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Aggregate public-private remuneration patterns in South Africa*

Andreas Wörgötter† Sihle Nomdebevana‡

Abstract

This paper investigates the public-private remuneration pattern in South Africa since the introduction of an inflation-targeting framework in 2000. Co-integration tests and analysis confirm that there is a stable, long-run relationship between nominal and real remuneration in the public and private sector. The adjustment to the deviations from this long-run relationship is strong and significant for public-sector remuneration, while private-sector wages neither respond to the deviations from the long-run relationship nor lagged changes of public sector remuneration. The causal direction from private- to public-sector remuneration does not change if real earnings are calculated with the gross domestic product (GDP) deflator. This is confirmed by simple Granger causality tests. If this pattern remains stable, efforts to slow down the speed of the wage-price spiral should not exclude the private sector.

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Introduction

This paper provides an empirical investigation into the nature of remuneration pattern outcomes in South Africa by examining the relationship between public- and private-sector wages. It complements those studies that are mainly concerned with the structural differences between public- and private-sector employment and remuneration (Bosch, 2006).

Remuneration patterns constitute an important linkage between the micro and macro spheres of the economy. On the micro level, they reflect the incentives and constraints for individual decisions about how many hours to work and which wage to accept. On the macro level, wage dynamics have important consequences for inflation, unemployment, and – through work experience – productivity. Together, this has an impact on the sacrifice ratio or, in other terms, the real costs needed to maintain price stability. For instance, in a bargaining system with more than one trade union, wage leadership reduces the effective number of independent trade unions and increases the degree of centralization of wage bargaining. Assuming that the leading trade union has some degree of inflation aversion, this could allow the central bank to be more accommodative while simultaneously reducing inflation and unemployment to their lowest socially optimal levels (Coricelli, Cukierman, and Dalmazzo, 2006). Without referring to monetary policy regimes, either completely centralized or completely decentralized bargaining systems are associated with better macroeconomic performance (Calmfors and Driffill, 1988).

One of the reasons why the remuneration pattern is important comes from the structural diversity of the economy. A familiar approach is to distinguish between economic activity which is exposed to international competition and economic activity which is not so exposed. The separation into a public sector and a private sector, which is applied in this paper, makes the same distinction. Exporters, especially when located in small open economies, usually face competition from other global suppliers. Maintaining cost and price competitiveness therefore imposes an immediate constraint on wage-cost dynamics. This does not mean that the wages paid by export-oriented producers should be lower. It only means that external competition provides guidance about how far wage costs can go. Suppliers serving the domestic economy face competition only from among themselves and from potential market entrants. The strength of the competition then depends on technological characteristics, market size, and regulation. Usually, domestic competition – when sheltered from international suppliers – is less fierce than in export-oriented sectors, and the scope for open or tacit collusion is potentially significant.

The public sector is free from competition concerns on its supply side. The wage bill is constrained by the budget while the earnings / employment split is influenced by alternative options in the private sector. In general terms, one can assume that private-sector earnings are more driven by market developments than public-sector earnings. The direction of causality therefore either increases (in the case of public-sector earnings following the private-sector developments) or decreases (in the case of the private-sector following public-sector earnings) the role of market forces.

Different exposure to competition on product markets therefore generates a different framework for wage negotiations and outcomes, even if labour-force regulation, and specifically dismissal protection, is applied uniformly throughout the economy. This heterogeneity becomes even more important if wage bargaining follows a pattern, meaning that negotiations in one sector follow the outcomes in another sector. In such cases, the orientation of the wage leader to price stability has an important consequence for the sacrifice ratio, which is determined by the pressure on the wage formation process to limit inflationary wage increases.

This is perhaps most true for the relationship between public- and private-sector earnings, because there is an asymmetry of budget constraints between the two sectors. In other words, the public sector has the capacity to let the earnings of its employees deviate from the private sector, regardless of market forces. The public- /

private-sector earnings pattern is therefore relevant for the efficiency of market forces contributing to the restoration and subsequent maintenance of a labour-market equilibrium.

The sections that follow provide a short overview of the literature, describe the data, present the outcomes of the standard time series analysis, and end with conclusions.

Literature Review

The theoretical literature on pattern bargaining takes two opposing views. One string of literature, strongly influenced by Calmfors and Driffill (1988), takes an institutional approach, which links bargaining outcomes to the setup of the bargaining framework. In this context, not all externalities may be considered by individual economic agents. For instance, excessive payroll taxation and regulatory interference into wage formation can contribute to a loss of external competitiveness and a growing gap between productivity and wage costs (Agudelo and Sala, 2016). Beyond competitiveness, there is also the issue of fairness and excessive inequality of pay (Gwatidzo and Benhur, 2013), which is particularly important for economies where monopsony plays a role.

Following this line of literature, there is possibly a positive role to play for pattern bargaining, removing information asymmetries, and internalising externalities, for instance from wage growth on inflation. This literature treats labour organisations like trade unions, as exogenous.

On the other side are authors like Pollan (2004), who consider the institutional setup, including the coverage of collective bargaining, as part of an economic optimization process. In this respect, pattern wage bargaining cannot improve outcomes compared with decentralized bargaining under inflation targeting (Calmfors and Seim, 2013). This is less relevant for the public- / private-sector earnings pattern because the public- / private-sector split can be assumed to be exogenous and only slowly changing.

In the area of macrostructural interactions, the Scandinavian model of inflation links inflation differentials to sectoral productivity differences in a model with centralized and solidaric wage determination (Frisch, 1977). In this model, the higher structural rate of inflation, which comes from the lower productivity growth in the domestic sector, does not pose a problem for international competitiveness. The wage leader in the export sector sets wage increases on a level which is compatible with international competitiveness. This pattern of wage outcomes is in line with macroeconomic stability and contributes to a lower sacrifice ratio. The disciplining effect of unemployment on wage formation is replaced by the internalization of the concern for international competitiveness through a centralized bargaining process with monopoly trade unions and employer associations. An important assumption in this model is that the size of the two sectors is exogenously given. In this type of model, private-sector earnings lead public-sector earnings because the wage ceiling is established by maintaining international competitiveness.

'Dutch disease' models describe cases in which one sector (usually resource extraction) grows because of newly discovered profitable deposits (like the gas fields in the Netherlands) and a wage differential therefore becomes necessary to attract workers from other sectors, mainly manufacturing. It is assumed that labour is not internationally mobile. The 'disease' element of this otherwise beneficial setting comes from the spillover of wage increases to sectors which face international competition (and therefore cannot pass on wages to higher prices) and/or which face technological and/or organisational barriers to increasing productivity. As a consequence, more workers lose jobs in export-oriented manufacturing than can find new employment opportunities either in mining or in services sectors, which benefit from the higher incomes generated by the expansion of the mining sector. A variant of the 'Dutch disease' can arise if internationally determined raw-material prices increase and thus increase the profitability of mining exports (Ahrend, de Rosa and Tompson, 2007).

For South Africa, mining is an important contributor to economic activity, exports, and jobs. While in the past productivity advances allowed mines to operate longer, internationally determined raw-material prices became the dominant determinant of the profitability of the sector from the beginning of the 2000s (Gwatidzo and Benhur, 2013). A similar context as in the case of 'Dutch disease' may have distorted the wage-setting process in post-communist countries (D'Adamo, 2014). In these countries, government played a big role in the redistribution of income and wealth through privatization and the restructuring of state-owned enterprises. It is therefore not surprising to find many cases of wage leadership by the public sector. This could also be the case for South Africa, if government revenue from mining is spent to increase public-sector wages above private-sector wages (including in the export industries).

In all variants of the 'Dutch disease', wage pressures arise which are not in line with macroeconomic stability and which therefore contribute to an increase of the sacrifice ratio. This is also the case if government benefits from extra revenue and uses it to increase wages in the public sector.

In most member countries of the Organisation for Economic Co-operation and Development (OECD), public-sector wages follow the outcomes of private-sector wage negotiations (Lamo, Pérez, and Schuknecht, 2012). However, there are also cases of public-sector leadership and spillover effects.

For Sweden, it is confirmed that the private sector is the wage leader and the public sector follows (Lindquist and Vilhelmsson, 2006). Public-sector wages do not Granger-cause private-sector wages. For Austria, it is found, with data on collectively bargained wages, that reference norms play a significant role and that external norms seem to matter more than internal norms (Knell and Stiglbauer, 2012). However, in an earlier paper, Pollan (2004) finds Austrian remuneration outcomes characterised by high and rising diversity, which is incompatible with a wage pattern hypothesis. For the United States, Marshall and Merlo (2004) find that trade unions prefer pattern bargaining over simultaneous industry-wide bargaining and sequential bargaining with a random pattern. They also point out that pattern bargaining establishes significant entry barriers. This could also be the case for South Africa, if public-sector wages cause private-sector wages to follow and new market entrants cannot afford to hire labour.

For the euro area, it is found that Germany acts as wage leader (Ramskogler, 2012). This could have encouraged the European Central Bank to run its accommodative monetary policy despite the warning signals from an overheating housing market during the run-up to the most recent global financial crisis.

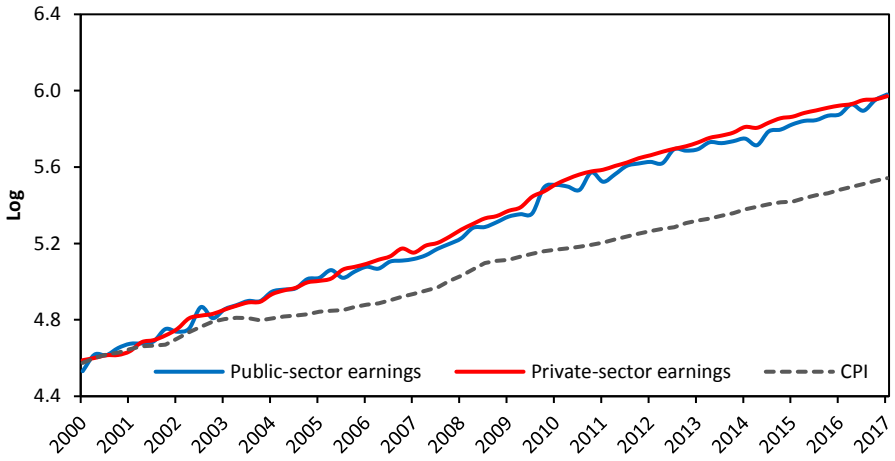
Data

We use quarterly average remuneration (earnings) data from the first quarter of 2000 to the first quarter of 2017 for both the public and the private sectors. The choice of the observation period was motivated by the introduction of South Africa's inflation-targeting regime. Real remuneration is calculated by deflation with the deflator of gross value added excluding agriculture, following the methodology applied by Statistics South Africa (Stats SA).

Remuneration data are collected by Stats SA; the seasonal adjustment was carried out by the South African Reserve Bank. The term 'earnings' is used synonymously for 'remuneration'.

Figure 1 shows the development of both public- and private-sector remuneration, together with the consumer price index (CPI). The CPI is shown because it is the headline inflation measure most popular in South Africa. All the variables are presented in logarithmic terms.

Figure 1:
Nominal public- and private-sector earnings and the consumer price index



Sources: SARB and Stats SA

A visual inspection of the data signals that private-sector earnings progress relatively smoothly, with only some cyclical responses, while public-sector remuneration is much more volatile. The CPI is quite smooth but shows more pronounced cycles.

These observations are confirmed by the descriptive statistics in Table 1. The nominal public- and private-sector earnings grow, on average, by 2.0% per quarter (by 8.1% and 8.2% respectively when annualised). Consumer price inflation amounts to 1.4% per quarter, which is equivalent to an average annual inflation of 5.6%.

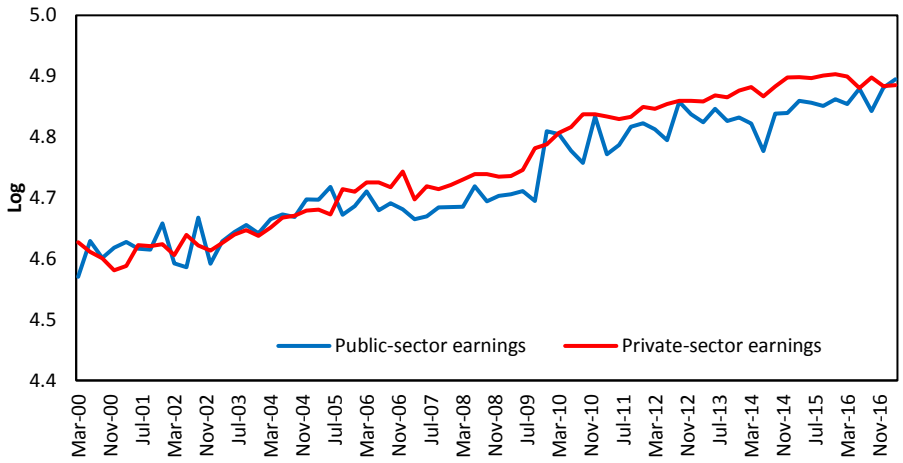
Table 1: Descriptive statistics for changes of logs of nominal and real earnings and the consumer price index

	D(LCPI)	D(LWPU)	D(LWPR)	D(LRWPU)	D(LRWPR)
Mean	0.014075	0.020334	0.020460	0.003963	0.004089
Standard Deviation	0.008344	0.033545	0.013121	0.032704	0.014370
Because real earnings are deflated with a different price index, the adding-up conditions are not met.					

While the rate of earnings increases in the public and private sectors is nearly identical, development in the public sector is much more volatile than in the private sector. The standard deviation of public-sector remuneration is about 2.5 times as big as in the private sector. This feature is preserved for the deflated earnings. In other words, consumer price inflation does not contribute to earnings volatility. The higher volatility of public-sector earnings must therefore have other reasons. Worthwhile to note is also the fact that the ratio between average nominal and average real earnings growth is above 5, which is unusually high, even for an emerging economy.

Figure 2 shows the development of real remuneration. It confirms the impression that public-sector remuneration is much more volatile than private-sector remuneration.

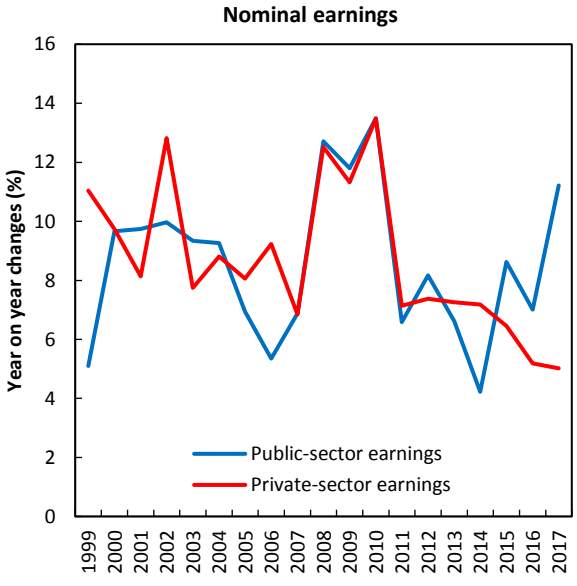
Figure 2:
Real public- and private-sector earnings



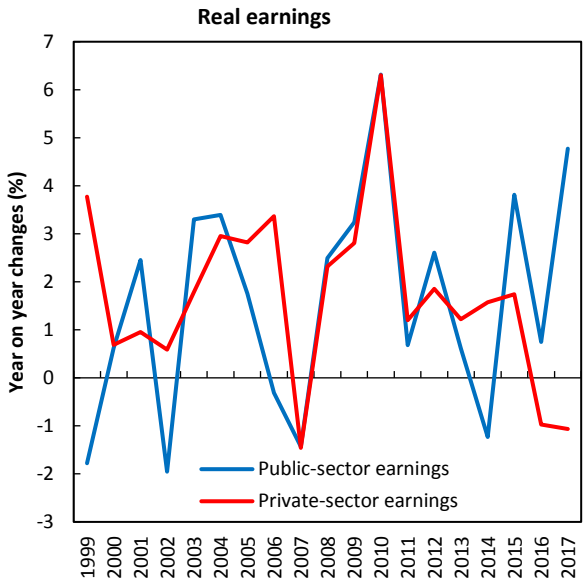
Sources: SARB and Stats SA

Figure 3 shows the smoothed year-on-year growth rates of nominal and real public- and private-sector earnings. For both the nominal and the real series, public-sector earnings growth fluctuates around private-sector earnings, suggesting a pattern which is characterised by private-sector earnings being the mean to which public-sector earnings revert. According to this pattern, public-sector earnings should moderate again in the near future and cross the private-sector earnings growth line from above.

Figure 3: Nominal and real public- and private-sector earnings changes



Sources: SARB and Stats SA



Sources: SARB and Stats SA

Estimates

We test the short- and the long-run public- and private-sector earnings pattern, using the well-known Granger causality test and the Vector Error Correction Model (VECM) methodology (Johansen, 1991). Lamo et al (2012) applied the same methodology for their investigation of public/private wage patterns in OECD countries.

Table 2 shows the results of a simple Granger causality test between the quarter-on-quarter changes of logged public- and private-sector earnings. The null hypothesis of no causality is rejected for nominal and real private-sector earnings causing public-sector earnings at a 5% significance level. The null hypothesis cannot be rejected for public-sector earnings causing private-sector earnings.

Table 2: The Granger causality test			
Null hypothesis	Observations	F-statistic	p-value
Nominal earnings			
Private-sector earnings do not Granger-cause public-sector earnings	66	3.92686	0.0249
Public-sector earnings do not Granger-cause private-sector earnings		0.15645	0.8555
Real earnings			
Private-sector earnings do not Granger-cause public-sector earnings	66	3.37051	0.0409
Public-sector earnings do not Granger-cause private-sector earnings		0.26000	0.7719

The simple Granger test only takes the information from the first differences into account and therefore catches only the short-run elements of earnings leadership. VECMs also use information about levels and therefore cover also the long-run aspects of earnings leadership. The VECM methodology (Juselius, 2006) combines the estimate of a long run relation among the endogenous variables (in our case public and private sector earnings) with the short run adjustment towards it.

Table 3 reports the bi-variate co-integration tests for nominal remuneration in the public and private sectors and the consumer price index, as well as for real remuneration in the public and private sectors. The results clearly reject the null hypothesis of no co-integration relationship between nominal and real remuneration in the public and private sectors respectively. On the contrary, no co-integration between nominal remuneration in the public and private sectors respectively and the CPI cannot be rejected.

Table 3: Co-integrating relationships for nominal and real remuneration in the public and private sectors and the consumer price index	
	D(LWPU) D(LWPR) D(CPI)
Co-integrating relationship	LWPU = (0.9639 * LWPR) + 0.1691 (no co-integration is rejected)
	LWPU and LCPI: no co-integration is not rejected
	LWPR and LCPI: no co-integration is not rejected
Descriptive statistics for changes of logs of real earnings	
	D(LRWPU) D(LRWPR)
Co-integrating relationship	LRWPU = (0.84023 * LRWPR) + 0.7376 (no co-integration is rejected)

VECM and VAR estimates were calculated for nominal and real public- and private-sector remuneration. Table 4a and 4b summarise the results of these estimates. The complete information is provided in the appendix.

Table 4a: Summary of VECM estimates (2000q3:2017q1)					
	Nominal earnings: D(LWPU) D(LWPR)			Real earnings: D(RLWPU) D(RLWPR)	
	Co-integrating (long-run) relationship			Co-integrating (long-run) relationship	
LWPU(-1)	1.000000		LRWPU(-1)	1.000000	
LWPR(-1)	**-0.958249**		LRWPR(-1)	**-0.843923**	
Standard error	(0.00919)			(0.03844)	
	[-104.315]			[-21.9547]	
C	-0.199012		C	-0.720068	
Error correction	D(LWPU)	D(LWPR)	Error correction	D(RLWPU)	D(RLWPR)
CointEq1	**-0.791588**	0.045309	CointEq1	**-0.710340**	0.115808
	(0.17580)	(0.09148)		(0.17358)	(0.09555)
	[-4.50277]	[0.49530]		[-4.09221]	[1.21200]
D(LWPU(-1))	-0.108295	0.002089	D(LRWPU(-1))	-0.113081	-0.053763
	(0.12224)	(0.06361)		(0.12550)	(0.06909)
	[-0.88594]	[0.03284]		[-0.90102]	[-0.77822]
D(LWPR(-1))	-0.046778	-0.105550	D(LRWPR(-1))	0.166086	-0.220959
	(0.26391)	(0.13733)		(0.22970)	(0.12644)
	[-0.17725]	[-0.76861]		[0.72307]	[-1.74754]
C	0.023583	0.022567	C	0.003851	0.005185
	(0.00610)	(0.00318)		(0.00324)	(0.00178)
	[3.86331]	[7.10459]		[1.18921]	[2.90842]
R-squared	0.449496	0.025711	R-squared	0.426250	0.099567
Adj. R-squared	0.423282	-0.020684	Adj. R-squared	0.398929	0.056689
F-statistic	17.14687	0.554169	F-statistic	15.60131	2.322104
Mean dependent	0.020334	0.020460	Mean dependent	0.003963	0.004089
SD dependent	0.033545	0.013121	SD dependent	0.032704	0.014370
Bolded coefficients are significant at the 5% level					

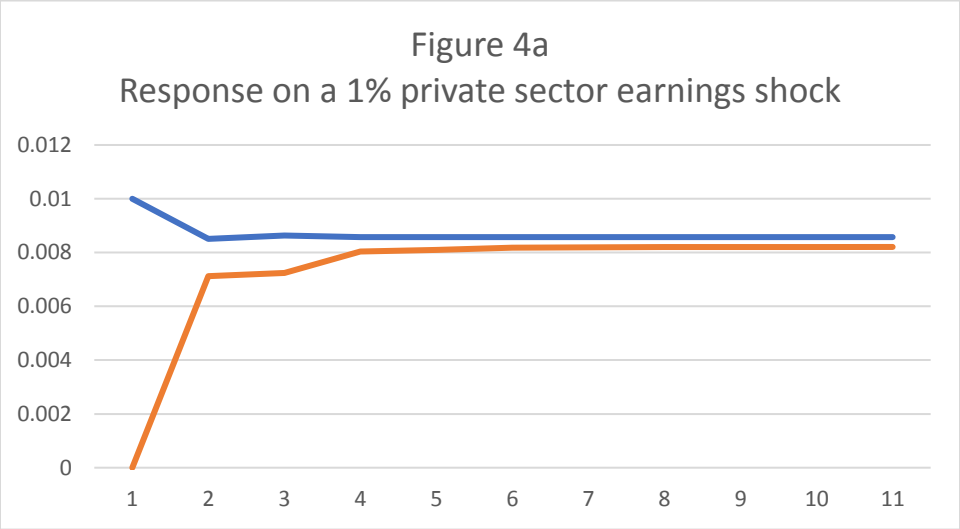
No co-integration is rejected for nominal public- and private-sector earnings. Contrary to Lamo, Pérez, and Schuknecht (2012), we do not impose a unit coefficient for the co-integrating relationship but estimate it. It turns out that the estimated coefficient of private-sector earnings is close to, but significantly below 1 (-0.958249 for nominal earnings and -0.843923 for real earnings).

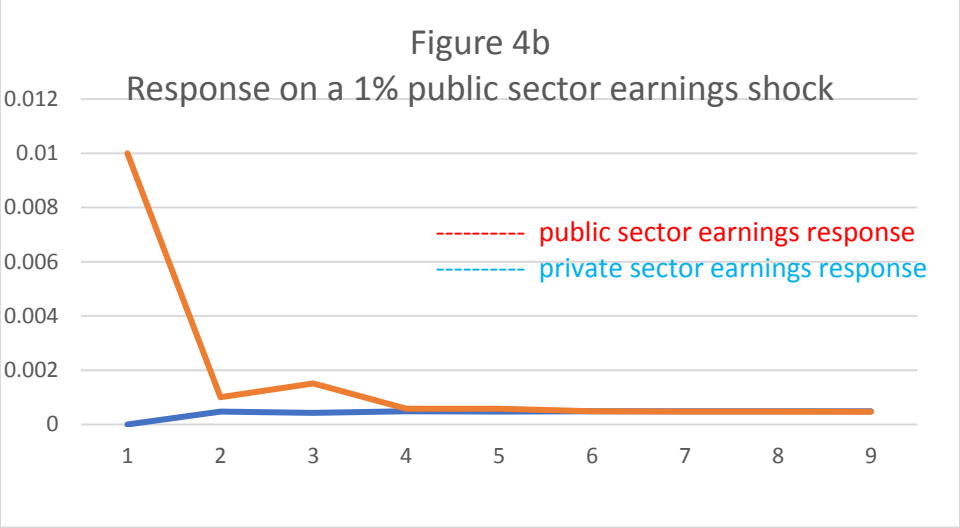
Nominal public-sector remuneration follows nominal private-sector remuneration because the estimated coefficient of the error correction term (the lagged deviation from the co-integrating relationship) is negative (-0.791588) and significant (standard deviation = 0.17580) in the equation for public-sector earnings changes and the error correction term enters the equation for private-sector earnings changes only with a small (0.002089) and insignificant (standard deviation = 0.09148) coefficient.

The explanatory power is high for public-sector remuneration (R2 = 0.449496 for nominal earnings and 0.426250 for real earnings) and insignificant for private-sector remuneration (0.025711 for nominal earnings and 0.099567 for real earnings). In other words, information in the past changes of private-sector earnings as well as deviations from the co-integrating relationship explain about 40% of the variance of public-sector

earnings growth. On the other hand, the past changes of public-sector earnings and deviations from the co-integrating relationship have no explanatory power for nominal or real private-sector earnings.

The adjustment is strong and rapid. About 80% of the deviation from the co-integrating relationship is compensated by public-sector earnings changes within one quarter. The reaction of private-sector earnings to deviations from the co-integrating relationship is small and insignificant. Figures 4a and 4b show the response of public and private sector earnings on a 1% shock of private and public sector earnings. A bit more than 80% of a private sector earnings shock remains permanent in private and public sector earnings after 4 quarters while only 5% of a public sector earnings shock remains permanent.





The coefficients of past changes of public- and private-sector earnings are small and insignificant.

No co-integration is also rejected for real public- and private-sector earnings. Real public-sector remuneration follows private-sector remuneration. The co-integration relationship is a bit flatter for real earnings compared to nominal earnings, with an elasticity of 0.84 compared with 0.96 respectively. This could be coming from

public-sector earnings recipients being a bit more affected by the inflation illusion. The lower coefficient of private-sector earnings in the co-integrating relationship reflects the fact that higher rates of inflation are indexed at a lower rate on public-sector earnings changes. On average, this is compensated by a higher constant (-0.720068 relative to - 0.199012). This is also confirmed by a smaller – albeit still significant – adjustment coefficient of 0.71 compared with 0.79 of the VECM for the nominal earnings. The explanatory power is again high for real public-sector remuneration and low but significant for real private-sector remuneration. The coefficients of the lagged changes of real public- and private-sector earnings are also small although partly significant at the 10% level.

The estimation results of a VAR model with two lags (Table 4b) confirm our main finding of a causal relation from private sector earnings on public sector earnings with only insignificant feedback. In line with the Granger causality test (Table 2) only lagged changes of private sector earnings are significant in the public sector earnings equation, but lagged changes of public sector earnings are insignificant in the private sector earnings equation.

Table 4b: Summary of VAR estimates (2000q4:2017q1)					
	Nominal earnings: DLWPU DLWPR			Real earnings: DLRWPU DLRWPR	
	DLWPU	DLWPR		DLRWPU	DLRWPR
D(LWPU(-1))	**-0.718711**	0.032110	D(LRWPU(-1))	**-0.702945**	-0.001539
	(0.11784)	(0.05867)		(0.11515)	(0.06308)
	[-6.09920]	[0.54731]		[-6.10437]	[-0.02440]
D(LWPU(-2))	**-0.384727**	0.010391	D(LRWPU(-2))	**-0.449375**	-0.038376
	(0.11354)	(0.05653)		(0.10980)	(0.06014)
	[-3.38854]	[0.18383]		[-4.09277]	[-0.63811]
D(LWPR(-1))	**0.621334**	-0.135961	D(LRWPR(-1))	**0.595961**	**-0.302652**
	(0.25759)	(0.12825)		(0.23046)	(0.12623)
	[2.41209]	[-1.06013]		[2.58598]	[-2.39758]
D(LWPR(-2))	0.479871	0.056996	D(LRWPR(-2))	0.239000	0.006278
	(0.26613)	(0.13250)		(0.23900)	(0.13091)
	[1.80314]	[0.43016]		[1.00001]	[0.04796]
C	0.020504	0.021301	C	0.005539	0.005699
	(0.00894)	(0.00445)		(0.00353)	(0.00194)
	[2.29338]	[4.78540]		[1.56765]	[2.94470]
R-squared	0.398814	0.029987	R-squared	0.423406	0.102799
Adj. R-squared	0.359392	-0.033621	Adj. R-squared	0.385596	0.043966
Sum sq. resids	0.044319	0.010986	Sum sq. resids	0.040108	0.012033
S.E. equation	0.026955	0.013420	S.E. equation	0.025642	0.014045
F-statistic	10.11653	0.471436	F-statistic	11.19841	1.747300
Mean dependent	0.020687	0.020552	Mean dependent	0.004445	0.004310
S.D. dependent	0.033677	0.013200	S.D. dependent	0.032713	0.014365
Bolded coefficients are significant at the 5% level					

Conclusions

Two hypotheses of patterns in remuneration outcomes have been explored in this paper:

a) Is there a relationship between nominal remuneration in the public and private sectors; and

b) is there a relationship between real remuneration in the public and private sectors?

Our Granger causality test and VECM estimates strongly suggest that public-sector remuneration follows private-sector remuneration in the short and long run without feedback. This pattern also holds for real remuneration in the public and private sectors.

Past observations of public-sector remuneration have no explanatory power for private-sector remuneration. A large difference in explanatory power is also confirmed for the deflated remuneration series. The similarity of the estimation results with nominal and real remuneration data suggests that the response to inflation shocks is similar for public- and private-sector remuneration, although there is more stability in the relationship between inflation and public-sector earnings compared with private-sector earnings.

The main conclusion for economic policy is that efforts to reduce excessive nominal wage growth should not exclude the private sector. This holds of course only if the described earnings pattern remains stable. According to our findings public sector earnings will follow private sector earnings, but not the other way round.

Further research to investigate the underlying pattern on a disaggregated level is under way.

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Appendix

List of abbreviations

GDP	Gross Domestic Product
n/a	not applicable
OECD	Organisation for Economic Co-operation and Development
SARB	South African Reserve Bank
SD	Standard Deviation
Stats SA	Statistics South Africa
VAR	Vector Auto-Regression
VECM	Vector Error Correction Model

List of variables

LWPU	log nominal public-sector remuneration
LRWPU	log real public-sector remuneration
LWPR	log nominal private-sector remuneration
LRWPR	log real private-sector remuneration
LCPI	log consumer price index
D(LWPU)	quarter-on-quarter changes of log nominal public-sector remuneration
D(LRWPU)	quarter-on-quarter changes of log real public-sector remuneration
D(LWPR)	quarter-on-quarter changes of log nominal private-sector remuneration
D(LRWPR)	quarter-on-quarter changes of log real private-sector remuneration
D(LCP)I	quarter-on-quarter changes of log consumer price index

"log" is used to denote natural logarithm

Sources of variables

Series code	Series name	Description	Source(s)	Label
Public-sector wages				
LABP110D	Remuneration per worker in non-agriculture: public sector	Constant prices index = 2000	SARB and Stats SA	LWPU
LABP110L	Remuneration per worker in non-agriculture: public sector	Current prices index = 2000	SARB and Stats SA	LRWPU
Private-sector wages				
LABP120L	Remuneration per worker in non-agriculture: private sector	Current prices index = 2000	SARB and Stats SA	LWPR
LABP120D	Remuneration per worker in non-agriculture: private sector	Constant prices index = 2000	SARB and Stats SA	LRWPR
Consumer price index				
GEM(M1, CPI9100B)	Consumer price index = 2000	Seasonally adjusted quarterly series	SARB and Stats SA	LCPI

Tests and estimation results for nominal and real public and private remuneration

1. VECM with nominal wages

1.1. Lag length criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	109.8961	n/a	0.000112	-3.425274	-3.357238	-3.398515
1	330.4164	**420.0387***	**1.15e-07***	**-10.29893***	**-10.09483***	**-10.21866***

1.2. Johansen co-integration test *(both tests indicate one co-integrating relationship)*

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.255042	22.65340	15.49471	0.0035
At most 1	0.042742	2.926736	3.841466	0.0871

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.255042	19.72666	14.26460	0.0062
At most 1	0.042742	2.926736	3.841466	0.0871

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* Rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

1.3. VECM results with one lag

Co-integrating Eq	CointEq1
LWPU(-1)	1.000000
LWPR(-1)	-0.958249
	(0.00919)
	[-104.315]
C	-0.199012

Error correction	D(LW9)	D(LW1)
CointEq1	-0.791588	0.045309
	(0.17580)	(0.09148)
	[-4.50277]	[0.49530]
D(LWPU(-1))	-0.108295	0.002089
	(0.12224)	(0.06361)
	[-0.88594]	[0.03284]
D(LWPR(-1))	-0.046778	-0.105550
	(0.26391)	(0.13733)
	[-0.17725]	[-0.76861]
C	0.023583	0.022567
	(0.00610)	(0.00318)
	[3.86331]	[7.10459]
R-squared	0.449496	0.025711
Adj. R-squared	0.423282	-0.020684
Sum sq. resids	0.040886	0.011071
SE equation	0.025475	0.013256
F-statistic	17.14687	0.554169
Log likelihood	152.8871	196.6540
Akaike AIC	-4.444391	-5.750866
Schwarz SC	-4.312768	-5.619242
Mean dependent	0.020334	0.020460
SD dependent	0.033545	0.013121

Determinant resid covariance (dof adj.)	1.12E-07
Determinant resid covariance	9.89E-08
Log likelihood	350.2053
Akaike information criterion	-10.15538
Schwarz criterion	-9.826322

2. VECM with nominal public wages and CPI

2.1. Lag length criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	109.9578	NA	0.000111	-3.427232	-3.359196	-3.400473
1	343.4355	444.7194	7.64e-08	-10.71224	-10.50813	-10.63196
2	362.0315	**34.24034***	4.81e-08	-11.17560	**-10.83542***	**-11.04181***
3	366.2497	7.498885	**4.78e-08***	**-11.18253***	-10.70628	-10.99522

2.2. Johansen co-integration test (*both tests indicate no co-integrating relationships*)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.115792	8.237914	15.49471	0.4403
At most 1	0.001752	0.115743	3.841466	0.7337

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized no. of CE(s)	Eigenvalue	Max-eigenvalue statistic	0.05 critical value	Prob.**
None*	0.115792	8.122171	14.26460	0.3664
At most 1	0.001752	0.115743	3.841466	0.7337

Max-eigenvalue test indicates no co-integration at the 0.05 level
* Rejection of the hypothesis at the 0.05 level
** MacKinnon–Haug–Michelis (1999) p-values

2.3. VECM results

No co-integration cannot be rejected

3. VECM with nominal private wages and CPI

3.1. Lag length criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	112.2129	NA	0.000104	-3.498824	-3.430788	-3.472065
1	400.7880	549.6668	1.24e-08	-12.53295	-12.32885	-12.45268
2	416.8556	**29.58477***	**8.43e-09***	**-12.91605***	**-12.57587***	**-12.78226***

3.2. Johansen co-integration test (*both tests indicate no co-integrating relationships*)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.098584	8.079216	15.49471	0.4570
At most 1	0.018451	1.229148	3.841466	0.2676

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.098584	6.850067	14.26460	0.5070
At most 1	0.018451	1.229148	3.841466	0.2676

Max-eigenvalue test indicates no co-integration at the 0.05 level
* Rejection of the hypothesis at the 0.05 level
** MacKinnon–Haug–Michelis (1999) p-values

3.3. VECM results

The VECM cannot be run if co-integration does not exist.

4. VECM with real wages

4.1. Lag length criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	198.7969	NA	6.63e-06	-6.247520	-6.179484	-6.220761
1	325.6920	**241.7049***	1.34e-07	-10.14895	**-9.944843***	**-10.06867***
2	330.6776	9.179983	**1.30e-07***	**-10.18024***	-9.840063	-10.04645

4.2. Johansen co-integration test (*both tests indicate two co-integrating relationships*)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.246004	19.25885	15.49471	0.0129
At most 1	0.005064	0.340146	3.841466	0.5597

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.246004	18.91870	14.26460	0.0085
At most 1	0.005064	0.340146	3.841466	0.5597

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* Rejection of the hypothesis at the 0.05 level
** MacKinnon–Haug–Michelis (1999) p-values

4.3. VECM results

Co-integrating Eq	CointEq1
LRWPU(-1)	1.000000
LRWPR(-1)	-0.843923
	(0.03844)
	[-21.9547]
C	-0.720068

Error correction	D(LW23)	D(LW22)
CointEq1	-0.710340	0.115808
	(0.17358)	(0.09555)
	[-4.09221]	[1.21200]
D(LRWPU(-1))	-0.113081	-0.053763
	(0.12550)	(0.06909)
	[-0.90102]	[-0.77822]
D(LRWPR(-1))	0.166086	-0.220959
	(0.22970)	(0.12644)
	[0.72307]	[-1.74754]
C	0.003851	0.005185
	(0.00324)	(0.00178)
	[1.18921]	[2.90842]
R-squared	0.426250	0.099567
Adj. R-squared	0.398929	0.056689
Sum sq. resids	0.040501	0.012272
SE equation	0.025355	0.013957
F-statistic	15.60131	2.322104
Log likelihood	153.2035	193.2020
Akaike AIC	-4.453837	-5.647821
Schwarz SC	-4.322213	-5.516198
Mean dependent	0.003963	0.004089
SD dependent	0.032704	0.014370

Determinant resid covariance (dof adj.)	1.21E-07
Determinant resid covariance	1.07E-07
Log likelihood	347.4294
Akaike information criterion	-10.07252
Schwarz criterion	-9.743462