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The Development of Wages in the Public Sector and their Correlation with Wages in the Private Sector

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Abstract

This study finds that there is a long-term correlation between the development of wages in the public sector and in the private sector. Since 1999, after the wage gap between the two sectors was closed, the short-term correlations also became much stronger. During these years, wages in both sectors moved in tandem, with wages in one of them affecting wages in the other. This was in contrast to the 1990s, a period in which public sector wages led the development of wages in the private sector. Wage creep in the public sector is stable over time and is not affected by business cycles. Yet at the same time, the significant wage agreements in the public sector track private sector wage trends are pro-cyclical, and other than two agreements in the mid-1990s, expand when the fiscal deficit is low and contract when it is high. The wage agreements themselves are responsible for about one-third of total real growth in employee wages in the public sector, and there is an almost perfect correlation between them and the overall change in employee wages in the public sector. Essentially, the wage agreements signed in the public sector since 1999 are responsible for the strong correlation between wages in the public sector and wages in the private sector. The average wage in the public sector has increased by less than the average wage in the private sector, adjusted for workers' characteristics.

התפתחות השכר במגזר הציבורי והקשרים בינו לבין השכר במגזר הפרטי

יובל מזר

תקציר

מחקר זה מוצא כי קיים קשר ארוך טווח בין התפתחות המשכורות במגזר הציבורי ובמגזר הפרטי. משנת 1999, לאחר שפער השכר בין שני המגזרים נסגר, גם הקשרים קצרי הטווח התחזקו מאוד, המשכורות בשני המגזרים נעו יחד, והשכר באחד מהם השפיע על השכר באחר. בשנות ה-90 השכר במגזר הציבורי הוביל את התפתחות השכר במגזר הפרטי. בעוד שזחילת השכר במגזר הציבורי הינה בעלת שונות קטנה על פני השנים והיא אינה מושפעת ממחזורי עסקים; מרבית הסכמי השכר המשמעותיים במגזר הציבורי עוקבים אחרי מגמת השכר במגזר הפרטי, הם פרו-מחזוריים, ולמעט שני ההסכמים באמצע שנות ה-90, הם מרחיבים כשהגירעון הפיסקלי נמוך ומהדקים כשהוא גבוה. הסכמי השכר עצמם אחראים לכשליש מסך הגידול הריאלי בשכרם של העובדים במגזר הציבורי, ויש מתאם מושלם כמעט ביניהם לבין השינוי הכולל בשכר העובדים במגזר הציבורי. למעשה, הסכמי השכר שנחתמו במגזר הציבורי מאז 1999 הם אלו שאחראים למתאם הגבוה בין השכר במגזר הציבורי לשכר במגזר הפרטי. מאז שנות התשעים השכר הממוצע במגזר הציבורי, בתאמה לתכונות העובדים, עלה פחות מהשכר הממוצע במגזר הפרטי.

1. Introduction

a. Preface

It is generally assumed that wages in the private sector[1] are primarily determined by market forces and reflect labor productivity, while wages in the public sector are derived from wage agreements—collective or individual, political decisions[2], and wage creep. Since the wage path in each sector is determined in a different manner, there would be no necessary correlation between them - if we lived in a world with an unrestricted supply of employees. But in a world of restricted supply, a long-term correlation between the two sectors will exist, since both compete for a limited number of employees and human capital: Both try to lure the quality employees and subsequently retain them.

In addition to competition, there are other factors connecting the wage paths in the two sectors. To illustrate, changes in institutions common to both sectors—such as minimum wage, government corporations whose employees' wages are linked to public sector wages, or the Earned Income Tax Credit (work grant)[3]—may cause the wage paths in both sectors to change in tandem; an exceptional wage agreement in the public sector may lead to a price increase, which, in turn, will lead to compensation in the private sector as well; and price increases (especially unexpected ones) may push wages upward in both sectors.

Thus, quite a few causes can create correlations (either short-term or long-term) between the wage paths in the public and private sectors. But despite the significance of the topic and the interest it generates, there is little research on it.[4]

The most prevalent theoretical model in the literature assumes that the wages in the competitive sector—the private sector—lead the changes, and the wages in the public sector react to them. The underlying idea of this model is that the productivity is determined exogenously in the world, and that, in the long term, wages in the private sector are equal to the average productivity of its employees. Later on, the public sector wages will track the wage path of the tradable sector through the country's joint institutions, including the workers' bargaining power. In other words, the model assumes a single labor market in which the competition over workers results in a long-term correlation between the private sector (tradable) wages and the wages in the public (non-tradable) sector - see, for example, Strom (1995).

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[1] The business sector, excluding the entities owned by the government and public non-profit entities.

[2] There are two prominent theories in the literature regarding the manner in which wages in the public sector are determined. One attributes to wage setters personal political motivations, while the second attributes to them the goal of maximizing social welfare (Gregory and Borland, 1999; Forni and Giordano, 2003). The main channels through which the second approach works is by reducing the costs of the public sector and resolving market failures in the labor market, sometimes in addition to equality considerations.

[3] Previously called "income grant" or "negative income tax."

[4] Most of the literature in the field actually analyzes the employment paths in the two sectors and finds negative correlations between them. See, for example, Ardagna (2007), Algan et al. (2002), Forni and Giordano (2003) and Alesina et al. (2002). In Israel, a connection has not been found between changes in employment of the two sectors or between public sector employment and the business cycle, and a positive correlation has been found between private sector employment and the business cycle. That is, it was found that public sector employment is not cyclical and private sector employment is cyclical (Bank of Israel Annual Report for 2009, Box 6.1).

Under this model, let us assume an economy in which two sectors - private and public - compete for the same employees. In this case, a positive shock to the labor productivity of private sector employees will increase employment and wages in that sector, increase wages in the public sector and increase employment and wages in the economy as a whole. Employment of workers in the public sector will decrease in line with the elasticity of demand for workers in the public sector (Figure A-1 in the Appendix). It is likely that this elasticity is different than the elasticity of demand for workers in the private sector, both because it is more difficult to quantify the output in the public sector than in the business sector[5], and because employees in the public sector have different bargaining power than employees in the private sector, due to differences in their forms of association.

The model in question was corroborated by a study conducted in Sweden using the VAR method (Lindquist and Vihelmsson, 2004; Jacobson and Ohlsson, 1994), but other studies found no support for it in the Swedish economy (Friberg, 2007; Holmlund and Ohlsson, 1992; Tagstrom, 2000). Bemmels and Zaidi (1990) found support for the model in the Canadian economy. Greece was found to have weak exogeneity[6] between wages in the government sector and wages in the private sector; i.e., it was found that wages in the private sector do not determine the wages in the government sector (Demekas and Kontolemis, 1999). In Chile, the private sector was found to be leading wage changes (Mizala and Romaguera, 1995), and Romania was found to have bidirectional correlations (Chirstou, Klemm and Tiffin, 2007). The finding that correlations vary among countries decreased the model's significance to some extent, and was compounded by the finding that correlations vary even within countries over time.[7]

To the best of my knowledge, the most comprehensive empirical study in the field is featured in a working paper published by the European Central Bank in 2008 ("Public and Private Sectors Wages - Co-movement and Causality"). This study examines the correlations that exist, both in the long and short term, between the wage paths in the private and public sectors. It covers seventeen developed countries in the period spanning 1960 to 2006, and is based on 11 statistical methods for removing the trend from the original variables and two methods for excluding the nominal wages - the consumer price index or the GDP price index. The researchers found that, in most countries, there is a (long-term) cointegrative correlation between the wage paths in the two sectors: Although there is a wide variance among the institutions in the various countries, in almost all of them, the wages (excluding the trend) in both sectors move in tandem over time. The finding regarding the sector leading the wages, however, is not as uniform: While in most cases, wages in the private sector lead, and wages in the public sector only respond to changes in it (249 observations), there was also much evidence to the contrary (183 observations). The researchers suggest there is a correlation between the institutions of the countries and the causal correlations they find in the wage paths of both sectors, including: (1) The size of the public sector - the larger the sector the more likely the wages in the public sector will impact those of the private sector; (2) The economy's openness

[5] As part of the national accounting, the real public sector output is estimated as the public sector's total labor inputs.

[6] Weak exogeneity - exogeneity that results from statistical tests, without a structural model or significant causal explanation.

[7] Perez and Sanchez (2011), D'Adamo (2010).

(globalization) - the greater the economy's openness, the less likely the wages in the public sector will impact the wages in the private sector; (3) The workers' bargaining power or percentage of workers under collective agreements - the higher these figures, the more likely the wages in the public sector will impact the wages in the private sector.

This study examines the correlations between wages in the public sector and wages in the private sector in Israel: It examines long-term and short-term correlations, with and without taking into account the difference between them in terms of worker composition.

b. The data

This empirical study is based on three different databases - data of the National Insurance Institute, administrative micro data on public administration employees, and income surveys conducted by the Israel Central Bureau of Statistics. All data are annual since annual data are not affected by seasonality and are more reliable than quarterly or monthly data. The annual data actually smooth statistical noise, which may skew the analysis and flatten the processes and trends that have characterized the wages in the public and private sectors over time. Moreover, quarterly data on wage or GDP development do not add much information to the annual data.

We will use the National Insurance Institute data to examine whether long-term and short-term correlations exist between wages in the private sector and public services. These data detail the average wages per employee position, and their advantage is that they are administrative (i.e., not taken from a survey), but rather include all employees in Israel.

Several important comments should be made about these data. First, they cover wages for employee post—i.e., the figures are also impacted by the number of work hours and work days—and as such, are not necessarily the same as the average wage per employee, since certain employees may hold several jobs at the same time. Second, these data do not include the regular military services and career soldiers. Finally, the division into two sectors is based on the industry in which the employee works, rather than on his/her employer—i.e., public services are made up of the following industries: education, healthcare, welfare and social services and public administration, while the private sector is comprised of the remaining industries. Since defining a sector is based on the industry, there may be cases where we attribute workers to the public sector although, in effect, they belong to the private sector - such as tutors, physicians with private clinics, etc.[8]

Since surveys in Israel do not include an alternative definition of the public sector or private sector[9], we will overcome this difficulty in the following manner: we will examine at the same time the development of wages in public administration—a sub-industry of the public sector that primarily includes the central government—since its employees undoubtedly belong to the public sector. For this purpose, we use micro-administrative data on the employees of the public administration. This database includes individual data, such as wages, whether full time or part-time position, wage scale grade, ministry, rank, gender, tenure, age, etc. These are panel data, which can help distinguish between the wage development of workers who remained employed and retiring employees, new employees

[8] In any case, it is clear that wages and employment in these industries are impacted by demand for "public products".

[9] In contrast to most advanced economies: In most of them, the surveys include a specific question about a worker's employer—whether the entity is public or private.

and all employees. The public administration employees constitute about 15 percent of the employees in the public services. A detailed analysis of the wage development in this sub-industry (mainly due to the changes it is undergoing and less in terms of wage levels) also allows drawing conclusions about wage development in the entire public sector—which also includes the education and health industries.

To examine the development of wages in both sectors, while taking into account their differences in terms of employee composition, we will use the annual income surveys. To prepare these surveys, the Central Bureau of Statistics samples, each year—out of the entire population—a representative number of people, about 15,000 observations. The sampled employees report their income from employment and a large number of their characteristics, including age, gender, industry, years of education, etc. They also report their monthly wages and their number of work hours per work week; dividing the salary by the number of hours provides their average hourly wage. Similar to the National Insurance data, the division into the two sectors is also based on the industry in which the employee works.

c. The study's methodology and structure

This study examines the correlations that exist in Israel, both in the long and short term, between the wage paths in the private and public sectors. For this purpose, the analysis uses several statistical methods, common in the literature (detailed below), and is based on data from the period between 1980 and 2012.

Most of the study focuses on 1990 and onward (examining a relatively short period), for two reasons. First, it may be assumed that the economic correlations and powers characteristic of the economy before the 1990s are no longer the same: until the mid-1980s, the Israeli economy suffered from hyperinflation, and later on, the decade was characterized by a fixed foreign exchange regime; following the Economic Stabilization Plan, inflation declined, and the foreign exchange regime was gradually replaced by a floating exchange rate. Second, the study was not conducted to document the historical correlations between the wage paths in the two sectors, but rather with the intent to map the current correlations and draw information that is relevant for policy setting. Nevertheless, in some cases, we used data from the 1980s, mainly to depict the background for the wage development in later years.

The paper is structured as follows: Section 2 focuses on the long-term correlations between the wage paths in the public and private sectors. Since the common theoretical model assumes that the private sector wages lead the changes in the wage paths, the section begins by describing how these wages are determined—how they are connected to labor productivity in the long term—and how they have developed over the years studied. Later on, the section examines the long term correlation (the cointegrative correlation) between the wage paths in the private and public sectors.

Sections 3–5 focus on the short-term correlations. Section 3 begins by describing how wages are determined in the private sector, according to the rationale described above. It ends by presenting standard causality tests as well. Section 4 examines the short-term correlation between the wage paths in the private and public sectors, as well as the development of the correlation over the years - but takes into account that each of the sectors is characterized by a different employee mix. Section 5 details how wages in the

public administration developed in the short term, dividing the change in the employees' wages into a change originating from the wage creep of the workers who remained employed (promotion and tenure) and the change emanating from wage agreements. This analysis, as aforesaid, is based on an administrative file of panel data, which includes data on wages in the public administration. Later on, the section examines the conditions and backgrounds of the exceptional wage agreements signed in the public sector. Section 6 summarizes and presents questions for follow-up studies.

2. The mid-term to long-term equations

a. Wages in the private sector

To calculate the average labor productivity (LP), we divide the nominal annual business product (derived from the annual National Accounts data) by the number of employees in the private sector in a given year (derived from the annual labor force surveys). The wages are the annual wages for an employee position, and as aforesaid, it is derived from the National Insurance data.

Assumption I

There is a long-term cointegrative correlation between the average wage and average labor productivity.[10]

Over time, a company will not pay an employee (gross) wages which exceed his/her marginal output, otherwise the employee will generate a negative profit to the company; on the other hand, if the employee is paid lower wages than his or her marginal output, in a competitive market that has a limited number of employees, competing companies will offer the employee a little more and thus tempt the employee to work for them. This is true of all employees, so—over time—a company will pay its employees average wages that are more or less equal to their average marginal output.

It should be noted that, empirically, the net wages (gross wages less the income tax paid by the employee) are impacted by labor productivity more than the gross wages, but the impact on net wages also depends on the employees' bargaining power.

Figures 1a and 1b focus on the private sector and describe, respectively, the correlation in the sample period between the gross wages and net wages per employee position and the labor productivity.

[10] Lavi and Zussman (2005) analyze the factors affecting wages in the private sector in the long and short term, and find that in the long term, there is a unitary elasticity between the labor productivity and average salary in the private sector.

Figure 1a
Gross wage relative to output per employee in the private sector, 1980–2012

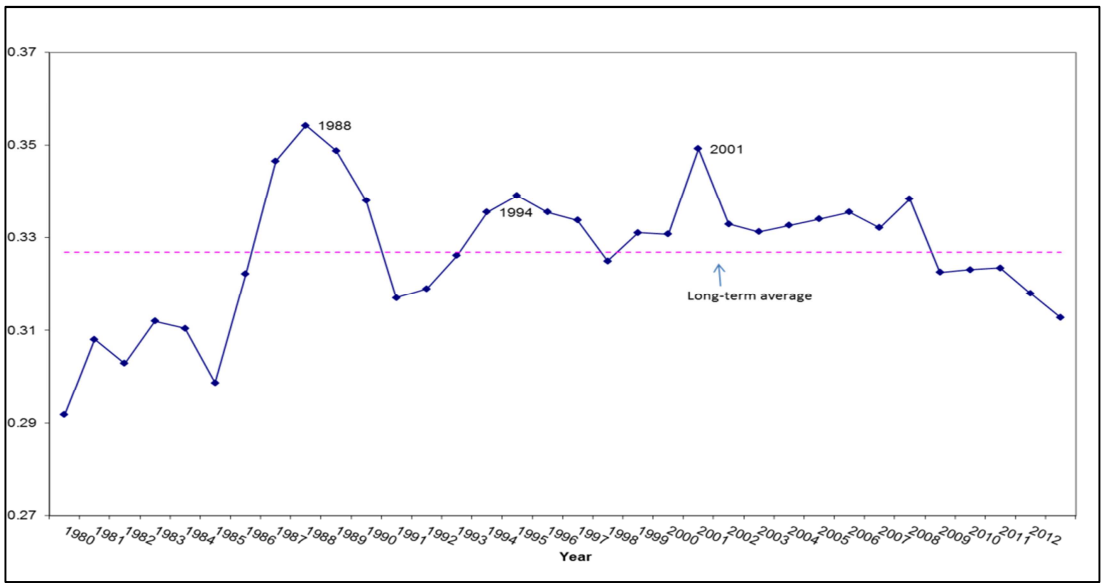
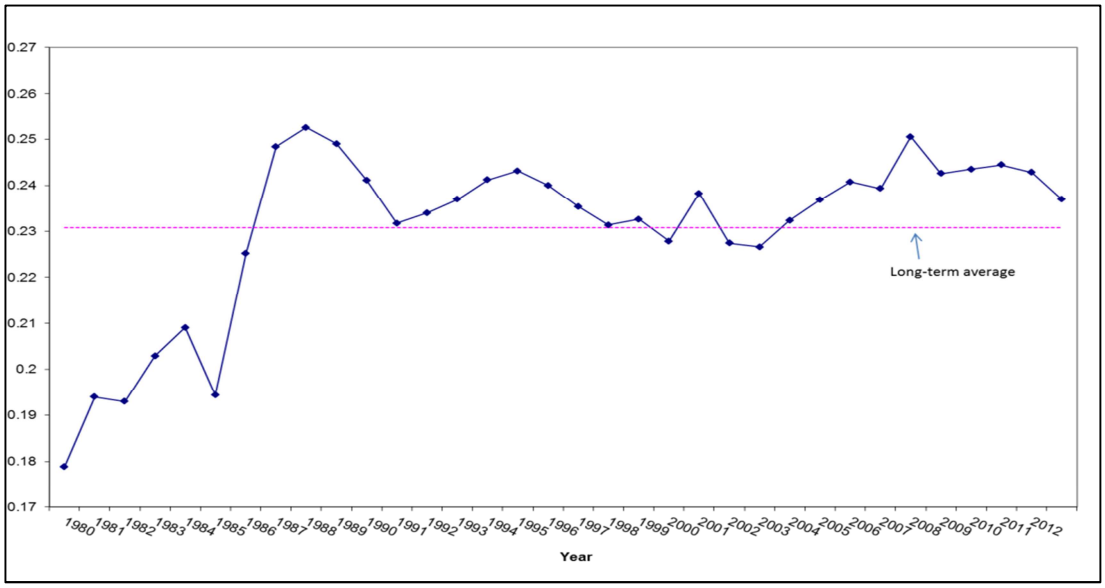


Figure 1b
Net wage relative to output per employee in the private sector, 1980–2012



As seen in the two figures, in the long term - there is a strong correlation between the average wage per employee and the average labor productivity. Over the past 32 years, both the ratio between gross wages and labor productivity, and the ratio between net wages and labor productivity, are close to the long-term averages.

Until 1988, there was an increase in gross wages in the private sector. Later on, it was eroded until 1995—with the increase in unemployment in the early 1990s and the great wave of immigration from the former Soviet Union—and rose sharply from 1995 to 2001. It reached a peak in 2001. Between 2001 and 2005, after the severe recession that hit the economy from 2001 to 2003, the wage level returned to normal, considering the average

labor productivity level, and since then - its level has eroded slightly. Looking at the net wages, the wage erosion disappears, as a result of the income tax rate reduction in the former decade.[11]

According to the simple statistical test outlined below, the net average wage is less correlated with the average labor productivity than the gross average wage. A stationarity test for the residuals also confirms that the cointegrative correlation between the gross wages and productivity is better than the corresponding correlation between the net wages and productivity: the residuals of the first correlation are stationary, at a significance level of 2 percent, and the second correlation—at a level that is slightly lower than 10 percent.

$\overline{W}_{p,t}$ is the wage for an employee position in the private sector in Year *t*,

LP_t is the average *LP* in *t*,

the gap between them in Year *t* is defined as a Year *t* residual.

$$residual_t = \frac{\overline{W}_{p,t}}{\overline{LP}_t} - \frac{1}{T}\sum_{t=1}^{T}\frac{\overline{LP}_t}{\overline{W}_{p,t}}$$

The mean square errors (MSE) of the gross wages and productivity:

$$\sqrt{\frac{1}{T}\sum_{t=1980}^{2012}(residual_t)^2} = 0.020$$

The MSE of the gross wages and productivity:

$$\sqrt{\frac{1}{T}\sum_{t=1980}^{2012}(residual_t)^2} = 0.024$$

b. The long-term correlation between the wages in the public and private sectors

In the long run, wages in the public sector cannot deviate from a long-term correlation with the wages in the private sector. The public sector competes with the private sector for high-quality workers and their retention, and the budgetary limit is derived from the business sector's productivity, since this productivity determines the GDP and the tax base, which finances the public sector wages. Since the nominal wages in the public sector are more rigid than in the private sector, especially in terms of reductions[12], it has been observed that, over time, they will track only the trend line of the average wages in the private sector, rather than accurately track any movement of wages in the private sector, since these movements are mostly derived from the state of the business cycle.

[11] For more information, see Box 6.1 in the Bank of Israel Annual Report for 2010.

[12] This is a durable finding, and has been found in almost all the studies on the topic. This outcome is mainly due to employees in the public sector having greater bargaining power than employees in the private sector, since the public sectors' rate of unionization is much higher, both in Israel and in other advanced economies. For more information, please see "Employee Unionization in Israel: The Situation in 2012", Recent Economic Developments No. 136, April to September 2013.

Assumption II

There is a long-term correlation between wages in the public sector and wages in the private sector.

$$\overline{W}_{G,t} = C \cdot \left(\overline{W}_{P,t}\right)^{\beta_1}$$

$\overline{W}_{G,t}$ is the wages for an employee position in the public sector in Year *t*, *C* is a constant.

This assumption is confirmed by the following figures and regressions below them. When examining real wages through consumer prices, rather than the nominal wages, the correlation coefficient between the wages decreases by about 15 percent (due to the canceling of a factor common to both series, i.e. the Consumer Price Index); however, in a binary regression, the residual path of public sector wages remains similar (Figure 3).

Figure 2a
Real wage per employee post in the private sector and in public services (2012 prices), 1980–2012

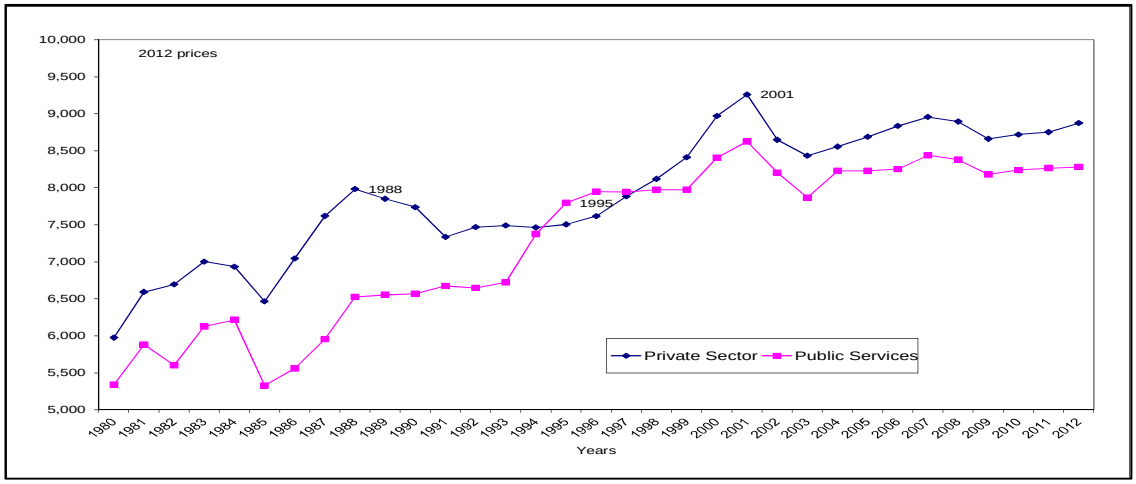
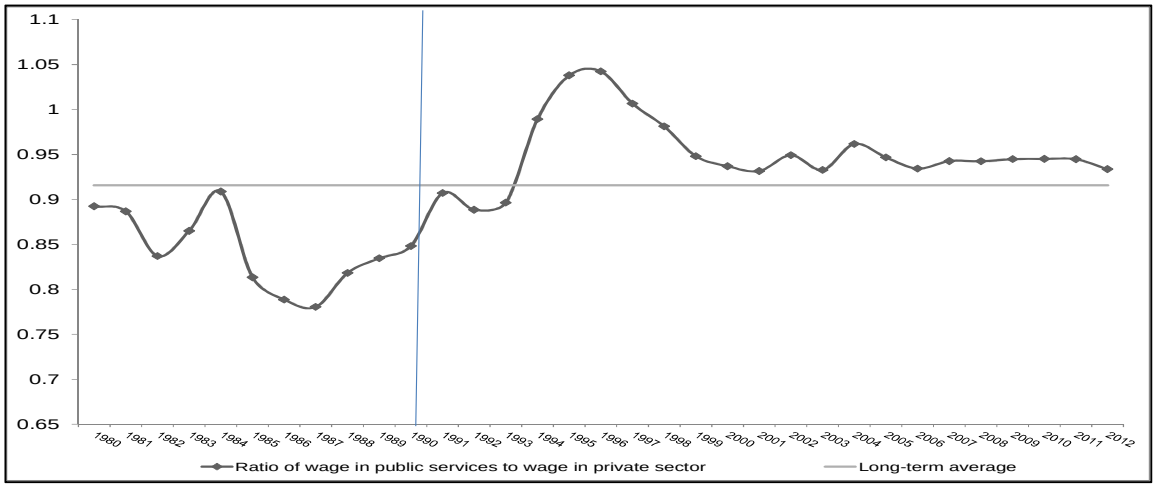


Figure 2b
Ratio of wage per employee post in public services to wage per employee post in the private sector, 1980–2012



Figures 2a and 2b show only the descriptive statistics, and indicate that there is a long-term correlation between the wages in both sectors.

Until 1988, wages developed similarly in both sectors, and in both, the average real wages rose rapidly even beyond the average labor productivity (Figure 1a). This development was due to individual pay increases (rather than from general wage agreements or cost of living allowances)[13], and these, in turn, may have resulted from a "habit" that persisted from previous years, a period characterized by high inflation. These specific increases were made against the backdrop of the Economic Stabilization Plan implemented in the economy in 1985, which resulted in a sharp decrease in the rate of inflation, as well as due to a relatively low unemployment rate during this period. Real wages in the private sector during those years grew faster than wages in the public services, 34 percent vs. 22 percent, respectively.

Between 1988 and 1991, following the increase in unemployment and large immigration wave from the former Soviet Union, the real wages in the private sector decreased significantly. The wages in the public services, on the other hand, continued to increase at a moderate pace until 1993. About half of the increase during this period resulted from "excessive/distorted promotion"[14], a practice which led to a real wage creep in the public sector. We note that since prices in those years rose rapidly, the Israeli economy instated wage linkage mechanisms, which automatically increased employee wages in line with the rise in the cost of living. These mechanisms alone are responsible for half of the increase in the nominal wages in the said years.

Between 1993 and 1995, extensive wage agreements were signed in the public sector, resulting in very sharp wage increases and the average wages in public services being even higher than in the private sector. Originally, these agreements were meant to correct general distortions as well as distortions in certain sectors (for example, removing below-minimum wages from the wage tables and improving the teachers' relative wages), but quickly expanded to include the entire public sector. The greater the variance in the wage agreements among the various working groups (groups by rankings, occupations, etc.), the greater the pressures for wage increases from these groups, as eventually evidenced by a real increase of more than 16 percent in the average public services wages within two years. This development apparently led to private sector wage pressures, which increased due to the erosion of wages relative to productivity and the decline in the unemployment rate; the pressures led to a very sharp increase in wages in the private sector until 2001—a cumulative 23 percent.

The figures also show that the correlation between the wages in both sectors has strengthened considerably since 1999, and have had a more or less fixed ratio ever since. A similar picture emerges from the figures describing how the wages in the public administration developed in relation to the public sector (A-2 and A-3 in the Appendix).

A more formal analysis, using long-term regressions, confirms the visible conclusion: there is a correlation between the wages in both sectors. Table 1 details the results of the various models examined, and includes an explanation of each model, the coefficient of the

[13] See the Bank of Israel 1994 Annual Report, Table 4.12.

[14] A promotion to a higher rank without a vacancy in that rank. For more information, please see the Bank of Israel Annual Report for 2001, Box 2.3.

explanatory variable (the real / nominal wages in the private sector), and an answer to the question whether there is a cointegrative correlation between the two variables.

Table 1
The long-term correlation between wages in the public and private sectors:

Long-term regressions

$$\log(\overline{W}_{G,t}) = \widetilde{C} + \beta_1 \cdot \log(\overline{W}_{P,t}) + \varepsilon_t$$

$$\widetilde{C} \equiv \log(C)$$

Model	Real wage			Nominal wage		
Period	1980–2012	1990–2012	1999–2012	1980–2012	1990–2012	1999–2012
Number of observations	33	23	14	33	23	14
β_1: Long term coefficient (standard deviation)	1.27 (0.103)	0.95 (0.134)	0.83 (0.083)	1.01 (0.005)	1.03 (0.025)	0.98 (0.026)
R-squared, long term	0.83	0.70	0.89	0.99	0.99	0.99
Is there a cointegrative correlation (ADF tests)	No	No	Yes (0.005)	No	No	Yes (0.006)

Short-term regressions

$$d\left(\log(\overline{W}_{G,t})\right) = \beta_2 \cdot d\left(\log(\overline{W}_{P,t})\right) + \hat{\varepsilon}_{t-1}$$

Model	Real wage			Nominal wage		
Period	1980–2012	1990–2012	1999–2012	1980–2012	1990–2012	1999–2012
β_2: Short term coefficient (standard deviation)			0.83 (0.066)			0.91 (0.101)
R-squared, short term			0.95			0.87

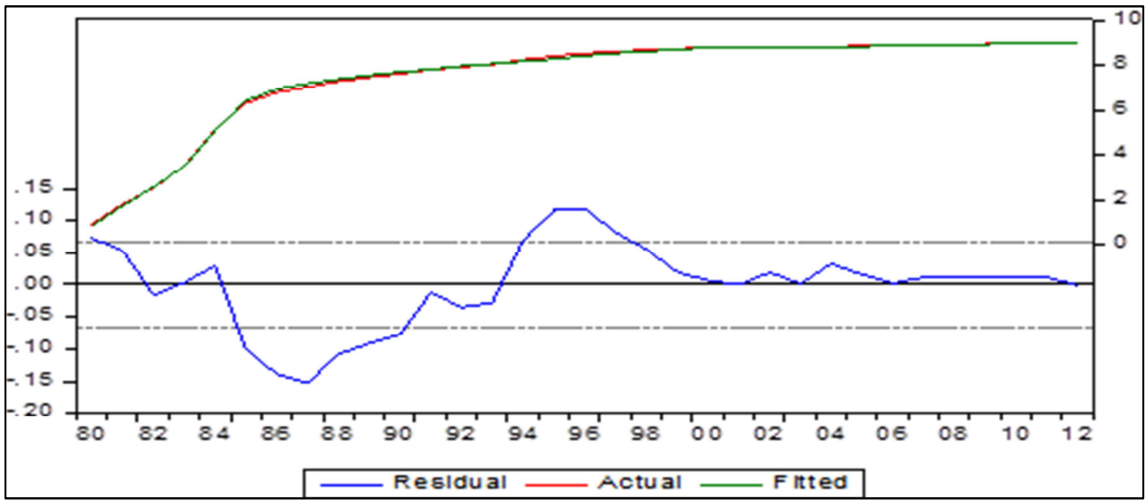
Since the standard stationarity differential (ADF—Augmented Dickey Fuller) test has low explanatory power, failure to reject the null hypothesis may be misleading[15]; namely—failure to reject the hypothesis that the variable is non-stationary does not necessarily indicate that the variable is non-stationary. The literature thus offers another test—KPSS—which examines a reverse null hypothesis, i.e., the hypothesis that the variables are stationary. It should be noted that in the four cases in which the hypothesis that the variables were not stationary was not rejected, the hypothesis that the variables were stationary was not rejected either. In other words, it is also possible to conclude that the residuals are non-stationary.

Figure 3 depicts the residual of the real public wages which was derived from an estimate of a binary regression of the long-term - from 1980 to 2012 (the model is described in the second column in Table 1).

[15] "Because of the low test power, nonrejection of the null hypothesis is probably often misleading" (Wyplosz, 2013).

Figure 3
Real wage in public services: Log of actual wages, log of expected wages, and the difference between them (residual), 1980–2012

$$\log(\overline{W}_{G,t}) = \tilde{C} + \beta_1 \cdot \log(\overline{W}_{P,t}) + \varepsilon_t$$



The figure reflects the sharp increase in public sector wages in relation to the private sector as a result of the wage agreements that came into effect around the mid-1990s, and the gradual erosion that began thereafter - until 2001 - in public sector wages relative to the private sector wages. The obvious decline in the deviation size from 1999 reflects the strengthening of the short-term correlation between wages in both sectors, a statistically valid strengthening (Table 1).

Having presented the background to the wage agreements signed in the public sector during the 1990s, we will now focus mainly on the manner in which wages in both sectors have developed since 1990.

3. The short term equations

a. Wages in the private sector

It is generally assumed that, in the long term, the gross wages of an employee in the private sector are determined according to the average GDP per employee. But when looking at the short term—annual data—one finds that this assumption is not necessarily valid. The main explanations for this are wage rigidity (particularly in relation to salary cuts), employment rigidity, as well as labor market regulation—such as the Minimum Wage Law—which naturally adds rigidity to it.

Some of the factors affecting the development of short-term wages in the private sector are estimated econometrically in a paper by Lavi and Sussman (2005). In addition to the labor productivity level, these factors include:

- The economy's business cycles and rate of unemployment: When the economy is in recession, demand for labor is low, and unemployment is on the rise; these developments undermine the bargaining power of workers, who are therefore willing to compromise on their wages. In contrast, when the economy's growth rate is relatively

rapid, unemployment declines, the demand for workers increases, and the workers' alternatives increase; therefore, upward wage pressures are expected. Moreover, the employees' monthly salary also depends on the number of their working hours, a figure which increases during a boom and decreases in times of decline, according to demand.

- The cyclical nature of corporate profits: in recessions (prosperity) there is pressure for cuts (increases) in manpower costs. In addition, short-term changes in demand may affect labor productivity. Finally, similarly to the business cycles in the economy, corporate earnings' cyclicality also affects the number of working hours and therefore the wages.
- Supply shocks: shocks like the one generated by a large wave of immigration will affect wage levels; the effect of the shock will increase along with its persistence and size.
- Policy changes, especially in tax rates or minimum wages: these are likely to affect the pressures for wage increases.
- Exceptional wage agreements in the public sector: Such agreements may increase workers' bargaining power in the private sector, undermining the stability of the relationship between employers and workers; this, in turn, will result in upward wage pressures.

Based on short-term regressions, we found that the change in public sector wages has no effect on the change in private sector wages.[16] However, each year between 1996 and 2001 there were very high growth rates in private sector wages as well as in the wage level (Figure 1). That is, the rate of private sector wage growth over the years was higher than expected, both in relation to labor productivity (Figures 1a and 1b) and relative to wages in the public sector (Figures 2a and 2b). Thus, it may be concluded that the growth rate in the private sector between these years was "too steep", and did not reflect the manner in which fundamental economic factors developed over that period.

Therefore, it seems that the increase between 1996 and 2001 constitutes a response to the generous wage agreements signed in the public sector in the mid-1990s. These exceptional agreements sharply raised public sector wages, resulting in public sector wages growing disproportionally relative to the growth of wages in the private sector, thus undermining the stability of wages in the private sector.[17] Private sector wages rose so rapidly over these years, that even in 2012, real gross wages in the private sector were not higher than in 2001. This erosion may also be due to the rapid increase in recent years in the participation rate, particularly since it occurred among population groups with potentially lower wage costs, and as a result of the sharp tax cuts which enabled an increase in employee compensation without increasing the employer's cost.[18]

b. The short-term correlation between the wage paths in the public and private sectors

In this section, we examine, statistically, the strength and significance of the short-term correlation between public sector wages and private sector wages, and its development over

[16] Short term regressions of the differential type, similar to the pattern presented at the bottom of Table 1. The regression results are not included in the paper, but may be obtained from the author.
[17] We shall return to this point towards the end of the paper, in the section dealing with the exceptional wage agreements in the public sector.
[18] For more information, see Box 6.1 in the Bank of Israel Annual Report for 2010.

the study period. To this end, we will exclude the first two variables from their long-term trend, since both are I(1).

There are several ways to exclude the long-term trend from a variable. In light of the basic development path of the real wages in both sectors - i.e., a relatively sharp rise at the beginning of the period, followed by stability (Figure 2a) - we will exclude the variables from a linear trend and a quadratic trend (both found to be highly significant).

Figure 4 shows the development of the wages less the trend in the public sector, private sector and public administration. It seems that, by the end of the 1990s, there was no correlation between the short-term development of the wages in the two sectors; the wages' development reflected the generous wage agreements signed in the early 1990s in the public sector, while at the same time, the subsequent sharp increase in private sector wages, which was apparently affected by these agreements. However, since then, the gap between the two sectors reflected the average of the long-term gap between them (Figure 2b), and a strong and stable short-term correlation developed between the wages in the two sectors.

Figure 4
The development of wages, detrended (log), 1990–2012

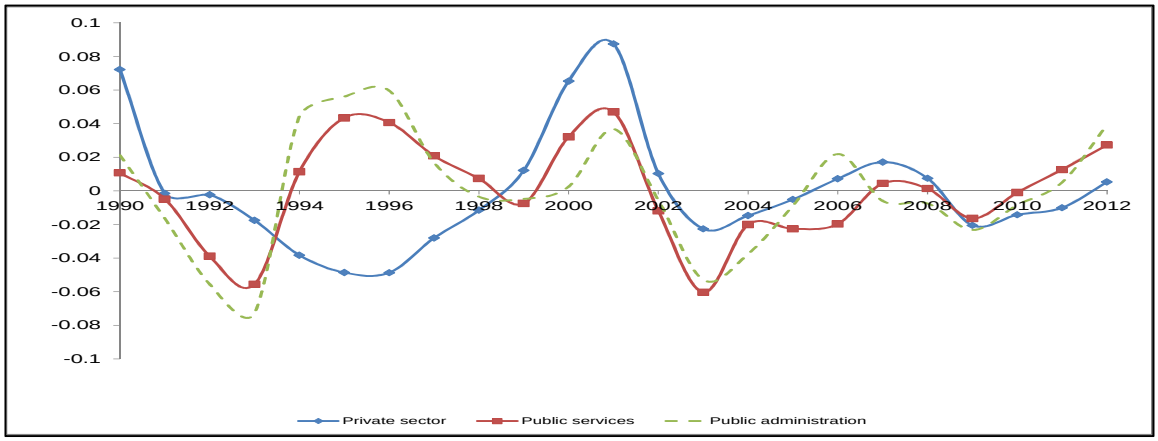


Table 2a shows the correlation between variables (Pearson's correlation coefficient) in a temporal and rolling manner. Each row is one year further, and the final year - 2012 - remains constant. The middle column represents the contemporaneous correlation, the left - the time-lagged correlation when the private sector leads, and right - the time-lagged correlation when the public services sector leads. Table 2b presents similar data, but this time, each row represents a fixed period of thirteen years, throughout the period under study. This table also provides statistical confirmation to the argument that there was no short-term correlation between the wage paths of the two sectors at the beginning of the study period, but - over the years - a correlation was created and strengthened gradually.

Table 2a
Correlation coefficients between wages (detrended) in public services and private sector, decreasing period, 1990-2012

	Private sector leads	Contemporaneous correlation	Public services lead
Years			
1990-2012	-0.13	0.21	0.14
1991-2012	-0.13	0.20	0.14
1992-2012	-0.13	0.20	0.14
1993-2012	-0.15	0.21	0.11
1994-2012	-0.14	0.19	-0.00
1995-2012	-0.06	0.21	0.02
1996-2012	0.08	0.38	0.20
1997-2012	0.19	0.62	0.36
1998-2012	0.22	0.73	0.42
1999-2012	0.22	0.76	0.42
2000-2012	0.23	0.76	0.51

Table 2b
Correlation coefficients between wages (detrended) in public services and private sector, fixed period, 1990-2012

	Private sector leads	Contemporaneous correlation	Public services lead
Years			
1990-2002	-0.18	0.13	0.12
1991-2003	-0.17	0.19	0.15
1992-2004	-0.14	0.20	0.17
1993-2005	-0.13	0.21	0.14
1994-2006	-0.12	0.17	-0.01
1995-2007	-0.03	0.19	-0.01
1996-2008	0.15	0.38	0.19
1997-2009	0.31	0.69	0.36
1998-2010	0.35	0.82	0.45
1999-2011	0.29	0.81	0.44
2000-2012	0.23	0.76	0.51

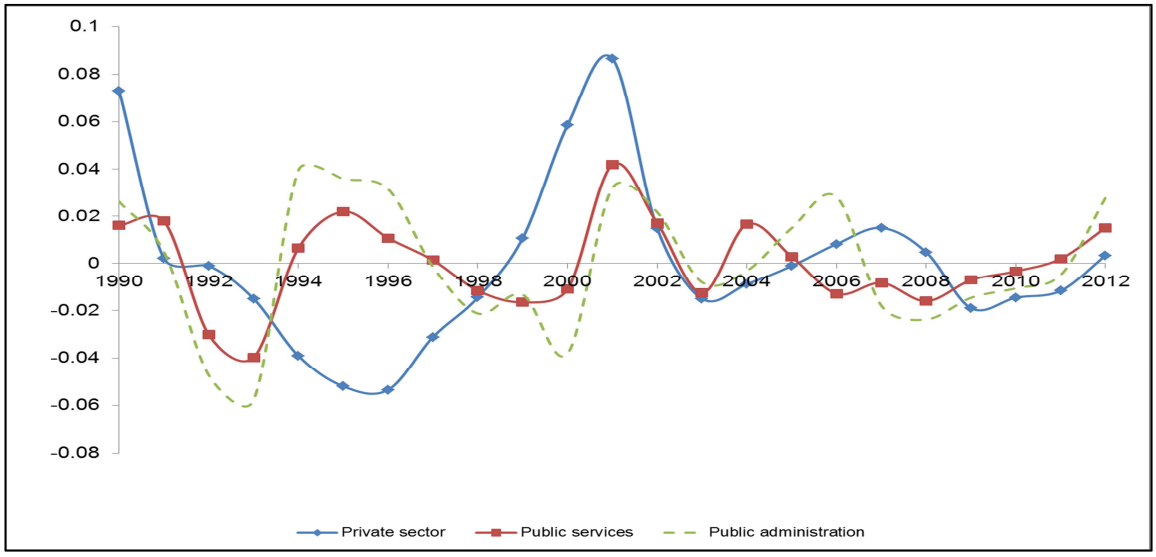
The two tables validate the picture that emerges from Figure 4: The strong and short-term correlation between public sector wages and private sector wages began to emerge only in the late 1990s. The table also suggests that the contemporaneous correlation is the highest of the three. It was found that the trends of the results in the tables (i.e., not necessarily the numbers themselves) were highly robust; they remain the same whether the public sector wages are replaced by the public administration wages, whether the research period is expanded to include the 1980s or the wages are deducted by the GDP prices rather than by consumer prices.

It should be remembered that the correlation does not necessarily indicate a causal correlation. For example, it may be possible that the high correlation reflects a common cause for the two variables, i.e., they could both be correlated with additional variables.[19]

It is natural to examine whether the cause is the business cycle. Excluding the trend from the last two variables counteracts its simultaneous effects on the wages in both sectors. To strengthen the hypothesis that the correlation in wages implies a correlation beyond the state of the business cycle, we will examine the development of the changes in the residuals of the wages in both sectors, with the explanatory variable in the regression being the per capita GDP in a given year, in addition to the variable trend of the wages. The results are presented in the two following figures.

Compared to the correlations without controlling for the growth rate (Tables 2a and 2b), the correlation between the wages in the two sectors was weakened as expected (by an average 30 percent), but remains high (Figure 5). The weakening specifically explains the correlation between the state of the business cycle and the wages in the public administration and the public sector.

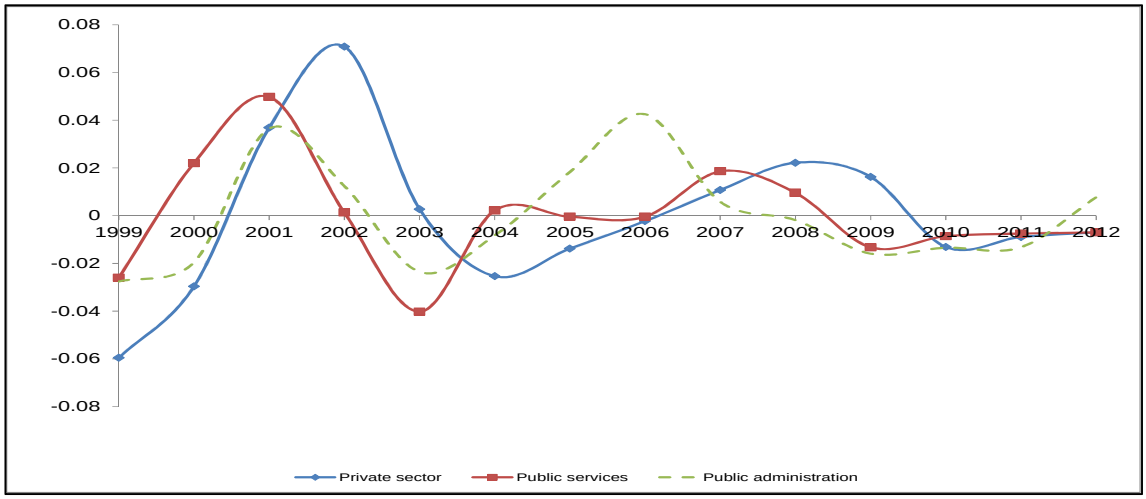
Figure 5
The development of the wage residuals net of GDP and trend (log), 1990–2012



When we examined only the last thirteen years (Figure 6) we found a similar phenomenon: the correlation between the wages weakened compared to the correlation without controlling for the GDP per capita, but remained high—0.48 between the wages in the public administration and the wages in the private sector, and 0.35 between the wages in the public sector and the wages in the private sector. Thus, the correlation between the wages in the two sectors is beyond the state of the business cycle, and the latter explains about a quarter to one-third of the total correlation between them since the beginning of the previous decade.

[19] We emphasize that the study is not necessarily designed to examine the causal correlation between the two variables. Even if we find there is no causal correlation between them, this does not contradict the finding that the correlation between them has been considerably strengthened since 1999.

Figure 6
The development of wage net of GDP (log), 1999–2012



c. Causality tests

In this sub-section, we will conduct causality tests for the average wages per employee position in the two sectors.[20] According to the common methodology, we will examine the direction of the causality using the Granger Causality Tests, product of the VAR model, and set the number of time-lags in accordance with accepted statistical tests (AIC, LR, SC). According to the null hypothesis, variable *X* does not cause variable *Y*, i.e., if the hypothesis is rejected, variable *X* causes variable *Y*.

Table 3 lists the results of the various models.

Table 3
Causality tests*

Model	Period	Real/Nominal	Detrended wage	Public wage a factor in private wages	Private wage a factor in public wages	Number of lags
				P.Value	P.Value	
Public wage, Private wage	1980-2012	Real	No	**0.00**	0.37	2
Public wage, Private wage	1980-2012	Real	Yes	**0.00**	0.10	2
Public wage, Private wage	1990-2012	Real	No	**0.04**	0.34	2
Public wage, Private wage	1990-2012	Real	Yes	0.16	0.71	2
Public wage, Private wage	1999-2012	Real	No	0.29	**0.00**	3
Public wage, Private wage	1999-2012	Real	Yes	**0.00**	**0.00**	3
Administrative wage, Private wage	1990-2012	Real	No	**0.00**	0.11	2
Administrative wage, Private wage	1990-2012	Real	Yes	**0.01**	0.73	2
Administrative wage, Private wage	1999-2012	Real	No	**0.02**	**0.00**	4
Administrative wage, Private wage	1999-2012	Real	Yes	0.17	**0.00**	4
Administrative wage, Private wage	1990-2012	Nominal	No	**0.08**	0.35	4
Administrative wage, Private wage	1990-2012	Nominal	Yes	**0.02**	0.79	2
Administrative wage, Private wage	1999-2012	Nominal	No	**0.00**	**0.05**	4
Administrative wage, Private wage	1999-2012	Nominal	Yes	**0.00**	**0.01**	4
Administrative wage, Private wage, including prices	1990-2012	Nominal	No	0.34	0.58	2
Administrative wage, Private wage, including prices	1990-2012	Nominal	Yes	**0.02**	0.86	2
Administrative wage, Private wage, including prices	1999-2012	Nominal	No	0.14	0.39	3
Administrative wage, Private wage, including prices	1999-2012	Nominal	Yes	0.11	0.17	2

* When the test begins in 1999, the number of observations is borderline low.

[20] In this subsection, we go back to using National Insurance files.

The results presented in the table are at significance which allows the rejection of the null hypothesis. To illustrate the point, the number 0.04 in the third row means that the hypothesis that wages in the public sector do not affect the wages in the private sector can be rejected at a significance level of 4 percent (that is, they do affect them). The table statistically confirms the picture that emerges from Figure 4. When considering the development of wages in both sectors from 1980 or from 1990, we find that wages in the public sector are leading the development of wages in the private sector; this finding is seen in most models, so it can be said it is robust. On the other hand, we did not find that the private sector wages lead the development of public sector wages. These findings change when the period is reduced and the correlations are examined from 1999 onward. From that year on, wages in both sectors affect each other's development. Moreover, when taking into account the short term only, the finding that the private sector wages cause the development of the public sector wages is made even more strong and well-based than the reverse finding. It can therefore be concluded that in the 1990s, the development of public sector wages led to the development of wages in the private sector, but in recent years, wages in both sectors have been moving in tandem and each affects the other.

4. Characteristics of employees in the two sectors over time

So far, we have examined the correlations between the gross wages per employee in the two sectors, i.e., irrespective of the differences between the characteristics of the employees in each sector. This study does not address the wage gap, excluding the characteristics, between the two sectors and its development over the years. But nevertheless, we wish to examine whether the correlation we found between the gross wages in the two sectors also exists between the wages when employee characteristics are excluded.

To do this, we use the income surveys from the studied years[21] (until 2011) to estimate Mincer Regressions, separately for each year, one regression for the monthly wages and one for hourly wages, once with additional explanatory variables and once without them. We shall limit the employee population to ages 28 to 55 and to employees who worked at least 10 hours per week. The notable explanatory variables are: gender, years of education, age and squared age.

$$\log(w_{i,t}) = \gamma_t \cdot PS + \varepsilon_{i,t}$$
$$\log(w_{i,t}) = \beta X_t + \lambda_t \cdot PS + \varepsilon_{i,t}$$

The previous sections have, in fact, shown that λ_t is stationary[22] and that there is a cointegrative correlation between the wages of the two sectors. The main idea was to test (1) whether λ_t is stationary - whether the wage gap between the two sectors has no long-term trend even when excluding the differences in the employees' characteristics; and (2) whether the differential between the estimated values and the dummy variable "public

[21] This is contrary to the findings presented in the previous sections regarding wages per employee position, which are based on the National Insurance files.

[22] The correlation coefficient between (1) the annual co-efficient of the variable "public sector" in the single-variable regression and (2) the relation between the wages per employee position in the public sector and the private sector wages (Figure 2b) is 0.85 in the case of hourly wages and 0.78 in the case of monthly wages per employee.

sector" is stationary—i.e., whether the differential between the gap excluding the characteristics and the gross gap has no long-term trend.

In both cases, the answer was negative, but it is particularly evident in the case of the differential: over the years, there is a clear trend in the public sector of a decrease in the differential between the conditional wage premium and the unconditional wage premium (this applies to both the monthly wages and hourly wages) - see Figure 7. That is, the gap between the wages excluding the characteristics has changed over time to the detriment of public services, since the extensive wage agreements were signed in the early to mid-1990s.

Figure 7
The gap between coefficients in the wage and business cycle equations in Israel, by year, 1991–2011

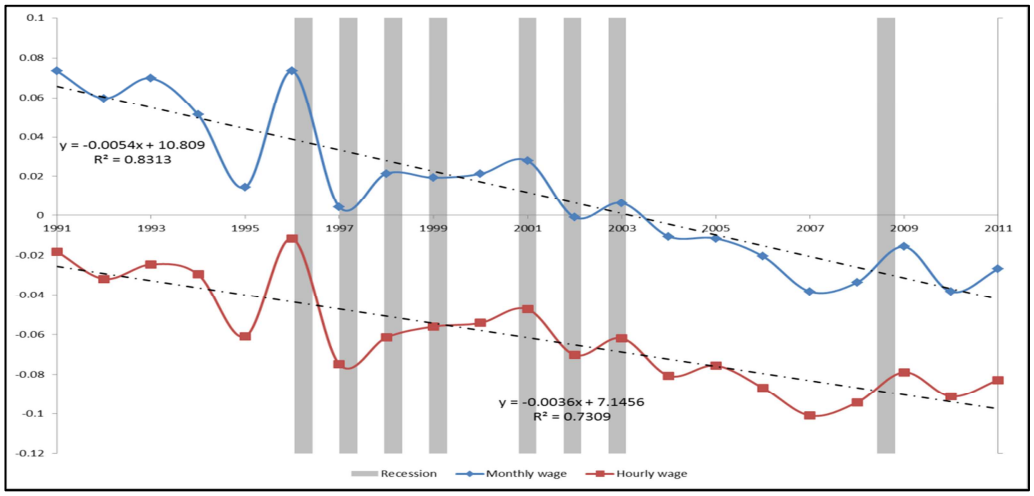


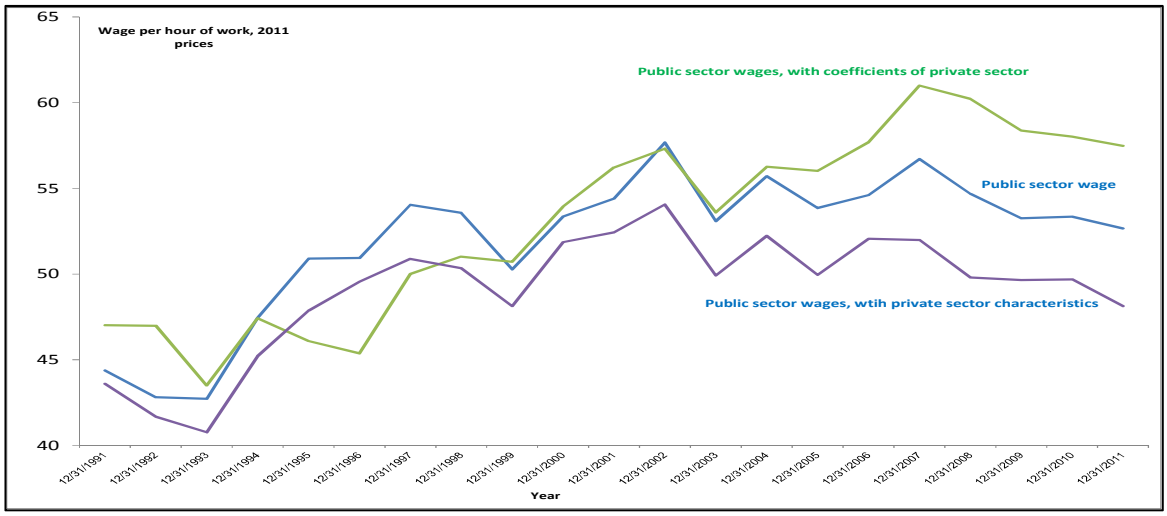
Figure 7 suggests that (a) the average of characteristics of employees in the public sector relative to the private sector has improved (in terms of their economic cost, for example, because they have become more educated than employees in the private sector), or that (b) the return on the characteristic of the public sector employees has been eroded relative to the return on the characteristics of employees in the private sector[23], or (c) both conclusions are correct.

To test this, we decompose the differentials between the wages in the two sectors according to the methodology of Oaxaca, 1973. Figure 8 shows the processing of the results of the decomposition, displaying the average hourly wage in the public sector, the average hourly wage in the public sector if the characteristics average in the public sector were identical to the average characteristics in the private sector (and the coefficients would remain as they are in the public sector), and the hourly wage in the public sector if the coefficients of the public sector characteristics were identical to those of the private sector (and the characteristics would have remained the same as they are, in effect, in the public sector).

[23] When running a Mincer Regression that is common to the public and private sectors in tandem with a dummy variable for the public sector, it is assumed that the return on the characteristics, i.e., the parameters, are identical in both sectors; and that if they have undergone a differential change over the years, it will be reflected in the value of the dummy variable.

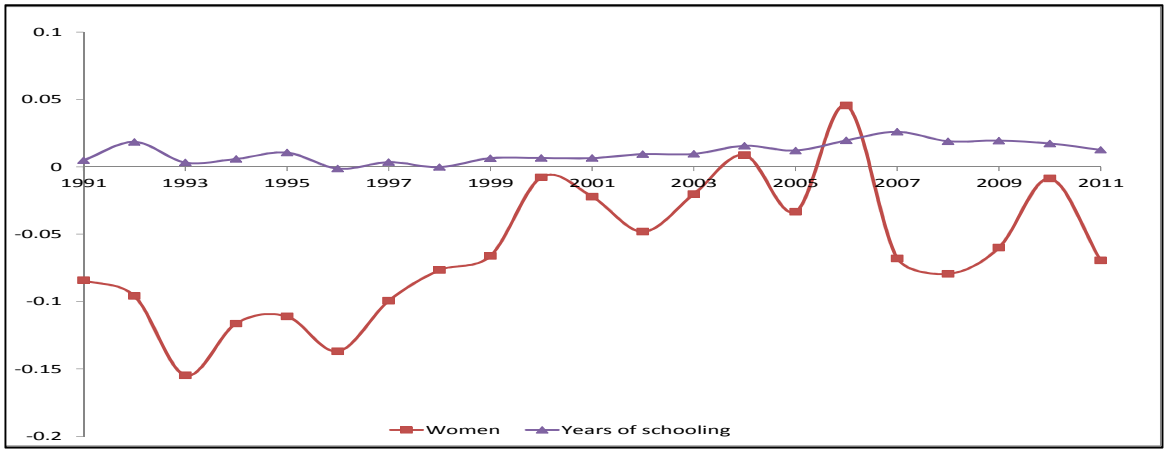
The gap between the actual wage developments and the lower line represents the effect of the characteristics on the development of the wage paths in respect of the employees in the public and private sectors. The positive gap represents the fact that, on average, the characteristics of public sector employees have gained an advantage over the characteristics of the private sector employees. The characteristic with the most significant improvement is the average level of education.

Figure 8
Public sector wages and a breakdown into characteristics and coefficients, 1991–2011



By contrast, since 2003, the gap created between the actual development of wages in the public sector and public sector wages with the coefficients of the private sector, represents the coefficients' effect; as a result, it can be concluded that beginning in 2003, the returns on private sector characteristics increased relative to the returns on characteristics in the public sector. The most significant increase is the return on education (see also Mazar, 2012) and the negative premium of women relative to men (see also Mazar and Peled, 2012). Figure 9 shows these developments over the years.

Figure 9
Women and years of schooling: The gap between the private sector coefficient and the public services coefficient, 1991–2011



The distribution of occupations in the two sectors (Figure 10) tells us that, starting from 1997, the percentage of college graduates and managers - relatively high-paying occupations - has increased in the private sector more than in the public sector. When examining the change in both sectors' return on education while taking into account the distribution of occupations, we find that the increase in the private sector is less significant.

Another possible explanation for the relative decrease in the return on education in the public sector vs. the private sector stems from the fact that the public sector encourages higher education among its employees and, in fact, pays some of them for it as a compensation component. This mechanism increases the supply of educated employees in the public sector but also reduces the return on education relative to the private sector. Further discussion from a microeconomic point of view is beyond the scope of this study.

Figure 10
Distribution of occupations in the private sector and in public services, 1997 and 2011

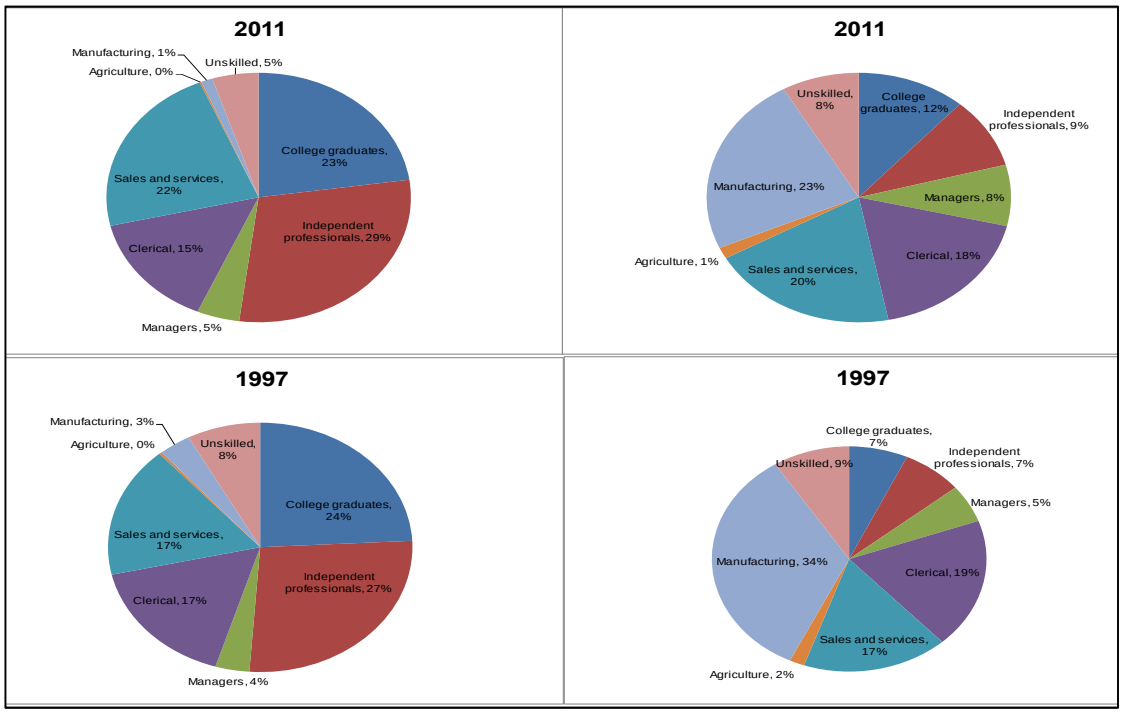


Figure 7 shows the years considered to be a recession period in Israel. According to the figure, the deviations from the general downward trend cannot be characterized in the context of the business cycle; for example, the 2001–03 economic downturn was characterized by a continued decline in premiums for work in the public sector, as was the subsequent growth period.

5. Wages in the public sector in the short term, according to public administration wages

a. Wages in the public sector in the short term, according to public administration wages

This subsection analyzes the path of the public sector wages using micro data (administrative wage files) on wages in the public administration (the central government). This includes an average of about one hundred thousand observations per year. Public administration is one of the arms of the public sector, and the development of its wages is

representative of the development of wages in the entire public sector: between 1990 and 2012, for example, there was, respectively, a 0.93 and 0.79 correlation between the rate of change in the nominal and real wages (*dlog*) of employees in the public administration and the rate of change in the nominal and real wages of public service employees (see Figures A-2 and A-3 in the Appendix).

In the short term, public sector wages are determined by wage agreements and wage creep. Wage creep stems from two factors. First, an automatic return on tenure, which forms part of the wages table[24]; second, promotion or a change in rankings or level (occupation) of workers who remained employed.

According to Mazar's estimate (2007), when other variables remain constant, each year of tenure increases wages in the public sector by an average of 0.6 percent.[25] The said study estimated the net return per year of tenure separately, and the estimation results are presented in Table 4, Column C—it appears that the return on tenure increases to some extent over time. A promotion has an average return of about 7 percent (Mazar, 2007).

On average, 22 percent of the workers who remained employed are promoted each year, a figure which has decreased over time (Table 4, Column D). The change in ranking has a yield of 5.6 percent (Michelson, 2012), and each year, on average, the ranking of 3.5 percent of the employees changes. If we multiply the percentage of promoted employees (in a particular year) by the return on promotion, and add to that the product of the percentage of employees changing rankings (in a given year) by the return on ranking, we will get the overall yield on promotion (for a particular year; see Table 4, Column E). Thus, wage creep leads to an average annual increase of 2.3 percent in the real wages of workers who remain employed (Table 4, Column F) and 75 percent of this increase is due to employee promotions. The decrease, over time, in the percentage of employees being promoted was also reflected in a downward trend in the growth rate of wages of workers who remained employed, and since 2003, their wages have increased by an average of only 2 percent.

The wages of all employees in a particular year is not affected only by the wages of workers who remain employed, but also by the level of wages and scope of the employees recruited during the year by the public administration (on average, 11 percent of the employees in a given year were not employed by the public administration in the previous year). The new employees often join for wages that are relatively low compared to those of the workers who remain employed (their wages average about 72 percent of the workers who remain employed and about 81 percent of the wages of employees who left the previous year), causing the real wages of all employees to grow over the years by an average of 1.25 percent per year - lower than the increase in the wages of workers who remain employed (3.9 percent per year).

In addition, the wages of both the workers who remain employed and of newly recruited employees is affected by wage agreements, collective or individual, signed during the year between the employees and their employers. This study assumes that the residual unexplained increase in a particular year in the wages of workers who remained employed

[24] The salary table links the employees' base salary to their rankings (which correspond to their professions), their level and tenure; the base salary constitutes about 40 percent of their gross wages (on average, across all rankings).

[25] Assuming the return, in percent, on promotion has not changed over time and has not changed since 2007.

are due to wage agreements.[26,27] Over the years, wage agreements have given steady employees an average real growth rate of 1.8 percent per annum; and with wage creep, they have brought the total increase in real wages of workers who remained employed to 4.1 percent per year - a rate that is very similar to the wage growth rate of workers who remained employed in the economy as a whole.[28] It was also found that wage agreements are responsible for about one third of the total increase in real wages of all employees during the period under study.

Table 4
Real growth in wage in public administration, 1991–2012

	(A)	(B)	(C)	(D)	(E)	(F)=(C)+(E)	(G)=(B)-(F)
Year	Total real growth in wages of all workers	Total real growth in wages of workers who persist in employment	Return to tenure	Percent of promotions	Total return to promotion	Wage creep of workers who persist in employment	Wage agreements (residual of change in wage that other factors don't explain)
1991	0.84	3.42	0.37	0.24	1.7	2.1	1.3
1992	-5.75	-3.61	0.41	0.21	1.5	1.9	**-5.5**
1993	2.87	5.36	0.48	0.29	3.4	3.8	1.5
1994	17.01	19.40	0.29	0.51	3.7	4.0	**15.4**
1995	-0.29	2.90	0.36	0.29	2.1	2.5	0.4
1996	5.93	8.19	0.47	0.31	2.3	2.8	**5.4**
1997	-3.41	-1.42	0.55	0.30	2.2	2.7	**-4.1**
1998	-1.47	1.22	0.51	0.27	2.0	2.5	-1.3
1999	-1.34	1.61	0.49	0.23	1.8	2.2	-0.6
2000	2.12	4.48	0.52	0.16	1.3	1.9	2.6
2001	6.20	9.18	0.61	0.20	1.7	2.3	**6.8**
2002	1.15	4.07	0.72	0.21	1.6	2.3	1.8
2003	-8.93	-6.26	0.79	0.20	1.5	2.3	**-8.6**
2004	3.98	4.87	0.74	0.17	1.3	2.1	2.8
2005	3.67	5.81	0.82	0.16	1.2	2.1	3.8
2006	3.33	5.21	0.74	0.18	1.4	2.1	3.1
2007	-1.92	3.66	0.69	0.17	1.3	2.0	1.7
2008	0.99	4.32	0.70	0.16	1.3	2.0	2.3
2009	-2.21	-1.76	0.71	0.16	1.3	2.0	**-3.7**
2010	-0.07	3.17	0.65	0.16	1.3	2.0	**1.2**
2011	2.03	5.75	0.67	0.17	1.2	1.9	**3.8**
2012	2.72	5.44	0.91	0.16	1.2	2.1	**3.3**
Annual average	**1.36**	**3.88**	**0.61**	**0.22**	**1.73**	**2.34**	**1.51**

There is a very high correlation (correlation coefficient of 0.97) between the calculated height of the wage agreements and the rate of overall change in the wages of all public administration employees. This high correlation is due to the relatively small number of newly-recruited employees; but it mainly stems from the fact that the wage increase is not the result of the wage agreements—namely, increase due to promotion and tenure—there is low variance, which is hardly affected by exogenous factors during the period under study

[26] Some of the changes under the heading of "wage agreements" resulted from the indexation mechanisms (to the Consumer Price Index) that were widely used in the 1990s in the public sector and/or from inflation surprises. Compounding these are one-off payments paid by public sector employees in certain years (for example, to help the state budget in 2004–2005, 2009 and 2012), one-off payments designed to compensate for wage erosion and other processes bearing lower weight.

[27] While in some years, such as in the early 1990s, employees received promotion as part of the implementation of wage agreements; but even if we take that into account, the results' trend would not change.

[28] Based on the income tax files of workers who persisted in employment for 1999–2011.

(except for the decrease in the rate of employees being promoted over the years). A possible conclusion may be that the public sector wage creep is a stabilizing factor in the economy, which contributes to smoothing business cycles. On the other hand, the said correlation shows that the path of wage agreements since 1999 is responsible for the high correlation generated since then between the wage paths in the public and private sectors (for more information on wage agreements, see the following subsection).It is possible to display, in an analytical manner, the sources of the increase in the wages of public sector employees:

All: total number of employees; *SW*: workers who remained employed; *NW*: newly recruited employees; Δ: percentage of newly recruited employees.

$$\overline{W}_{All,t+1} = \Delta \cdot \overline{W}_{SW,t+1} + (1-\Delta)\overline{W}_{NW,t+1} =$$
$$= \Delta \cdot (1+\delta)\overline{W}_{SW,t} + (1-\Delta)\overline{W}_{NW,t+1}$$
$$\frac{\overline{W}_{All,t+1}}{\overline{W}_{All,t}} = \frac{\Delta \cdot (1+\delta)\overline{W}_{SW,t}}{\overline{W}_{All,t}} + \frac{(1-\Delta)\overline{W}_{NW,t+1}}{\overline{W}_{All,t}}$$
$$= \Delta \cdot (1+\delta)\frac{\overline{W}_{SW,t}}{\overline{W}_{All,t}} + (1-\Delta)\cdot\frac{\overline{W}_{NW,t+1}}{\overline{W}_{All,t}}$$

$$1 + = (1 + \text{Promotions})\ (1 + \text{Agreements})\ (1 + \text{Tenure})\delta$$

That is, the total increase in wages of workers who remained employed in a particular year is equal to the product of the promotion, tenure increment and wage agreements.

It is worthwhile noting another figure: Despite the various mechanisms used to determine the wages in the public sector, and despite the variety of factors involved, starting in 1990 the average wages per employee in the public administration has risen at an average rate of 1.5 percent per year[29], similar to the increase in long-term productivity per employee, i.e., the labor productivity in the economy (about 1 percent per year).

b. Public sector wage agreements

In general, wage agreements are nominal, and are signed due to inflation forecasts in the near term. To calculate the nominal increase due to the agreement, we shall add the real increase in employees' wages and the actual change in the CPI in the same year. Each year, the Ministry of Finance publishes its inflation forecasts for the coming year.[30] If we deduct the annual inflation forecast from the value of the nominal agreement, we get an approximation of the real increase as a result of the planned agreement. Another way to

[29] 1.4 percent if the rate increase is calculated as follows:

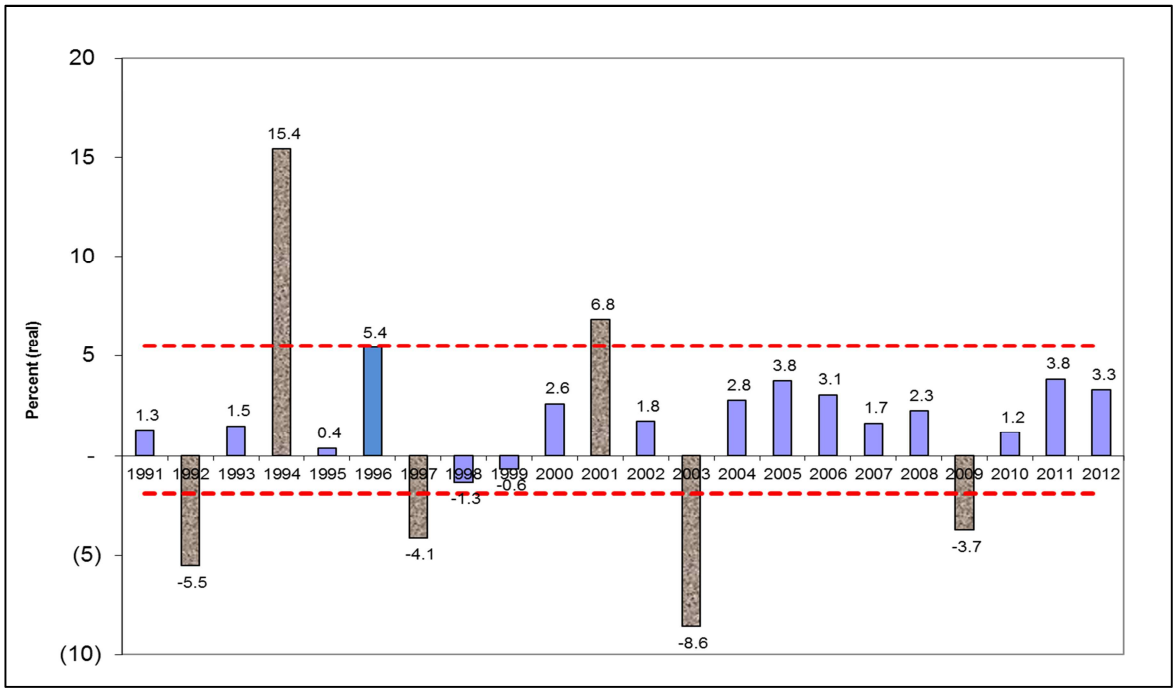
$$Average\ \_\ Annual\ \_\ Increase = \left[\left(\frac{\overline{W}_{real,2012}}{\overline{W}_{real,1990}}\right)^{\wedge\left(\frac{1}{2012-1990}\right)} - 1\right]\cdot 100$$

[30] Whether in the proposed budget, or the budget report itself, or in the annual report of the State Tax Revenues Administration.

look at the planned real agreement is to see it as a scheme of the actual real agreement and the differential between the actual inflation and the inflation forecast.

The wage agreements can be divided into two: significant wage agreements and regular/ current wage agreements. In this study, the wage agreement is considered significant if its real effect in absolute value is greater than plus/minus one standard deviation of the wage agreements, 4.8 percent, of the average real growth stemming from the wage agreements, 1.51 percent. Figure 11 depicts the real increase in the wages of workers who remained employed as a result of the wage agreements, while dividing the agreements into significant and regular ones.

Figure 11
Significant and regular wage agreements: The real increase, 1990–91 through 2011–12



The significant wage agreements

From time to time, the public sector is forced to sign significant wage agreements, both out of a desire to emulate the trend line of the private sector wages and to compensate for the erosion in real wages as a result of steep price increases, such as those prevalent in the early 1990s and even more so in the 1980s. Since the number of significant agreements is very small - i.e., they provide very few observations - this argument cannot be examined statistically. For this reason, we will attempt to characterize each of the significant wage agreements by four temporal components in comparison to their long-term average: (1) the average public administration wages compared to the average private sector wages; (2) the state of the business cycle in years *t, t-1*, as reflected in the per capita growth rate; (3) the fiscal situation in years *t, t-1*, as reflected by the current deficit, and (4) the growth forecast for the coming year (Table 5).

It is possible to deduce from Figure 11 that the most significant wage agreement in the public sector was signed in the early to mid-1990s (for more information on the topic, see Section 2.)

Assumption III

Wage agreements are a function of the government deficit in the previous year, the business cycle, the ratio between public sector wages and private sector wages in the previous year, and inflation expectations.

$$\Delta W_{G,t}(Agreements) = f\left(Deficit_{t-1}, BC_t, \frac{\overline{W}_{G,t-1}}{\overline{W}_{P,t-1}}, \pi_{t+1} \right)$$

Table 5
Characteristics of significant wage agreements, 1991–92 through 2008–09

Year	Real wage agreement in actuality	Planned real wage agreement	Ratio of average wage in public administration to average wage in private sector	Gap between real wage growth rates in public sector and private sector in the 5 years before the agreement (%)	Deficit t, t-1	Growth per capita	Growth forecast for t+1*
1991–92	-0.1	-9.3	1.40	3.5%	5.0	1.7	6.6
1993–94	14.0	19.5	1.40	13.6%	5.2	2.4	5.3
1995–96	2.4	2.7	1.45	17.5%	4.1	4.1	4.8
1996–97	-2.6	-6.7	1.47	**21.8%**	5.3	3.4	4.4
2000–01	5.7	**4.4**	1.42	**-4.6%**	2.6	3.3	4.4
2002–03	-3.1	-8.4	1.48	-13.0%	5.6	-1.2	0.2
2008–09	-3.3	**-2.0**	1.49	-0.7%	4.1	0.5	1.1
Average	**1.87**	**1.47**	**1.468**		**3.99**	**2.0**	**3.75**

Several main conclusions arise from the table:

- All public sector wage agreements moved in the same direction - i.e., narrowing the gap between the public sector wages and private sector wages - with the exception of wage agreements signed between 1991 and 1992. To illustrate, between 2000 and 2001 the public sector wage agreements increased the real wages of the workers who remained employed by almost 7 percent (the planned increase was smaller), since the average wages in the public sector eroded in relation to the average wages in the private sector. This was reflected by the fact that five years prior to the agreement, the average wages in the public sector increased at a lesser rate than the average private sector wages, by five percentage points. Between 2002 and 2003, the agreements reduced the real wage agreements in the public administration by 8.5 percent (the plan was to reduce it by a greater percentage), both due to the recession and because wages in the private sector fell sharply and caused the average wages in the public administration to be higher than the average of the long-term correlation between them.
- The most significant wage agreement in the public sector was signed between 1993 and 1994. Wage agreements in 1993–94 and 1995–96 were both fiscally exceptional and signed against the backdrop of a relatively high average deficit (but temporary - due to the large wave of immigration). Both were signed during a period when per capita growth rates were higher than average in the studied period. The 1995 to 1996 wage

agreement formed against the backdrop of the exceptional wage agreements signed in the public sector in the preceding period, which resulted in an average increase of more than 20 percentage points in the public sector wages compared to the average wages in the private sector.

- All significant wage agreements were pro-cyclical—they include wage increases (decreases) during growth (recession). This is an expected outcome given the deficit targets and taking into account the fact that the deficit is counter-cyclical as are private sector wages: in boom periods—private sector wages increase, the deficit shrinks, and the government can raise wages in the public sector since the deficit does not impose limits. This conclusion also applies to the growth expectations for the following year, with the exception of the agreement signed between 1991 and 1992, which included the expectation that in 1992, the economy would grow at a relatively high rate. The wage agreement signed between 1996 and 1997 was exceptional: it was anti-cyclical and resulted from an adjustment program formulated following a budgetary crisis. The agreement reduced the real wages of public sector employees despite the fact that the per capita GDP grew at a higher rate than the economy's (average) long-term growth rate, and despite the fact that the inflation expectations given at the time for the coming year were also higher than the long-term rate. This figure supports the claim that wage agreements signed in previous years were quite generous, and the government was forced to take a small step back and reduce real wages of public sector employees, although the economy grew at a higher rate and there was no pressure to reduce wages - except for the pressure caused by the high deficit, which resulted mainly from previous agreements.
- When taking into account the planned wage agreement rather than the actual agreement, most findings are strengthened. To illustrate, the actual inflation rate in 1994 stood at almost 15 percent, compared to a forecast of 9 percent, which eroded the significant wage agreement signed at the time. In 2003, prices declined unexpectedly, leading to a decline in actual wages that was smaller than expected; In other words, wage agreements signed that year were meant to decrease public sector wages more than they actually did, but the unexpected price decrease weakened their effect.[31] Two years 2001 and 2009 are an exception to the rule. In 2001, actual inflation was lower than the forecast, so the actual wage agreements were more extensive than the planned agreements. In 2009, actual inflation was higher than expected, and therefore the real effect of the wage agreements strengthened, leading the real wages of employees to fall at a greater rate than expected.

6. Summary and questions for further study

This study examined the correlations in Israel between wages in the public and private sectors since 1990. The study found that, although the two sectors use different mechanisms to determine wages, there is a long-term (cointegrative) correlation between wages in the two sectors, and the correlation has particularly strengthened since 1999. From that year, the correlation coefficient between the wages in the two sectors is high and statistically

[31]In this case, the salary reduction was temporary and was the result of a highly exceptional budget deficit. This explains why the planned wage reduction was higher.

durable. Causality tests show that, since 1999, there is a bidirectional correlation, although the hypothesis is that public sector wages are affected by the private sector wages is characterized by greater durability. It appears that, prior to 1999, public sector wages affected the wage path in the private sector, since the private sector wages increased significantly following the public sector wage agreements signed in the mid-1990s (this increase has even intensified in 2000 and 2001, the dot-com bubble years).

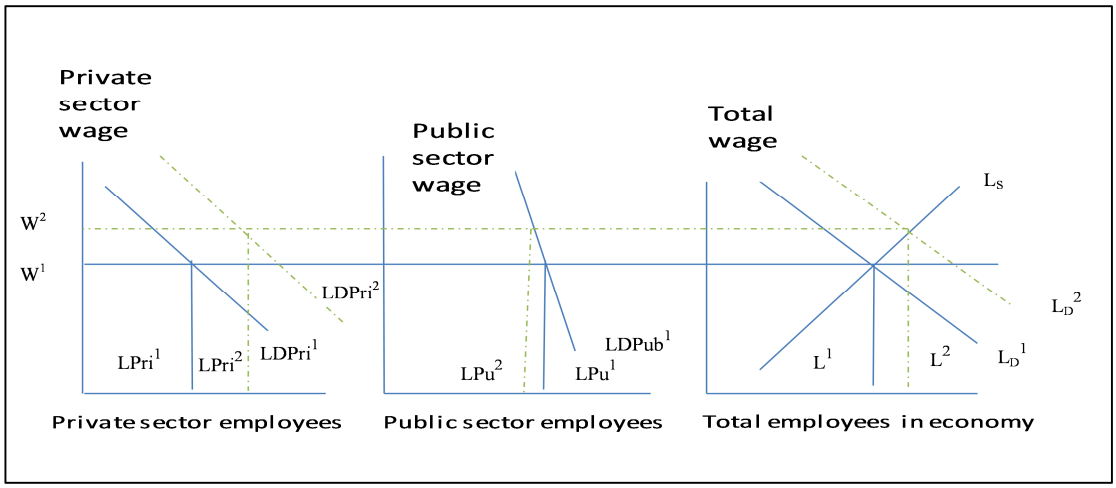
When we took into account the differences in the characteristics of public service employees and private sector ones, we found that public sector wages eroded compared to wages in the private sector since the signing of the extensive public sector wage agreements in the 1990s.

It was also found that the public sector wage agreements strengthened the short-term correlation between the wages in the two sectors, and that there is a 0.97 correlation between the total change in employees' wages in the public administration, and a 0.67 correlation between these wages and the total change in wages of private sector employees. On the other hand, the wage creep in the public administration is characterized by low diversity and thereby contributes to stabilizing the business cycles in Israel. Overall, the wage agreements are responsible for about one third of the total increase in real wages of all public sector employees during the studied year. The significant wage agreements in the public administration were, for the most part, pro-cyclical and in line with the state's current deficit.

To complete the picture conveyed by this paper, it would be worthwhile to examine the employees' pension track—defined benefit or defined contribution. Employees under defined benefit pension plans accumulate 2 percent of their wages per year of work, reaching an average of 70 percent of their total salary; the accumulation is part of the employees' wages and benefits. Employees under defined contribution pension plans, however, set aside a portion of their salary each month towards a long-term reserve which they will be able to use during retirement. Since the beginning of the previous decade, public sector employees are transferring from defined benefit pension plans to defined contribution ones, and currently all employees joining the public sector join the defined contribution track. (Some employees voluntarily move from the defined benefit track to the defined contribution one, for example, when moving from a collective employment agreement to an individual one.) The transition from the defined benefit to the defined contribution track places the pension conditions in the two sectors, as discussed in the study, on par, meaning that the net wages per public sector employee has decreased. Therefore, the transition of public sector employees to defined contribution pension plans has affected the wage gap between the sectors. Despite the importance of this topic, it is beyond the scope of the current study. Further study is needed in order to examine how this change has affected the wage profile of public sector employees and the movement between the sectors.

Appendix

Figure A-1
Simple model of the economy with two sectors, private and public



The figure presents a positive demand shock to employees (in labor productivity) in the private sector.

Figure A-2
Real wage per employee post in public services and public administration, 2012 prices, 1990–2012

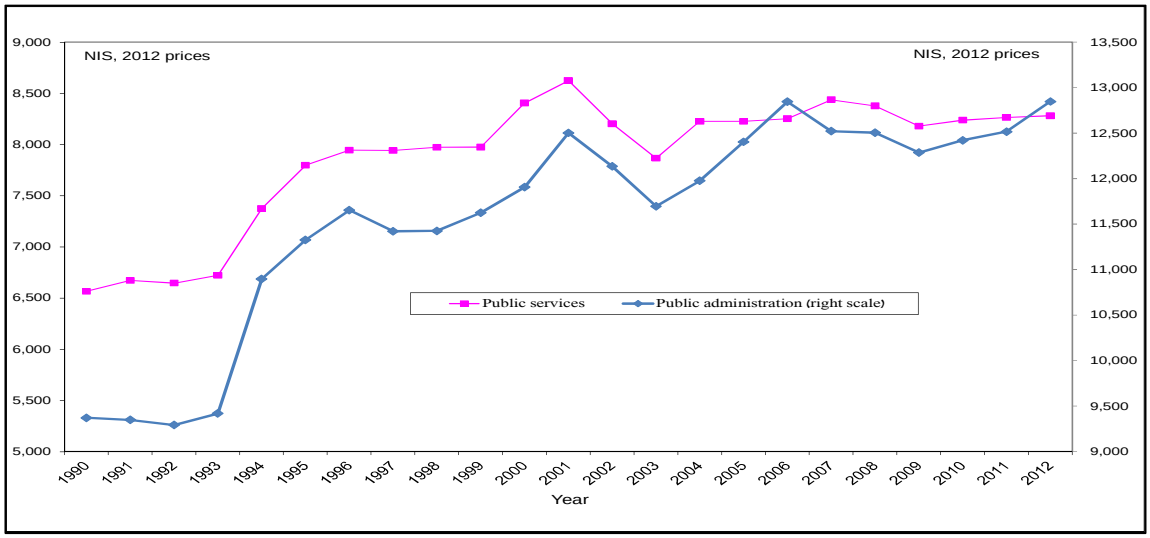
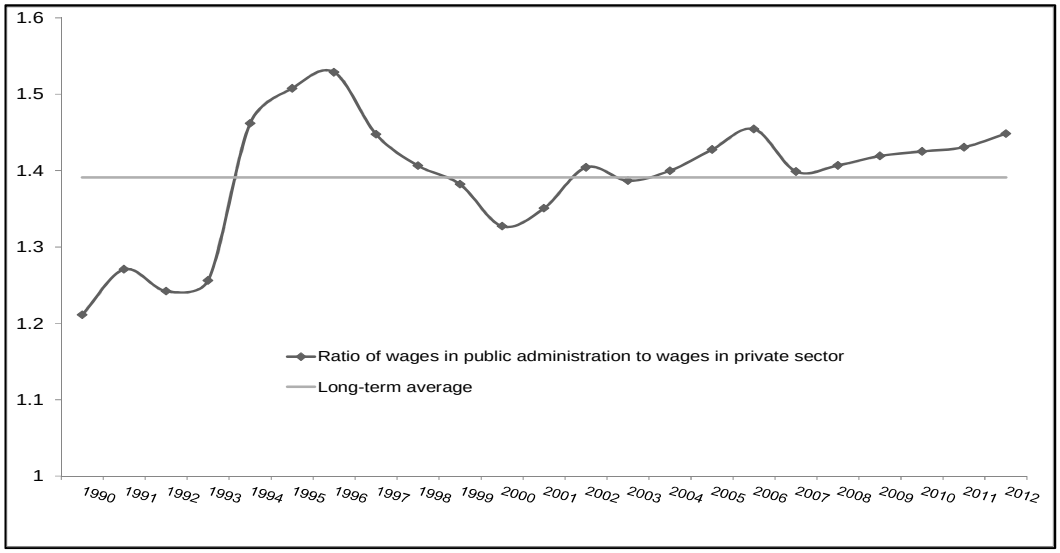


Figure A-3

Ratio between average wage per employee post in public administration and the average wage per employee post in the private sector, 1990–2012



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