Is Germany a compass for wage formation in Sweden?

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In this article, wage formation in Sweden since the Industrial Agreement was reached at the end of the 1990s is studied. Using wage-setting equations, wage determination in various sectors in Sweden is analyzed. The results confirm that the Industrial Agreement sets a mark for other sectors and that industrial wages provide a significant and strong explanatory value for wages in both the construction and service sector. Industry is export-dependent and wages in the sector shall ensure its long-term competitiveness, distribute the surplus between employers and employees and be in line with the Riksbank's inflation target in the long run. In Sweden, it has been debated whether wages in Germany have a direct impact on wages in Swedish industry, besides the effects from other channels, such as competitor prices. I find that Swedish industrial wages could have such a link with German industrial wages by using German wages in a wage-setting equation similar to how Swedish industrial wages are used to explain wages in the construction and service sectors, even though the relationship is not as strong. However, there is a much stronger link between Swedish industrial wages and industrial wages in the Euro area.

1 Introduction

In the 1970s and 1980s, nominal wage increases in Sweden were high, which in turn led to repeated devaluations and high inflation. This further drove up wages and the economy ended up in a wage–exchange-rate spiral, see Calmfors et al. (2019). As a result of the crisis in the early 1990s, several institutional changes were implemented. One of these was the switch to a floating exchange rate, combined with an inflation target for monetary policy, which had implications for wage formation. Another was the introduction of a new fiscal policy framework to reinforce budgetary discipline and bring government finances in order (see Molander and Paulsson, 2008).

A few years after these reforms, the Industrial Agreement was signed in 1997 with the aim to ensure that wage formation took long-term competitiveness of industry into account. The Industrial Agreement has become the norm and the wage agreements sets a mark for other sectors, see for example Gottfries (2019) and Calmfors et al. (2019). Compared with the 1970s and 1980s, there has also been a slowdown in wage increases and inflation. The slowdown in nominal wage and price changes has however not caused real wages to fall. Until the 2008 financial crisis, nominal wage growth in Sweden was relatively high, but wage increases have subsequently declined somewhat. There are several possible reasons for why wages are increasing more slowly. Growth in productivity has been lower, but competitor prices have also shown slower growth and inflation has fallen. The higher unemployment

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that resulted from the financial crisis and the drop in the unemployment compensation level might also have caused wage increases to ease off, see Jonsson and Theobald (2019), and Westermark (2019) for a further discussion about the significance of these and other factors.

This article studies what has affected Swedish wage formation since the Industrial Agreement was reached. Because the Industrial Agreement sets the norm for other sectors, the focus is on wage formation in the industrial sector. Industry is exposed to international competition and wages will therefore depend on the prices set by firms in competing countries, but also on the exchange rate and productivity. The state of the labour market and unemployment compensation levels can also affect wages.

Competitor prices depend on the marginal costs of competing firms, which in turn are affected by nominal wages and productivity in the firms. According to the so-called competitiveness model ('konkurrenskraftsmodellen'), wages should (under certain conditions) increase by around as much as they do in our competitor countries.[1] The competitiveness model can thus be thought of as competitor countries setting the mark for Swedish industry, just as Swedish industry does for other Swedish sectors. Therefore, the extent to which wages in industry depend on competitor prices, the exchange rate, productivity, the state of the labour market, and the industrial wages of our most important competitor – Germany, is studied.

Simple correlations indicate that the relationship between Swedish and German industrial wages is relatively weak. Wage equations that include German wages are also estimated, and these provide some support for wages in Germany potentially affecting Swedish industrial wages, besides what is motivated by fundamental factors such as competitor pricing and the exchange rate. However, an increase in German contractual industrial wages of 1 per cent does not have as large effects on Swedish contractual industrial wages, which increase by 0.7 per cent, at least in the long run. The relationship between actual Swedish and German wages is stronger, and in the long run Swedish industrial wages increase by around 1 per cent when German industrial wages rise by 1 per cent. If it is the case that German wages have a strong direct impact, then the Industrial Agreement does not work as intended, because a direct link between industrial wages in Sweden and Germany does not necessarily take due account of the underlying factors that determine an appropriate wage level in Swedish industry, that is to say competitor pricing, productivity, the exchange rate, the compensation level and the state of the labour market. The wage level shall ensure the long-term competitiveness of industry, appropriately distribute profits between employees and employers, and give inflation that is in line with the Riksbank's inflation target. In the estimations, there is some, but not unequivocal, support for Germany actually having a unique position and direct influence over industrial wage-setting. However it cannot be ruled out that industrial wages are actually based on other relevant factors, discussed in the following section, rather than through nominal wages in Germany.[2] On the other hand, an equivalent empirical analysis for contractual wages for the euro area show that there is a strong and unequivocal link between these and contractual Swedish industrial wages. So, if anything, the dependence seems to be between Sweden and the euro area, and Germany does not necessarily have a unique position in wage-setting (apart from it representing a large share of the euro area).

Another way of getting an idea about dependence on other countries is to compare the effects of how German industrial wages affect Swedish industrial wages with how the Industrial Agreement affects wages in other Swedish sectors. In order to study the extent

1 This can hold if expected productivity growth in Sweden coincides with that abroad and if the exchange rate is expected to be unchanged.

2 Stronger conclusions can unfortunately not be drawn where Sweden is concerned, although in an equivalent analysis for Germany, one can easily reject the hypothesis that Swedish industrial wages have an equivalent explanatory power in a German industrial wage-setting regression, indicating that, if any dependence does exist, Sweden is dependent on Germany and not vice versa.

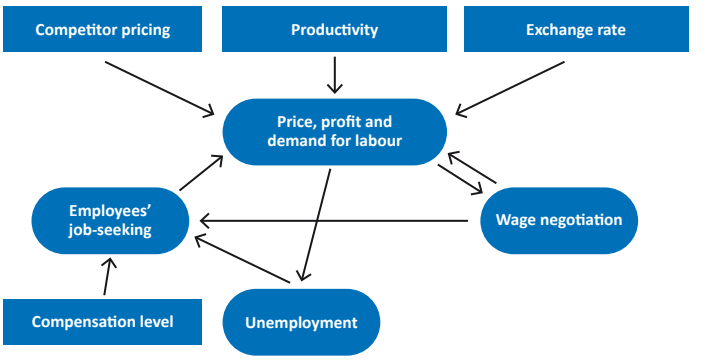
to which the Industrial Agreement affects the wages in other sectors, the relationship between industrial wages and wages in two other sectors is studied. Simple correlations indicate that the relationship is relatively strong, and the correlations are much higher than the correlation between German and Swedish industrial wages. Wage equations are then estimated for the construction and service sectors, with industrial wages included as an explanatory variable. When industrial wages are used to explain wages in the construction and service sectors, the coefficient of determination increases substantially and much more than when German wages are included in the wage equations for Swedish industry. An increase in industrial wages also leads to wages increasing about the same in both the construction and service sectors, at least in the long run. There are thus relatively clear indications that industrial wages set a mark for both the construction and service sector, and the link is stronger than that between Swedish and German industrial wages.

The article is structured as follows: In section 2 a simple wage formation model is discussed. In section 3 variables affecting wage formation over the period 1997 to 2017 are described, as well as the degree of synchronisation between Swedish and German wage agreements. Section 4 discusses the various wage formation models that are studied and empirical estimation results for contractual wages are presented. The results for actual wages are presented in section 5. In section 6, the extent to which the Industrial Agreement serves as a mark for other sectors is studied. Finally, the main findings and conclusions are summarised in section 7.

2 A wage formation model

Forslund et al. (2008) present an example of a wage formation model that describe the key factors that influence how wages are set, see also Westermark (2008). It has three theoretical mechanisms.[3] The first is a model for firm price-setting decisions, the second is a model for how wages are negotiated and the third is a model for how unemployment and compensation levels affect wage determination. Figure 1 provides a description of the three mechanisms.[4]

Figure 1. An overview of the mechanisms in wage formation



Source: The figure is adapted from Westermark (2008)

Wages will be affected by competitor prices, productivity and the exchange rate, as these factors affect the size of a firm's surplus. In wage negotiations between firms and workers, the surplus will be shared between the parties. The prices set by a firm depend on factors such as competitors' prices and the firm's own productivity. If for example competitors'

3 The model also has a mechanism for expectations and sluggishness in adaptation to shocks.
4 In an extension, we follow Bennmarker et al. (2011) and let nominal wages depend on the general price level in the economy, see Appendix A.

prices increase, demand will increase for the firm. The firm then hikes its prices and hence obtains a greater surplus. Similar effects arise if the exchange rate depreciates, that is to say there is a drop in the value of the currency. Productivity too affects both prices and surplus. As an example, an increase in productivity via lower marginal costs gives lower prices and a higher surplus. To sum up, increased competitor prices, a weaker exchange rate and higher productivity thus lead to an increase in the firm's surplus, and hence in wages as well.

Conditions on the labour market also affect wage formation. A common approach for analysing the labour market and wage formation is what is known as search and matching models. In these models, workers and firms take into account of what would happen if they do not agree when negotiating. If the worker leaves the firm, the firm could lose the production of the worker. The worker's alternatives to staying on at the firm are affected by how many other workers are searching for work, and the intensity of their job search. Workers who do not have a job are affected by the compensation they receive while unemployed, and by the probability of finding a job. They will probably look for work more intensively if the compensation level is lower and the chance of finding a new job is higher. The wage negotiated between the firm and worker thus also depends on the compensation level and state of the labour market.

To sum up, wage outcome depends on competitor pricing, the exchange rate, productivity, the state of the labour market and the unemployment compensation level.

An important determinant for competitor pricing is marginal costs at competing firms. Marginal costs are in turn affected by wages and productivity in these firms. There has been a discussion on the extent of dependence of wage formation in Sweden on wage formation in important competitor countries, such as Germany, see Kinnwall (2017). Via fundamental factors, that is to say competitor prices, German wages affect Swedish wages. It is possible, though, because Germany is an important export market, that German wages could also affect Swedish wage-setting beyond the fundamental channel via export prices.

3 Wages, productivity and competitor prices in data

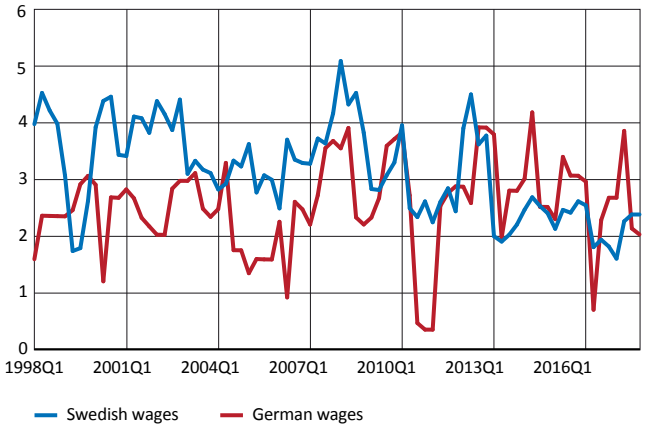
Figure 2 illustrates contractual nominal wage increases in Swedish and German industry between 1998 and 2017. The average increase in contractual wages have been roughly the same in the two countries, even though it appears to have been somewhat lower in Germany than in Sweden for a few years preceding the financial crisis in 2008, and subsequently somewhat higher. A reason for the lower wage increases in Germany before the financial crisis could be that Germany carried out substantial reforms of the labour market during the period, known as the Hartz reforms, see for example Krebs and Scheffel (2013). The correlation between the growth rate in Swedish and German contractual wages is however fairly low, around 0.31. In terms of actual wages, shown in Figure 3, the picture is somewhat different. Before the financial crisis, actual wages rose faster in Sweden than in Germany, but wage inflation has subsequently been on about the same level. The correlation between actual wages is 0.10, which is substantially lower than for contractual wages. This difference could possibly be explained by actual wages being affected by wage drift and changes in employee composition.[5]

5 If workers with lower wages lose their jobs to a greater extent in a recession, compared with in a boom, this mechanism causes the average wage to drop in a boom and rise in a recession, all else equal.

Figure 2. Industrial contractual wages in Sweden and Germany 1998Q1–2017Q4
Percentage change (4 quarters)

Sources: National Mediation Office and Bundesbank

Figure 3. Actual industrial wages in Sweden and Germany 1998Q1–2017Q4
Percentage change (4 quarters)



Sources: National Mediation Office, the Riksbank and Bundesbank

An important factor affecting both contractual and actual wages is the scope for wage increases in the negotiation. This can be defined as

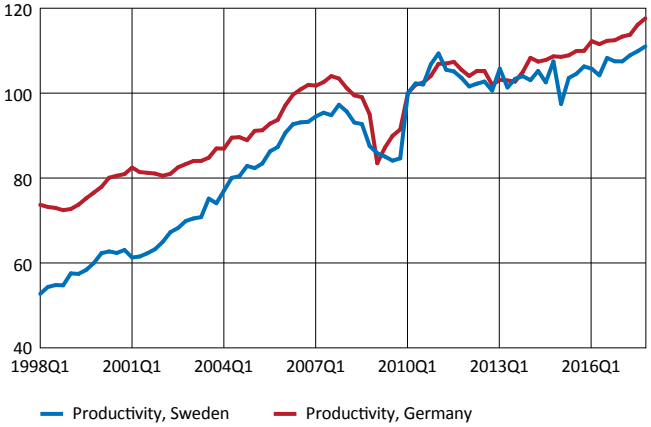
(1) $z_t + e_t + ppi_t$.

The scope for wage increases, or the value of what a worker produces, depends on the firm's productivity z_t, the nominal exchange rate e_t and the competitor price ppi_t. The competitor price is affected by the marginal costs of competing firms, which in turn depend on the firms' wages and productivity.

Figure 4 shows that productivity grew faster in Sweden than in Germany until the 2008 financial crisis. The growth rate then fell in both countries and has since developed in a relatively similar way. Competitor prices have shown a similar pattern, measured as competition-weighted producer prices in our competitor countries' industrial sectors. Figure 5 illustrates competitor prices, that is to say competition-weighted producer prices, and German producer prices.[6] Both grew faster up until the financial crisis, compared with the subsequent period.

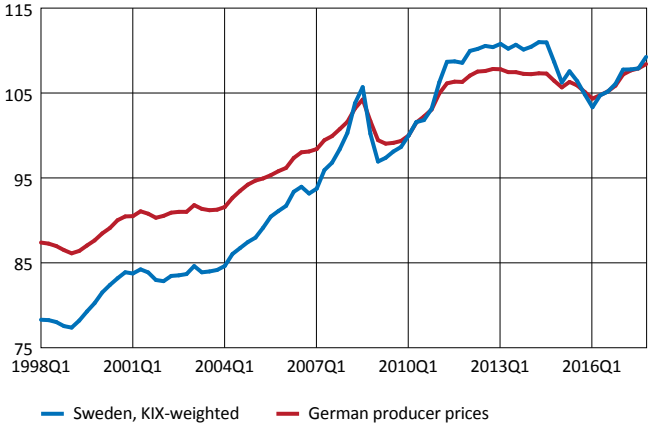
6 For the competition-weighted producer prices, 'KIX weights' are used. See Erlandsson and Markowski (2006) for a detailed description.

Figure 4. Industrial productivity in Sweden and Germany 1998Q1–2017Q4
Q1 2010 = 100



Sources: National Institute for Economic Research, Statistics Sweden and Bundesbank

Figure 5. KIX-weighted competitor prices for Sweden and German producer prices, industry 1998Q1–2017Q4
Q1 2010 = 100



Sources: Own calculations and OECD

Wage growth in relation to the scope for wage increases, that is to say the value of what the worker produces, indicates how much of the scope the employee obtains in the negotiation. Figure 6 shows wages in relation to the scope in Sweden and Germany during the period. We can see that, in both countries, wages fell in relation to the scope up until the financial crisis, but have since been relatively constant.

Figure 6. Wage/Scope for wage increases 1998Q1–2017Q4
Q1 2009 = 100

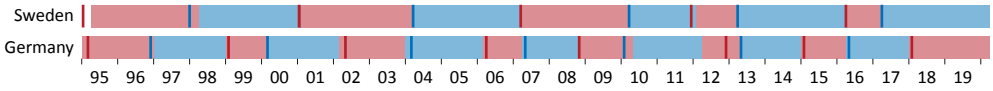
Note. Scope for wage increases is defined as $z_t + e_t + ppi_t$. Wages refers to actual wages
Source: Own calculations

3.1 How synchronised are Swedish and German wages?

Figures 2 and 3 indicate that there may be a relationship, albeit weak, between German and Swedish wages. One way of studying whether German wages affect those in Sweden is to look at the degree of coordination between German and Swedish agreements.

Figure 7 illustrates contract periods and contract dates for Swedish and German wage agreements. In general, it seems that German agreements often have a shorter duration than Swedish agreements. The average length of German agreements is around 20 months, and 30 months for Swedish agreements. There is not a full degree of synchronisation between contract dates. Out of the ten Swedish agreements, six are reached at a time close to when German agreements were reached. An even more important factor could be that, for these agreements, four of the Swedish agreements were reached before the German agreements, one in the same month and one afterwards. If the German agreements sets a mark for the Swedish ones, it is not unreasonable that Swedish industry waits until the German agreements have been signed, before reaching its own. However, it could also be the case that the Swedish parties can form a relatively precise estimate of the expected agreement level in German industry even before the German bargaining parties have finished negotiations.

Figure 7. Swedish and German wage contracts in industry
Time of agreement (red and blue lines) and agreement duration, alternating in red and blue blocks (the length shows the duration of the agreements) in the same colour as the agreement contract date



Source: See Appendix D

4 Estimated models

The two previous sections provide an overview of how wages and variables that are important for wage formation have developed since the mid-1990s. To gain more precise answers to what affects wage formation in Sweden, more advanced statistical analysis is needed, however. This section therefore describes how wage formation in Sweden is modelled and estimated, based on the theoretical model in section 2. The analysis closely follows Engle and Granger's (1987) method and estimates first of all a dynamic ordinary least square (DOLS) model with variables in levels to analyse the long-run relationship between

the different variables. If wages deviate from the long-run relationship, this will affect what happens to wages in the short run. If for example wages are too low in relation to the long-run relationship, wages ought to increase more than the long-run increase. In the analysis, the wage-setting relationship is then estimated in differences, with the deviation in the long-run relationship included. When the long-run relationship do not hold exactly at a certain point in time, for example because wages are too high in relation to the long-run relationship and the disturbance term is positive, wage increases are affected and wages ought to increase at a slower rate.[7] The deviation in the long-run relationship is thus corrected in the short-run relationship, a so-called error correction approach. The model is thus estimated first in levels:[8]

$$(2) \qquad w_t = \beta_c + \beta_z z_t + \beta_e e_t + \beta_p ppi_t + \beta_{ls} ls_t + \beta_{rr} rr_t + \beta_{wDE} w_t^{DE} + \varepsilon_t,$$

where w_t is Swedish industrial wages, z_t is labour productivity, e_t is the exchange rate, ppi_t is competitor prices, ls_t is a measure of labour shortage, rr_t is the nominal compensation level and w_t^{DE} denotes wages in German industry. The effect of German wages on Swedish wages will be the effects over and above those that go via competitor prices. The residual $\hat{\varepsilon}_t$ is then calculated in the long-run relationship and used in the following short-run regression:

$$(3) \qquad \Delta w_t = \alpha_c + \alpha_z \Delta z_t + \alpha_e \Delta e_t + \alpha_p \Delta ppi_t + \alpha_{ls} \Delta ls_t + \alpha_{rr} \Delta rr_t + \alpha_{wDE} \Delta w_t^{DE} + \alpha_{wlag} \Delta w_{t-4} + \alpha_\varepsilon \hat{\varepsilon}_{t-4} + v_t$$

where $\Delta x_t = x_t - x_{t-4}$ and v_t is a disturbance term. Models (2) and (3) will be estimated both with and without the German wages to study whether Germany has an influence on top of the fundamental factors. The estimations are performed for both contractual and actual wages, and in the estimations with Swedish contractual wages and actual wages, German contractual wages and actual wages, respectively, are used.[9]

Productivity is measured as hourly labour productivity and wages as hourly wage. The exchange rate is the KIX-weighted exchange rate and competitor prices are KIX-weighted producer prices in the industrial sector in our competitor countries. The labour shortage measure is the National Institute of Economic Research's measure of labour shortage in industry. Data for Germany has been obtained from Bundesbank.

4.1 Estimation results for contractual wages

The estimations for the long-run relationship for contractual wages are shown in Table 1 for the period 1997Q1–2017Q4.[10, 11] In the two columns in the middle of the table it can be seen that both the standard model without German wages and the model with German wages have a high explanatory power.

7 If the coefficient for the disturbance term is negative.

8 The DOLS approach also includes difference terms of the explanatory variables in the long-run relationship.

9 The agreements normally only cover wage changes. Based on these, a series for contractual wage levels can however be derived.

10 See Appendix A for estimations of wage equations where CPI is also included.

11 Because lags are included in (2) and (3) the estimations are carried out on a longer horizon, compared with the figures above.

Table 1. Estimation results for the long-run relationship in equation (2)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With German wages	With German wages, without producer prices
β_c	−4.210* (0.651)	−4.576* (0.255)	−4.452* (0.278)
β_z	−0.018 (0.072)	0.080* (0.030)	0.139* (0.020)
β_e	0.048 (0.079)	0.030 (0.032)	0.007 (0.033)
β_p	0.943* (0.118)	0.209* (0.093)	-
β_{ls}	0.016 (0.014)	0.006 (0.006)	0.010 (0.005)
β_{rr}	0.448* (0.062)	0.044 (0.052)	−0.047 (0.027)
β_{wDE}	-	0.704* (0.083)	0.834* (0.035)
F-test (p-value)		47.8 (0.00)	
Adjusted R^2	0.9909	0.9986	0.9983

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2.

In the standard model without German wages, the competitor price and the compensation level are significant, and an increase in competitor price or compensation level pushes up wages. When German wages are included as an explanatory variable, there is a sharp drop in coefficient β_p for competitor prices, while the coefficient for German wages is strongly positive and highly significant; if German wages increase by 1 per cent, Swedish wages rise by 0.7 per cent. A possible explanation is that, instead of studying competitor prices broadly, the parties in wage formation have an unjustifiably heavy focus on German wages. The relationship between Swedish wages and competitor prices will be weaker because the German wages capture part of the variation that normally goes via marginal costs.[12] If the competitor price increases by 1 per cent, wages increase by just over 0.2 per cent, and by just below 0.1 per cent if productivity increases by 1 per cent. In the column to the far right, a model is also shown without competitor prices, but with German wages. The explanatory value therein is essentially identical to the column that includes competitor prices. German wages have a somewhat stronger effect on the wages while the compensation level is insignificant.

We can use a simple statistical test, known as an F-test, to determine whether the model with German wages fits the data better than the model without German wages. Such a test indicates that German wage levels have significant effects in the long-run relationship.

Estimations for the short-run relationship in model (3) are shown in Table 2. The compensation level affects wage increases significantly in all models. The second column describes the results when German wages are also included. The coefficient for the change in German wages is not significantly different from zero, while an F-test indicates that German wages should be included in the relationship. In the column to the far right, a model is shown without competitor prices, and the coefficient of determination there is lower than for the model with both German wages and competitor prices.

12 The model is based on wages, productivity, exchange rate, competitor prices, compensation level, and state of the labour market covarying over time. In order for the results that are based on the theoretical model to be interpreted as indicating a relationship between the variables, they must covary in data. To use statistical vocabulary, the variables must be cointegrated. If this is the case, there is a long-term relationship between the variables, so-called cointegration. Tests (ADF test, with trend) show that there is cointegration at the 10 per cent level both with and without German wages in the relationship (test –3.31 with p-value 0.072 without German wages and –3.22 with p-value 0.088 with German wages). The tests thus weakly indicates cointegration.

Table 2. Estimation results for the short-run relationship in equation (3)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With German wages	With German wages. without producer prices
α_c	0.024* (0.003)	0.016* (0.004)	0.016* (0.004)
α_z	0.008 (0.015)	0.017 (0.015)	0.016 (0.015)
α_e	−0.019 (0.017)	−0.005 (0.016)	−0.014 (0.015)
α_p	0.038 (0.034)	0.055 (0.034)	-
α_{ls}	−0.003 (0.002)	−0.002 (0.002)	−0.001 (0.002)
α_{rr}	0.036* (0.016)	0.060* (0.015)	0.049* (0.013)
α_{wDE}	-	0.074 (0.105)	0.049 (0.105)
α_ε	0.219* (0.075)	−0.642* (0.178)	−0.618* (0.180)
α_{wlag}	−0.059 (0.111)	0.152 (0.104)	0.219* (0.097)
F-test (p-value)		3.98 (0.049)	
Adjusted R^2	0.199	0.231	0.213

Note. * denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2.

The results show that there are indications that German wages affect Swedish wages, even though the relationship does not appear to be entirely unequivocal. German wages are significant in the long-run relationship, but not in the short-run relationship, and F-tests indicate that the model with German wages is better than the model without for the long-run relationship and the short-run relationship.[13] Estimations with wages from the euro area gives a much stronger relationship, with a much higher coefficient of determination (0.521) in the short-run relationship (instead of 0.231 with German wages in the equivalent regression in Table 2), see Appendix B for these results.

4.2 Comparison with other models, and evaluation

An important component in wage formation, which is not explicitly modelled in models (2) and (3), is the formation of expectations. This is important because expectations about future productivity and prices affect the size of the expected surplus. In an alternative approach, one might assume that productivity will grow at its long-run average rates and the exchange rate will remain at its present level. If expectations about competitor prices are based on firms' marginal costs, they thus depend on expectations of productivity and wages abroad. In the alternative model, the wage outcome is determined by the upper and lower bound of the bargaining set, and the relative bargaining power of the parties. The upper bound of the bargaining set is closely linked to the change of the surplus in the negotiation over the term of the contract. The lower bound is instead determined by workers wanting unchanged real wages. The change in the surplus over time depends on the change of the exchange rate, productivity and competitor prices over time. The change in expected surplus will be $E\Delta z + E\Delta ppi + E\Delta e$ where E denotes expectations. Because the competitor price via marginal costs depends on wage and productivity in our competitor countries, the upper bound will be the expected change in the exchange rate plus the difference in expected productivity growth in Sweden and competitor countries (Δz^*) plus the change in our competitor countries' wages (Δw^*), i.e. $E\Delta z + E\Delta w^* - E\Delta z^* + E\Delta e$. If it is assumed for the sake of simplicity that the parties' expectations about the exchange rate are that it does not

13 Equivalent regressions have been estimated for Germany, in which Swedish industrial wages are used as explanatory variables. Swedish industrial wages are neither significant in the long-run relationship nor the short-run relationship and F-tests indicate that Swedish wages should not be included in either of the wage equations (2) or (3).

change over the term of the contract[14] ($E\Delta e = 0$) and that productivity is expected to grow at the same rate in Sweden as in competitor countries ($E\Delta z = E\Delta z^*$), then the upper bound equals expected wage growth in our competitor countries. The lower bound equals the change in expected price level ($E\Delta p$) during the period due to the desire of workers to have unchanged real wages. Bargaining power Υ is determined as a function of unemployment for workers in industry and labour shortage in industrial firms. Wages will then be $w = \Upsilon\,(E\Delta z + E\Delta w^* - E\Delta z^*) + (1 - \Upsilon)\,E\Delta p$. Table 3 below shows results from a model based on this approach (the Expectations model).[15]

In order to compare the above model with others, the mean square error (MSE) in the model is then studied. Let the estimated coefficients in the short-run relationship be denoted as $\hat{\alpha}_i$. Define

$$(4) \qquad \widehat{\Delta w}_t = \hat{\alpha}_c + \hat{\alpha}_z \Delta z_t + \hat{\alpha}_e \Delta e_t + \hat{\alpha}_p \Delta ppi_t + \hat{\alpha}_{ls} \Delta ls_t + \hat{\alpha}_{rr} \Delta rr_t + \hat{\alpha}_{wDE} \Delta w_t^{DE} + \hat{\alpha}_{wlag} \Delta w_{t-4} + \hat{\alpha}_\varepsilon \hat{\varepsilon}_t.$$

In order to calculate MSE, forecasts from (4) are then used, that is to say $\widehat{\Delta w}_t$, determined at the contract date, and if we let Δw_t^{avtal} be data for contractual wages and N the number of agreements, then

$$(5) \qquad MSE = \frac{1}{N} \Sigma_t (\widehat{\Delta w}_t - \Delta w_t^{avtal})^2$$

is a measure of how well the model on average manages to capture wage growth in the agreements. Note that the sum is over contract dates in the expression above.

Table 3 shows MSE for the two models described above, as well as the wage formation model of the National Institute of Economic Research, see National Institute of Economic Research (2018).

Table 3. Mean squared error (MSE) for certain models

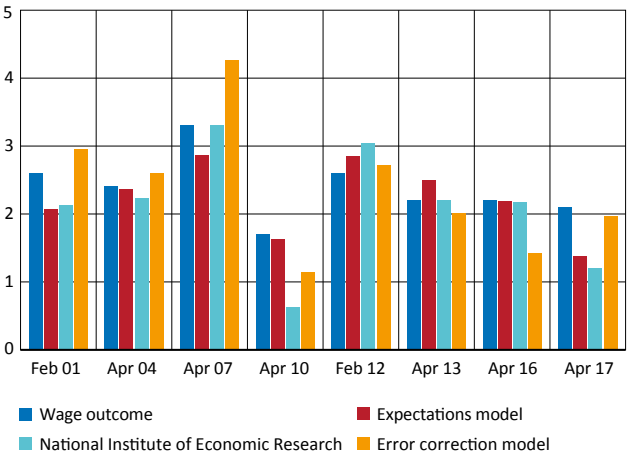
Model	MSE, 1998–2017	MSE, 2001–2017
Expectations model	0.128	0.145
National Institute of Economic Research	-	0.179
Error correction model with German agreements	0.562	0.262

Source: Own calculations

The National Institute of Economic Research's model and the expectations model are relatively comparable, while the error correction model appears to give somewhat poorer results. Alternatively, MSE can be calculated for all estimated observations and not just at the contract date. In the error correction model, we then obtain 0.214 and for the National Institute of Economic Research's model 0.052. Here too, the error correction model again performs worse than the National Institute of Economic Research's model. Figure 8 illustrates actual outcomes and forecasts for each agreement, that is to say Δw_t^{avtal} and $\widehat{\Delta w}_t$ for each contract in the three different models. The expectations model has large deviations for the first and last contract, while the National Institute of Economic Research's model works poorly for the fourth and last contract. The error correction model works poorly for the third, fourth and seventh contract, again indicating that the error correction model is somewhat worse than the other models, in line with the results in Table 3.

14 Holds if the exchange rate follows a random walk.
15 The model has been inspired by Henry Ohlsson, see also Ohlsson (2013).

Figure 8. Outcome and forecast for each agreement 2001–2017



Source: Own calculations

5 Analysis of actual wages

The results for actual wages are, in qualitative terms, relatively similar to the results for contractual wages, see Table 4 and 5. In the model without German wages, competitor price and compensation level are significant in the long-run relationship, and with German wages productivity and German wages are significant.[16] If German wages rise by 1 per cent, Swedish wages increase by about as much, and if productivity increases by 1 per cent, wages increase by around 0.2 per cent. In the column to the far right of the table, a model is also shown without competitor prices, but with German wages. The explanatory value is essentially identical to the column to the left, which includes competitor prices. German wages have more or less the same effect on the wages while productivity has a somewhat stronger effect.

Table 4. Estimation results for the long-run relationship in equation (2)
Refers to the period 1997Q1–2017Q4, actual wages

Coefficient	Standard model	With German wages	With German wages. without producer prices
β_c	−6.809* (1.050)	−6.113* (0.534)	−5.906* (0.527)
β_z	0.065 (0.116)	0.202* (0.062)	0.265* (0.039)
β_e	0.153 (0.128)	0.060 (0.065)	0.045 (0.066)
β_p	1.300* (0.190)	0.096 (0.194)	-
β_{ls}	0.014 (0.023)	−0.012 (0.013)	−0.001 (0.011)
β_{rr}	0.591* (0.100)	0.027 (0.093)	0.009 (0.052)
β_{wDE}	-	1.031* (0.142)	1.014* (0.057)
F-test (p-value)		26.5 (0.00)	
Adjusted R^2	0.9900	0.9975	0.9974

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2.

If, like before we apply a statistical F-test to compare the models with and without German wages, the results indicate that German wages seem to have significant effects in the long-run relationship.

16 For actual wages too, cointegration tests indicate only weak support for a long run relationship between the variables. Tests for cointegration indicate that there is cointegration for actual wages at the 5 per cent level when German wages are included in the cointegrated relationship (test–3.51, p-value 0.045). If German wages are excluded, there is cointegration at the 10 per cent level (test–3.25, p-value 0.082).

The results for the short-run relationship is shown in Table 5. Only lagged wages affect wage changes significantly in the model without German wages. In both the models with German wages, productivity, the compensation level and the lagged wage change affect Swedish wages significantly, while German wages do not have any significant effect on Swedish wages. An F-test indicates however that German wages should be present in the short-run relationship. The model without competitor prices has about the same coefficient of determination as the model with both German wages and competitor prices.

Table 5. Estimation results for the short-run relationship in equation (3)
Refers to the period 1997Q1–2017Q4, actual wages

Coefficient	Standard model	With German wages	With German wages. without producer prices
α_c	0.019* (0.005)	0.011 (0.006)	0.011 (0.006)
α_z	0.046 (0.025)	0.054* (0.023)	0.052* (0.022)
α_e	0.010 (0.028)	0.009 (0.024)	0.003 (0.022)
α_p	0.027 (0.055)	0.029 (0.049)	-
α_{ls}	−0.002 (0.003)	−0.002 (0.003)	−0.002 (0.003)
α_{rr}	0.038 (0.025)	0.059* (0.022)	0.053* (0.020)
α_{wDE}	-	0.124 (0.136)	0.113 (0.134)
α_ε	−0.013 (0.077)	−0.621* (0.129)	−0.620* (0.129)
α_{wlag}	0.382* (0.128)	0.511* (0.106)	0.536* (0.097)
F-test (p-value)		23.1 (0.00)	
Adjusted R^2	0.169	0.364	0.370

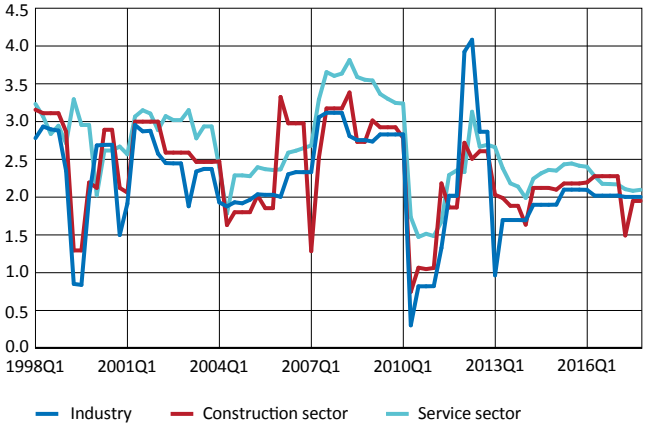
Note. * denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2.

The results for actual wages are thus relatively similar to the results for contractual wages. Even though there seems to be indications that German wages affect Swedish wages, the results are not unequivocal. At least in terms of the short-run relationship, German wages are not significant while a statistical F-test indicates that German wages should be included, similar to the results for contractual wages.

6 The impact of the Industrial Agreement on other sectors

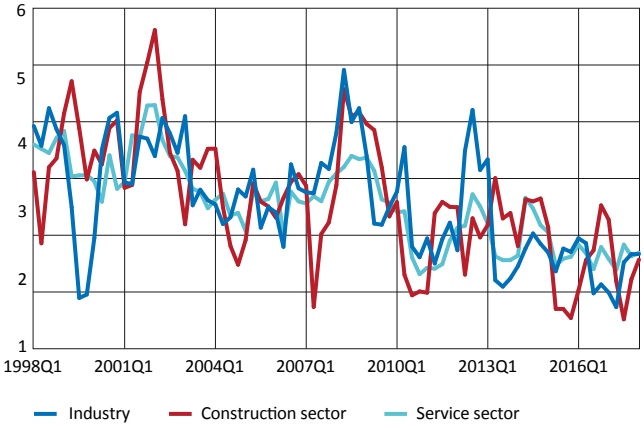
The results for how well German wages sets a norm for industrial wages in Sweden can be viewed in light of how well industrial wages sets a mark for other sectors in the Swedish economy. In this section, it is therefore studied how well the Industrial Agreement serves as a mark for certain other sectors. The sectors studied are the construction and service sectors, because limitations in access to data exclude other sectors. Figures 9 and 10 illustrate contractual and actual wage changes in the construction, service and industrial sectors over time. They show that both contractual and actual wages for the construction and service sectors follow industrial wages well, even though the average increase is higher for the service sector for contractual wages.

Figure 9. Contractual wages in the industrial, construction and service sectors 1998Q1–2017Q4
Growth in per cent



Source: National Mediation Office

Figure 10. Actual wages in the industrial, construction and service sectors 1998Q1–2017Q4
Growth in per cent



Source: National Mediation Office and the Riksbank

The correlation between wage changes in industry, and the construction and service sectors, is also much higher than the correlation between Swedish and German industrial wage changes. For contractual wages, the correlation is 0.79 for the construction sector and 0.64 for the service sector, and for actual wages the correlation is 0.49 for the construction sector and 0.74 for the service sector. The correlation thus falls when switching from contractual wages to actual wages for the construction sector, which indicates that wage drift and composition effects weaken the relationship with industrial wages.

In order to study the relationship statistically, a modification of the models in equation (2) and (3) is used. In the model for industry estimations, the competitor price ppi_t is used as an explanatory variable. Because Sweden is a small open economy, it is not unreasonable to assume that competitor prices for the industrial sector are taken as given by Swedish firms. They can therefore be treated as exogenous variables in the estimation. Because the construction and service sectors largely have their sales in Sweden, it is more difficult to treat competitor price as exogenous. Specifically, the prices are a function of wages and productivity via marginal costs, and we can therefore eliminate the prices from the estimated equations.[17] As in Forslund et al. (2005), we also make the simplified assumption that these

17 For example, a modification of the model in Trigari (2009) gives wage equations in which wage is a function of productivity, the state of the labour market and compensation level.

sectors only produce for the domestic market, which implies that the exchange rate does not affect the surplus in the sectors either.

In the estimated model – besides the state of the labour market, the compensation level and productivity – industrial wages are also used as an explanatory variable.[18] The Industrial Agreement's wages affect wages in the other sectors in the same way as German wages affect industrial wages in the wage equations for industry.

6.1 Estimation results for contractual wages

Estimations for the long-run relationship are shown in Table 6, with the construction sector in columns 1–2 and the service sector in columns 3–4. If industrial wages are used as an explanatory variable, the results change considerably in both sectors. For the construction sector, productivity is significant but with the wrong sign, in the model that does not include industrial wages. The compensation level is also significant. When industrial wages are included, productivity is significant and affects wages positively. Industrial wages affect wages in the construction sector about 1 to 1. The effects of increased productivity are small however and if productivity increases by 1 per cent, wages increase by 0.03 per cent. The coefficient of determination also increases sharply, much more than when German industrial wages are included in the long-run relationship for Swedish industrial wages (see Table 1). For the service sector, in the estimations without industrial wages, an increase in productivity leads to higher wages. If industrial wages are included in the relationship, the coefficient for productivity falls sharply, the coefficient for the compensation level is close to zero, while industrial wages have a strongly positive relationship with wages in the service sector.[19] An increase in industrial wages of 1 per cent leads to an increase in wages in the service sector by about as much, while the effects of increased productivity on wages is at more or less the same level as in the construction sector. The coefficient of determination increases substantially when industrial wages are included in the relationship, and here too much more than when German wages are used in the estimations for industry. An F-test indicates also that industrial wages appear to have significant effects in the long-run relationship.

Table 6. Estimation results for the long-run relationship (2)
Refers to the period 1997Q1–2017Q4 for the construction sector, 2003Q1-2017Q4 for the service sector, contractual wages

	Construction sector		Service sector	
Coefficient	**Standard model**	**With industrial wages**	**Standard model**	**With industrial wages**
β_c	3.728* (0.446)	−0.189* (0.084)	−16.357* (5.095)	−0.377* (0.098)
β_z	−0.549* (0.075)	0.027* (0.013)	2.759* (0.834)	0.062* (0.016)
β_{ls}	0.006 (0.012)	−0.003* (0.001)	−0.119 (0.085)	−0.001 (0.001)
β_{rr}	1.041* (0.083)	−0.035 (0.021)	−0.490 (0.610)	−0.056* (0.007)
β_{wInd}	-	1.085* (0.020)	-	1.191* (0.004)
F-test (p-value)		1 374.2 (0.00)		39 128 (0.00)
Adjusted R^2	0.9510	0.9996	0.6729	0.9999

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2, and 3 and 4, respectively.

18 The labour shortage measure is the National Institute of Economic Research's measure of labour shortage in the service sector and construction sector, respectively.

19 Cointegration test for contractual wages in the construction sector when industrial wages are included in the cointegrating relationship gives cointegration at the 5 per cent level (test–3.64, p-value 0.03); without industrial wages cointegration at the 5 per cent level (test–4.06, p-value 0.01). Cointegration tests for contractual wages in the service sector when industrial wages are included in the cointegrating relationship gives cointegration on the 1 per cent level (test–4.22, p-value 0.008); without industrial wages no cointegration (test–1.76, p-value 0.71). The cointegration tests indicate cointegration, apart from for the service sector when industrial wages are not included in the relationship.

In terms of the short-run relationship, industrial wages give qualitatively similar effects as in the long-run relationship, see Table 7. The coefficient of determination increases much more than when German industrial wages are included in the estimations for industry (see Table 2). Industrial wages affect wages in the construction and service sectors positively, unlike the estimations for industry in which German wages do not have any significant effects on Swedish industrial wages. An F-test indicates also that industrial wages have significant effects in the short-run relationship.

Table 7. Estimation results for the short-run dynamic regression (3)
Refers to the period 1997Q1–2017Q4 for the construction sector, 2003Q1–2017Q4 for the service sector, contractual wages

	Construction sector		Service sector	
Coefficient	**Standard model**	**With industrial wages**	**Standard model**	**With industrial wages**
α_c	0.016* (0.002)	0.0003 (0.001)	0.013* (0.004)	−0.004* (0.002)
α_z	−0.021 (0.014)	−0.004 (0.007)	0.027 (0.033)	−0.002 (0.012)
α_{ls}	0.002* (0.001)	0.0001 (0.0004)	0.001 (0.001)	0.0002 (0.001)
α_{rr}	0.020 (0.012)	−0.014* (0.006)	0.025 (0.015)	−0.010 (0.006)
α_{wlnd}	-	0.716* (0.044)	-	0.835* (0.045)
α_{ε}	−0.781* (0.238)	−0.899* (0.111)	−1.851 (1.187)	−1.231* (0.410)
α_{wlag}	0.335* (0.080)	0.301* (0.037)	0.493* (0.137)	0.430* (0.047)
F-test (p-value)		269.1 (0.00)		350.1 (0.00)
Adjusted R^2	0.284	0.845	0.192	0.904

Note. * denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2, and 3 and 4, respectively.

To sum up, the estimations strongly indicate that the Industrial Agreement sets a norm for the construction and service sectors. In Tables 6 and 7, industrial wages are always significant, and the models' explanatory value increases sharply if they are included. Results from statistical F- and t-tests also indicate that they should be present in the wage equations.

The results are similar for actual wages; see Appendix C. Industrial wages have effects both on contractual wages and the actual wages in the construction and service sector.

The effect of industrial contractual wages on other sectors in Sweden thus appears to be stronger than the effects of German industrial wages on Swedish industrial wages. The correlations for wage changes in Swedish industry and other sectors are much higher than the correlation between Swedish and German industrial wages. Swedish industrial wages affect wages in other sectors essentially on a one-to-one basis in the long run, while the effect of German industrial wages on those of Sweden is weaker. In the short run, industry wage changes have a strong impact on wage changes in other sectors, while the effects of changes in German industrial wages on Swedish industrial wage changes are small and not significant. The coefficient of determination also increases much more when industrial wages are included in both the long-run and short-run relationship for both the construction and service sectors, compared with the estimations for industry when German wages are included.

7 Summary and conclusions

This article studies wage formation in Sweden since the Industrial Agreement was reached in 1997. Wage equations are estimated to attempt to obtain an understanding of what determines wages different sectors. The Industrial Agreement has functioned as intended in that wages in other sectors are largely explained by industrial wages. Industrial wages thus provide a substantial increase in the explanatory power for wages in both the construction and service sectors, compared with models that are estimated without the inclusion of industrial wages. Industrial wages, which set the mark, depend on the surplus produced by firms. Because industry is export-dependent, this surplus depends on the exchange rate, competitor prices and productivity. There has been a debate about whether German industrial wages could have a direct impact on Swedish wages besides the effects via competitor price. In this article, the empirical support for such an assertion has been studied. The empirical analysis provides some but not unequivocal support for determining with certainty that German nominal wages have direct influence on Swedish nominal wages. An in-depth analysis is thus needed to examine whether this is the case. The empirical analysis however provides unambiguous support for there being a strong and statistically significant relationship between contractual Swedish industrial wages and contractual wages for the euro area. Contractual German industrial wages thus do not appear to have a unique position for Swedish contractual industrial wages; rather, the important factor appears to be the contractual wages for the entire euro area. By virtue of its size, however, Germany of course has great influence on contractual wages in the euro area.

References

Bennmarker, Helge, Lars Calmfors and Anna Larsson (2011), 'Wage Formation and the Swedish Labour Market Reforms 2007–2009', *report for the Swedish Fiscal Policy Council* 2011/1.

Calmfors, Lars, Simon Ek, Ann-Sofie Kolm and Per Skedinger (2019), *Kollektivavtal och lönebildning i en ny tid* (*'Collective agreements and wage formation in a new era'*), Dialogos förlag, Stockholm.

Engle, Robert F. and Clive W. J. Granger (1987), 'Co-Integration and Error Correction: Representation, Estimation, and Testing', *Econometrica*, vol. 55, no. 2, pp. 251–276.

Erlandsson, Mattias and Alek Markowski (2006), 'The Effective Exchange Rate Index KIX – Theory and Practice', *National Institute of Economic Research Working Paper*, no. 95.

Forslund, Anders, Nils Gottfries and Andreas Westermark (2005), 'Real and Nominal Wage Adjustment in Open Economies', *Department of Economics, Uppsala University working paper*, 2005:18.

Forslund, Anders, Nils Gottfries and Andreas Westermark (2008), 'Prices, Productivity and Wage Bargaining in Open Economies', *Scandinavian Journal of Economics*, vol. 110, no. 1, pp. 169–195.

Gottfries, Nils (2019), 'Europanormen saknar relevans: Om sambandet mellan lönebildning, penningpolitik, växelkurs och konkurrenskraft' ('The European norm lacks relevance: About the relationship between wage formation, monetary policy, exchange rate and competitiveness'), report 6F.

Jonsson, Magnus and Emelie Theobald (2019), 'A changed labour market – effects on prices and wages, the Phillips curve and the Beveridge curve', *Sveriges Riksbank Economic Review*, no. 1, pp. 28–49.

Kinnwall, Mats (2017), 'Svensk inflation är irrelevant för industrins konkurrenskraft' ('Swedish inflation is irrelevant to industrial competitiveness'), 7 December 2017 https://www.industriarbetsgivarna.se/nyhetsrum/nyheter/nyheter-2017/svensk-inflation-ar-irrelevant-for-industrins-konkurrenskraft.

National Institute of Economic Research (2018), *Wage Formation Report 2018.*

Krebs, Tom and Martin Scheffel (2012), 'Macroeconomic Evaluation of Labor Market Reform in Germany' *IMF Economic Review*, vol. 61, no. 4, pp. 664–701.

Molander, Per and Gert Paulsson (2008), 'Vidareutveckling av det finanspolitiska regelverket' ('Enhancement of the fiscal policy regulations'), *report for the Swedish Fiscal Policy Council*, no. 5.

Ohlsson, Henry (2013), 'Competitiveness and purchasing power: Collective bargaining in a small open economy', manuscript.

Trigari, Antonella (2009), 'Equilibrium Unemployment, Job Flows, and Inflation Dynamics', *Journal of Money, Credit and Banking*, vol. 41, no. 1 , pp. 1–33.

Westermark, Andreas (2008), 'Lönebildningen i Sverige 1966–2009' ('Wage formation in Sweden 1966–2009), *report for the Swedish Fiscal Policy Council* 2008/6.

Westermark, Andreas (2019), 'How can various structural changes in the economy affect wages and inflation?', *Sveriges Riksbank Economic Review*, no. 2, pp. 71–90.

Appendix A – Estimations with CPI

In this section, estimations are described for a model in which the price level in terms of CPI is used as an explanatory variable in the equations (2) and (3). In the regression, the nominal compensation level is replaced by the replacement rate, because the price level captures nominal factors. The estimations for the long-run relationship for contractual wages are shown in Table A1 for the period 1997Q1–2017Q4. Both the model without German wages and the model with German wages have a high explanatory value. German wages also have a positive effect on Swedish wages.

Table A1. Estimation results for the long-run relationship (2)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With German wages
β_c	−7.725* (1.245)	−3.514* (0.448)
β_z	0.195* (0.070)	0.094* (0.020)
β_e	−0.034 (0.126)	0.008 (0.038)
β_p	−0.922* (0.428)	0.292 (0.162)
β_{kpi}	2.393* (0.399)	−0.503* (0.238)
β_{ls}	0.055* (0.015)	−0.005 (0.006)
β_{rr}	−0.194 (0.162)	0.001 (0.053)
β_{wDE}	-	0.913* (0.062)
F-test (p-value)		66.6 (0.00)
Adjusted R^2	0.989	0.999

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level.

In the standard model, competitor prices have a sign that conflict with theory. German wages are significant, and affect Swedish wages at almost one to one. A statistical F-test indicates however that German wages should be present in the regression.

Estimations for the short-run relationship in (3) are shown in Table A2. The replacement rate affects wage changes significantly in both models. The second column describes the results when German wages are also included. Competitor prices also affect wages positively when German wages are included in the long-run relationship. However, the coefficient for the change in German wages is not significantly different from zero, and an F-test also indicates that German wages should not be included in the relationship.

Table A2. Estimation results for the short-run dynamic regression (3)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With German wages
α_c	0.021* (0.003)	0.021* (0.004)
α_z	0.019 (0.016)	0.014 (0.016)
α_e	−0.003 (0.017)	−0.013 (0.017)
α_p	0.073 (0.052)	0.107* (0.051)
α_{ls}	−0.003 (0.002)	−0.004 (0.002)
α_{rr}	0.042* (0.018)	0.046* (0.018)
α_{wDE}	-	−0.000 (0.112)
α_{kpi}	−0.155 (0.095)	−0.189* (0.095)
α_ε	−0.173* (0.066)	−0.628* (0.225)
α_{wlag}	0.146 (0.108)	0.143 (0.108)
F-test (p-value)		1.23 (0.27)
Adjusted R^2	0.127	0.130

Note. * denotes significance at the 5 per cent level.

Appendix B – Estimations with contractual wages for the euro area

In this section, estimations are described for a model in which German contractual wages are replaced by contractual EMU wages in equations (2) and (3).[20] Estimations for the long-run relationship in model (3) are shown in Table A3.

Table A3. Estimation results for the long-run relationship in equation (2)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With EMU wages
β_c	−4.210* (0.651)	−0.292 (0.214)
β_z	−0.018 (0.072)	−0.018 (0.013)
β_e	0.048 (0.079)	−0.009 (0.016)
β_p	0.943* (0.118)	0.105* (0.044)
β_{ls}	0.016 (0.014)	−0.008* (0.003)
β_{rr}	0.448* (0.062)	0.090* (0.019)
β_{wEMU}	–	0.873* (0.040)
F-test (p-value)		190.2 (0.00)
Adjusted R^2	0.9909	0.9996

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level.

Just like for German wages, there is a sharp drop in coefficient β_p for competitive prices, while at the same time the coefficient for EMU wages is strongly positive and highly significant when wages for the euro area are included as an explanatory variable; if wages in the euro area increase by 1 per cent, those in Sweden rise by just shy of 0.9 per cent. The relationship is thus stronger than for German wages. The coefficient for competitor price also declines more when wages for the euro area are used, compared with when German wages are used. The F-test also clearly indicates that EMU wages should be included.[21]

Estimations for the short-run relationship in model (3) are shown in Table A4. The compensation level affect wage changes significantly in both models, and the coefficient increases when wages for the euro area are included. When wages for the euro area are included, the coefficient of determination increases much more than in the estimations with German wages in Table 2. Changes in wages for the euro area also have a strongly positive and significant effect on changes in Swedish contractual industrial wages. Also, the F-test indicates clearly that they should be in the regression.

To sum up, it appears that the relationship between Swedish contractual industrial wages and contractual wages for the euro area is much stronger than the relationship between Swedish and German industrial wages.

20 No series for the same geographical area for actual wages was available and therefore the estimation is only done for contractual wages.
21 Tests (ADF test, with trend) show that there is cointegration when wages for the euro area are included (at the 0.1 per cent level, critical value –4.83).

Table A4. Estimation results for the short-run relationship in equation (3)
Refers to the period 1997Q1–2017Q4, contractual wages

Coefficient	Standard model	With EMU wages
α_c	0.024* (0.003)	−0.003 (0.004)
α_z	0.008 (0.015)	0.004 (0.012)
α_e	−0.019 (0.017)	−0.009 (0.013)
α_p	0.038 (0.034)	0.033 (0.027)
α_{ls}	−0.003 (0.002)	−0.001 (0.002)
α_{rr}	0.036* (0.016)	0.059* (0.012)
α_{wEMU}	-	0.881* (0.118)
α_ε	0.219* (0.075)	−0.776* (0.264)
α_{wlag}	−0.059 (0.111)	0.183* (0.081)
F-test (p-value)		49.3 (0.00)
Adjusted R^2	0.199	0.521

Note. * denotes significance at the 5 per cent level.

Appendix C – The effect of the Industrial Agreement on other sectors – actual wages

Compared with the estimations for contractual wages, the results are qualitatively similar for both sectors, see Tables A5 and A6. Industrial wages give a sharp increase in the explanatory value and the coefficient is significantly different from zero, both in the long-run relationship and short-run relationship.[22]

Table A5. Estimation results for the long-run relationship (2)
Refers to the period 1997Q1–2017Q4 for the construction sector, 2003Q1–2017Q4 for the service sector, actual wages

	Construction sector		Service sector	
Coefficient	**Standard model**	**With industrial wages**	**Standard model**	**With industrial wages**
β_c	4.899* (0.648)	−0.093 (0.290)	−18.818* (5.960)	−0.352 (0.235)
β_z	−0.714* (0.109)	0.005 (0.044)	3.185* (0.976)	0.054 (0.038)
β_{ls}	0.006 (0.017)	−0.004 (0.004)	−0.136 (0.099)	−0.002 (0.002)
β_{rr}	1.479* (0.121)	−0.005 (0.075)	−0.607 (0.713)	−0.041* (0.013)
β_{wInd}	-	0.963* (0.047)	-	0.957* (0.005)
F-test (p-value)		222.2 (0.00)		15 437 (0.00)
Adjusted R^2	0.9456	0.9975	0.6564	0.9999

Note. Engle and Granger (1987) regression, standard deviations in brackets.
* denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2, and 3 and 4, respectively.

Table A6. Estimation results for the short-run dynamic regression (3)
Refers to the period 1997Q1–2017Q4 for the construction sector, 2003Q1–2017Q4 for the service sector, actual wages

	Construction sector		Service sector	
Coefficient	**Standard model**	**With industrial wages**	**Standard model**	**With industrial wages**
α_c	0.032* (0.003)	0.021* (0.003)	0.008* (0.004)	0.002 (0.002)
α_z	0.018 (0.021)	0.031 (0.018)	−0.005 (0.026)	−0.031* (0.015)
α_{ls}	−0.001 (0.001)	−0.002* (0.001)	−0.001 (0.001)	−0.0001 (0.001)
α_{rr}	−0.012 (0.017)	−0.031* (0.015)	0.019 (0.012)	−0.009 (0.007)
α_{wInd}	-	0.369* (0.068)	-	0.640* (0.063)
α_ε	−0.346* (0.101)	−0.383* (0.086)	−1.866* (0.510)	−1.376* (0.290)
α_{wlag}	0.078 (0.088)	0.016 (0.075)	0.732* (0.109)	0.292* (0.075)
F-test (p-value)		29.2 (0.00)		103.3 (0.00)
Adjusted R^2	0.140	0.378	0. 462	0.831

Note. * denotes significance at the 5 per cent level. The F-test compares the models in column 1 and 2, and 3 and 4, respectively.

22 Cointegration for actual wages in the construction sector when industrial wages are included in the cointegrating relationship gives cointegration on the 5 per cent level (test–3.88, p 0.02); without industrial wages in the cointegrating relationship cointegration at the 1 per cent level (test–4.14, p 0.008). Cointegration for actual wages in the service sector when industrial wages are included in the cointegrated relationship gives cointegration on the 1 per cent level (test–4.87, p 0.001); without industrial wages no cointegration (test–1.73, p 0.72). Just as for contractual wages, the variables appear to be cointegrated, apart from for the service sector when industrial wages are not included in the relationship.

F-tests for whether industrial wages should be included clearly indicate that this is the case. Just as for contractual wages, industrial wages seem to have significant effects in both the long-run relationship and short-run relationship.

Appendix D – Synchronisation of Swedish and German wages

Table A7 shows the contract date and term of Swedish and German wage contracts. The table contains the data that forms the basis for Figure 7 in the main text.

Table A7. Swedish and German wage contracts in industry
Time of agreement, contract length and start date

Sweden	Germany
Jan 95, 36 months, valid from 1 Apr 95	Mar 95, 24 months, valid from 1 Jan 95
	Dec 96, 24 months, valid from 1 Jan 97
Jan 98, 34 months, valid from 1 Apr 98	
	Feb 99, 14 months, valid from 1 Jan 99
	Mar 00, 24 months, valid from 1 Mar 00
16 Jan 01, 38 months, valid from 1 Feb 01	
	May 02, 22 months, valid from 1 Mar 02
18 Mar 04, 36 months, valid from 1 Apr 04	Mar 04, 26 months, valid from 1 Jan 04
	Apr 06, 13 months, valid from 1 Mar 06
15 Mar 07, 36 months, valid from 1 Apr 07	May 07, 19 months, valid from 1 Apr 07
	Nov 08, 18 months, valid from 1 Nov 08
20 Mar 10, 22 months, valid from 1 Apr 10	Feb 10, 23 months, valid from 1 May 10
12 Dec 11, 14 months, valid from 1 Feb 12	
	Dec 12, 13 months, valid from 1 Apr 12
27 Mar 13, 36 months, valid from 1 Apr 13	May 13, 20 months, valid from 1 May 13
	Feb 15, 15 months, valid from 1 Jan 15
31 Mar 16, 12 months, valid from 1 Apr 16	May 16, 21 months, valid from 1 Apr 16
31 Mar 17, 36 months, valid from 1 Apr 17	
	Feb 18, 27 months, valid from 1 Jan 18

Sources: National Mediation Office, own data and Bundesbank