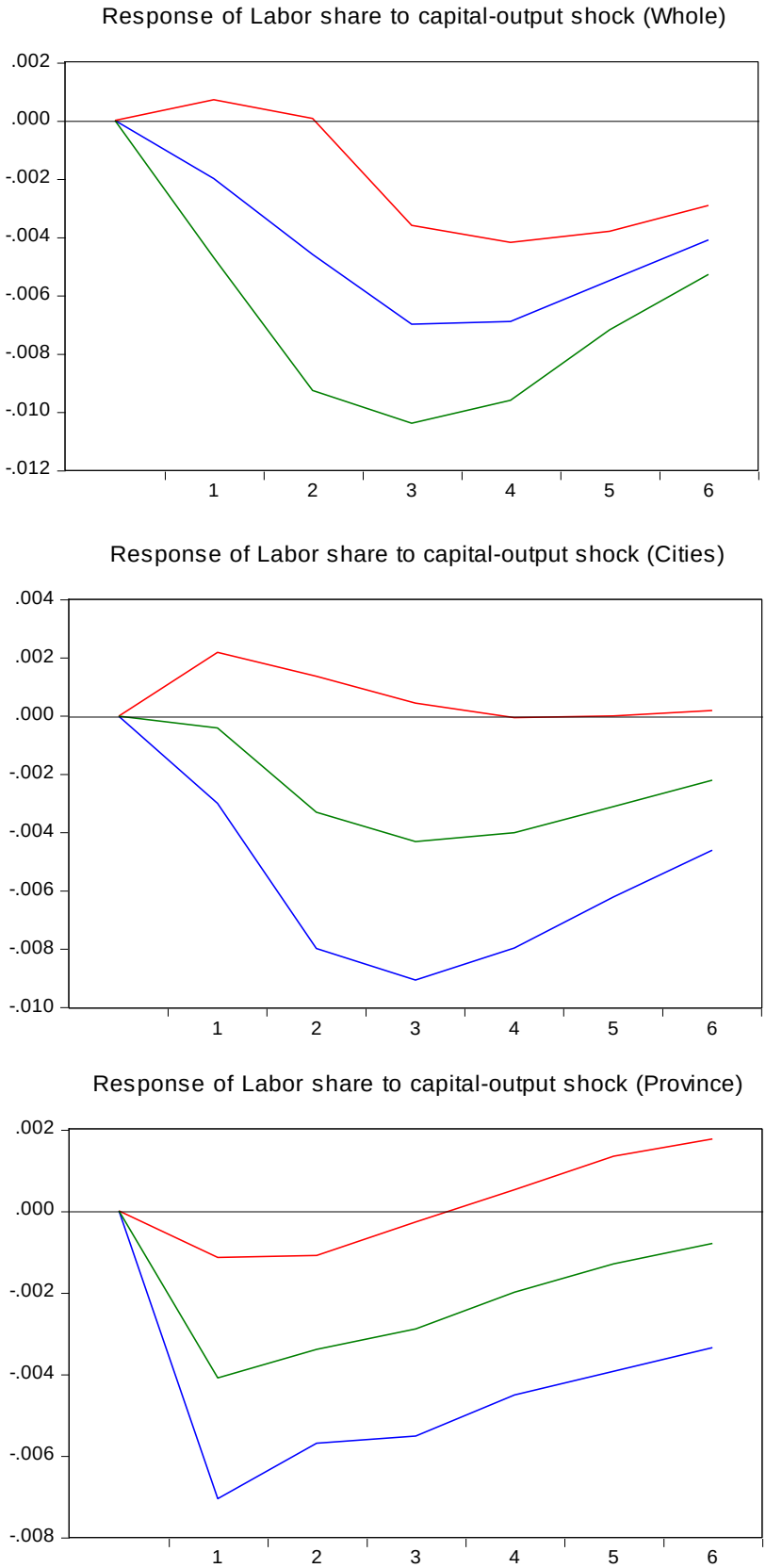
Note. All labor shares are adjusted for national and regional self-employments.

Figure 3.1 Impulse Responses to Own shocks



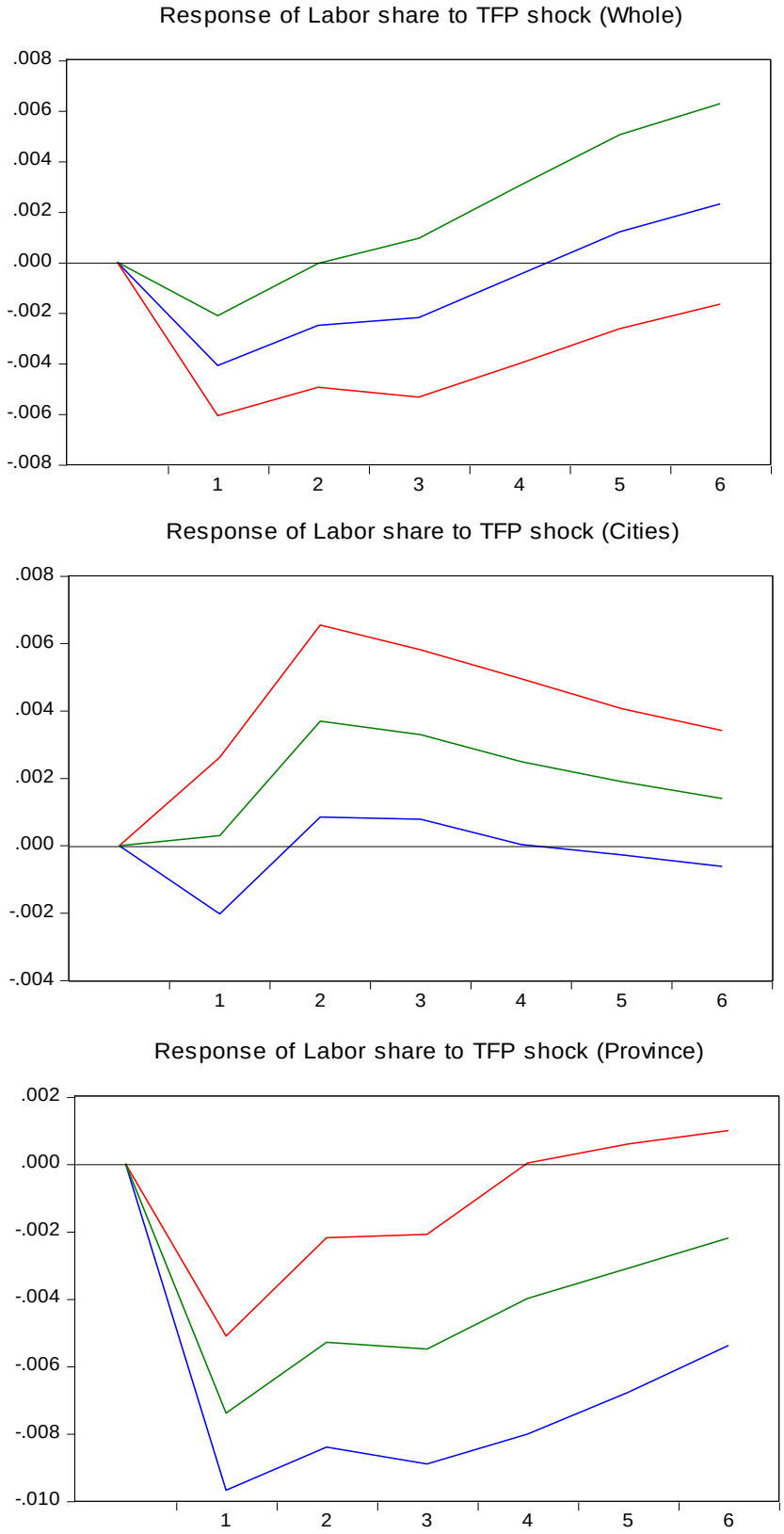
Note: The error bands are 16th and 84th percentiles based on 500 Monte Carlo simulations.

Figure 3.2 Impulse Responses to Capital-Output ratio shocks



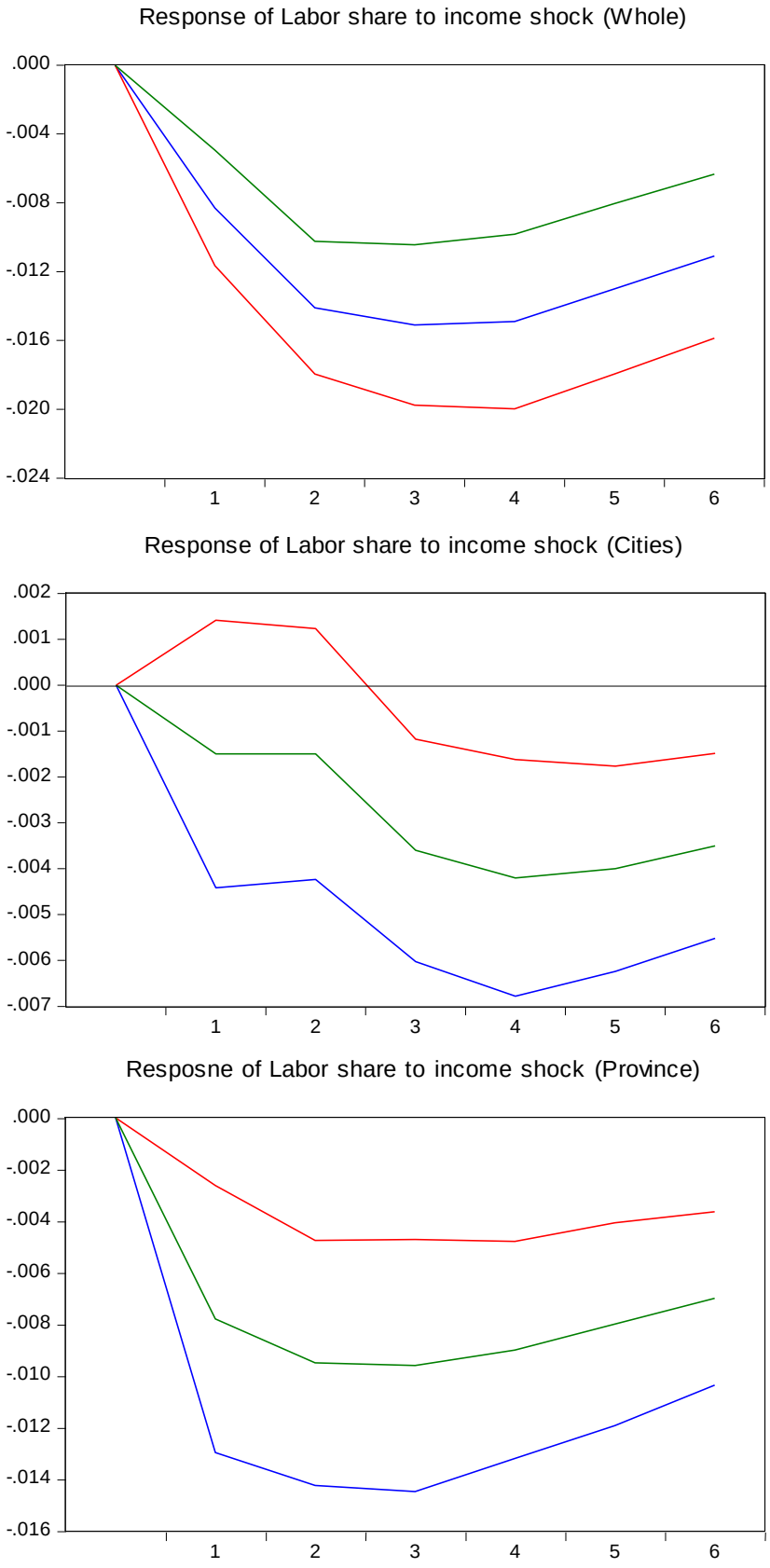
Note: The error bands are 16th and 84th percentiles based on 500 Monte Carlo simulations.

Figure 3.3 Impulse Responses to TFP shocks



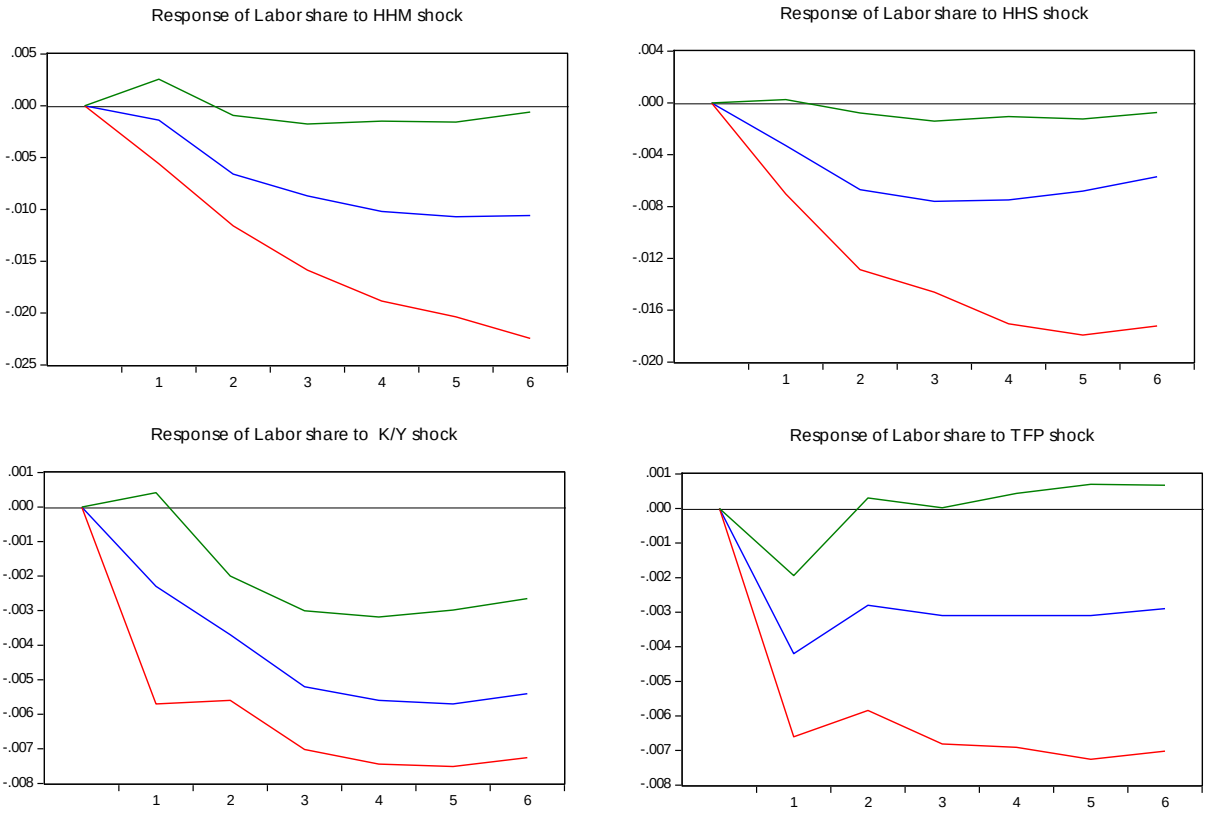
Note: The error bands are 16th and 84th percentiles based on 500 Monte Carlo simulations.

Figure 3.4 Impulse Responses to Income shocks



Note: The error bands are 16th and 84th percentiles based on 500 Monte Carlo simulations.

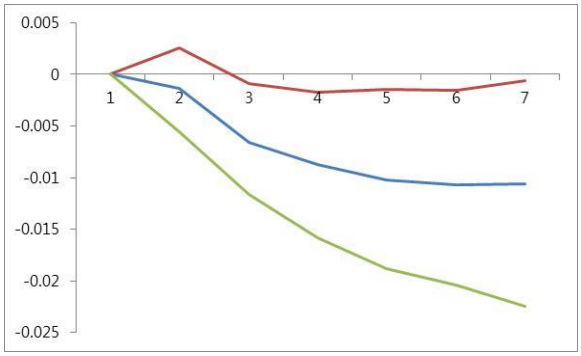
Figure 4.1 Response of Labor share from a 5-variable panel VAR



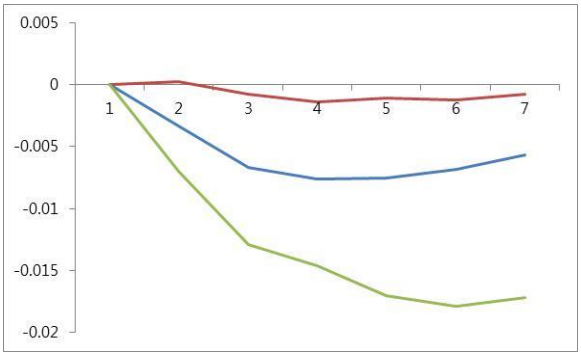
Note: The error bands are 16th and 84th percentiles based on 500 Monte Carlo simulations.

Figure 4.2 Response of Labor share to HHM and HHS shocks in Cities vs Provinces

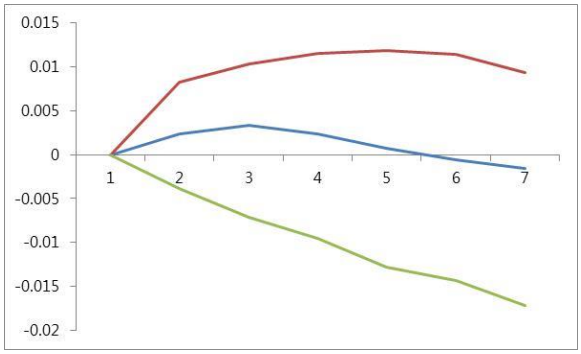
(a) HH-Manufacturing (City)



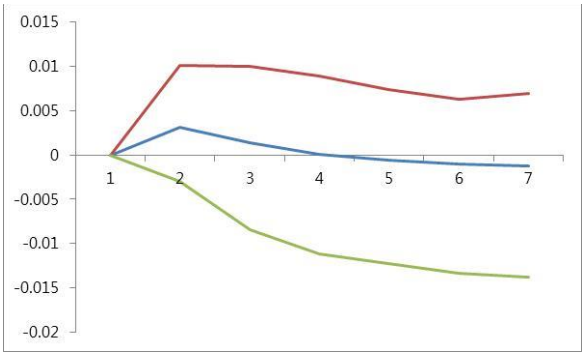
(b) HH-Service (City)



(c) HH-Manufacturing (Province)



(d) HH-Service (Province)

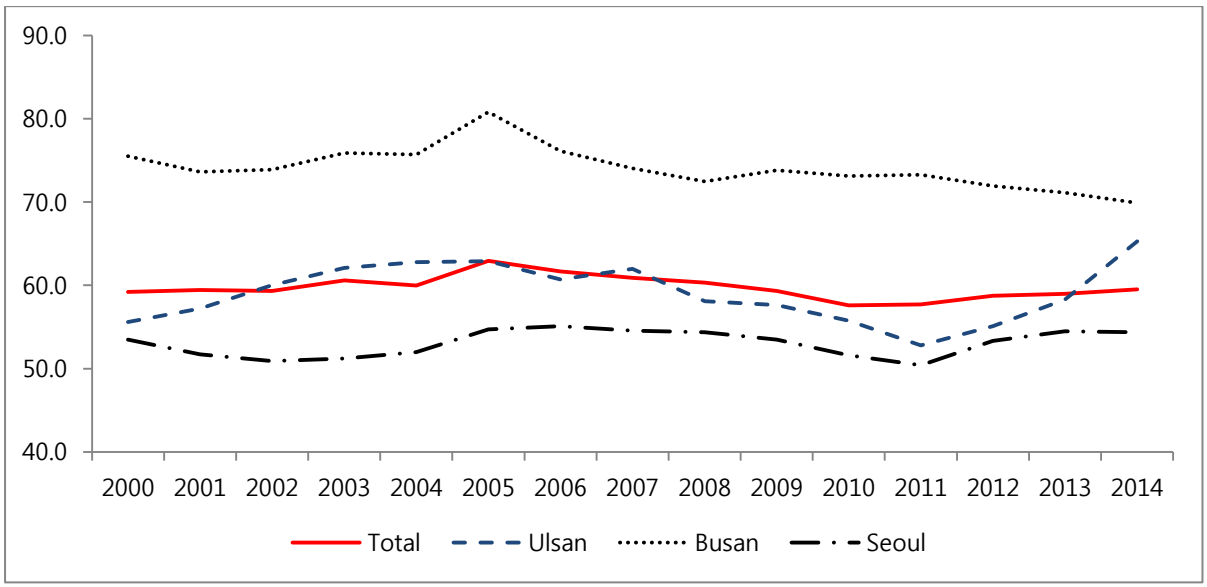


Note: The error bands are 16th and 84th percentiles based on 500 Monte Carlo simulations.

Appendix Figures

Figure A1

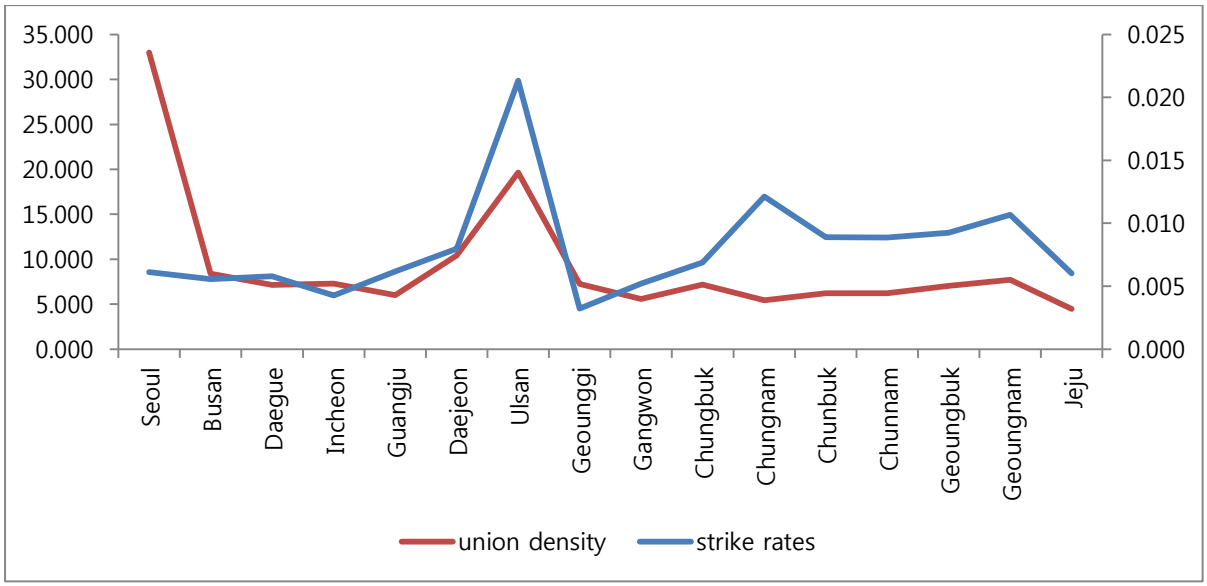
The National vs Regional Labor Shares in Korea (2000-2014)



Note. All labor shares are adjusted for national and regional self-employments. Busan shows the biggest decrease in labor share while Ulsan experiences the biggest increase between 2000 and 2014 among 16 metropolitan cities and provinces in Korea.

Figure A2

Strike rates and Union Densities by Region



Note. The left axis measures union density and the right axis strike rates.