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# Sectoral wage dynamics and intersectoral linkages in the context of export competitiveness: the case of Croatia

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**Abstract**

This study explores the determinants of sectoral wage dynamics in Croatia, including intersectoral wage linkages. Wage formation in the exporting sectors receives particular focus. Exporters are found to be wage leaders and labor productivity is a more important wage determinant for exporting than for other sectors. There are wage spillovers within a group of exporting sectors and possibly a bi-directional relationship between wages in exporting and private sheltered sectors. Thus, some exporting industries may face pressure from wage increases in more successful exporting and in private sheltered sectors. A more coordinated wage setting system could contribute to easing this pressure and improving overall export competitiveness.

**JEL classification numbers**

J30, J50, F16

**Keywords**

wages, wage setting, exports, competitiveness, Croatia

## I. Introduction

The aim of this study is to investigate the sectoral dynamics of wages in Croatia in the context of improving Croatia's external competitiveness. Excessive wage increases in the sectors of the economy producing internationally tradable goods, compared to productivity growth and corresponding developments in competitor countries, may lead to a deterioration in the country's trade balance. Developments in Croatian merchandise trade over the last decade or so are largely seen as unsatisfactory. For example, the coverage of merchandise imports by merchandise exports averaged 49.8% in the period between 1999 and 2010. This strongly contributed to persistent current account deficits, amounting to an average of 5.27% of GDP over the same period, despite significant tourism income.[1] Another important aspect is that the competitiveness of Croatian manufacturing exports largely depends on the labor costs of production and is not (particularly) quality-driven (Stojčić et al., 2012). In light of these developments and given the country's commitment to a fixed exchange rate policy (due to high euroization), it is necessary to consider policy options other than currency devaluation to improve Croatia's external trade position. This paper explores the suitability of the current wage setting process in Croatia as an instrument for strengthening the export competitiveness of Croatian companies by moderating wage increases in the exporting sectors.

A large body of literature addresses the institutional features of wage setting systems in different countries and their macroeconomic consequences (see, e.g., Flanagan, 1999, for an overview). These systems are typically distinguished by characteristics such as the trade union density, the share of workers covered by the terms of collective bargaining agreements, the level of collective bargaining, and the degree of coordination.[2] The existing research does not provide clear answers on the individual aspects of the wage setting process that generate the most favorable effects. It seems appropriate to analyze the performance of the overall systems, as different systems may be able to perform equally well (OECD, 2004, p. 130).

[1] The data source is the Croatian National Bank: http://www.hnb.hr/statistika/hstatistika.htm.
[2] See, e.g., Du Caju et al. (2008) for a recent categorization of wage setting systems in the EU.

Bagić (2010) provides a detailed and up to date characterization of the Croatian system of wage determination: (1) a comparatively high overall trade union density of 34.7%, with large sectoral differences ranging from only 16.8% in private companies to approximately 70% in the public sector including state owned enterprises (SOE); (2) at least part of the working conditions for approximately 60% of employees is determined through collective bargaining;[3] (3) there is no coordination at the industry level; (4) the terms of collective bargaining agreements may be extended administratively; and (5) despite the existence of some sectoral collective agreements, the bargaining process in Croatia is largely decentralized, and collective agreements in the private sector at the company level are more important in practice (Bagić, 2010, pp. 140; 179-182; 187; 191; 265). The last point seems to offer some optimism with respect to the general possibility for Croatian exporters to control their wages and international competitiveness given the individual companies' positions. However, the wages in the exporting sectors are not isolated from the rest of the economy. They may be affected, through different channels of influence and depending on the labor market situation, by wage increases in other sectors of the economy.

This study attempts to assess the ability of the current Croatian wage setting process to ensure improvements to Croatia's external competitiveness by moderating wage increases in the exporting sectors. To achieve this aim, we investigate the determinants of sectoral wage developments in Croatia, including intersectoral wage linkages. The results may have important policy implications. For example, if intersectoral wage spillovers run from private sheltered to exporting sectors, this could imply potential upward pressures on exporters' wages that may endanger their competitiveness, and thus, one should consider reforming the wage determination process. If intersectoral wage causality runs from government to exporting sectors, this would imply the possibility of using public sector wages as an instrument for moderating wage increases in the exporting industries.

[3] However, many of those are covered by private sector collective agreements, which are often not up to date.

## II. Related literature

There are a variety of theoretical models and hypothesis on wage setting, with different predicted outcomes with respect to wage moderation, such as *bargaining models*, *right-to-manage models*, the *efficiency-wage hypothesis* or the *insider-outsider hypothesis* (see Cahuc and Zylberberg, 2004, for detailed expositions and further references). However, under different theoretical approaches, negative externalities may be generated by wage setting outcomes in one company or sector of the economy on others. Some examples include the envy externality or consumer price externality (Calmfors, 1993, p. 163-164, lists seven types of such externalities treated in the literature). Such externalities can be internalized by cooperative wage setting behavior through inter-union and inter-employer cooperation. In a largely decentralized system, however, market forces impose restrictions on wages. This leads to the well-known Calmfors-Driffil hypothesis that strongly centralized and decentralized wage setting systems lead to lower real wages and higher employment than those with an intermediate extent of centralization (Calmfors and Driffil, 1988).[4] This hypothesis depends on various assumptions and the types of externalities considered (Calmfors, 1993, pp. 167-168), so that, e.g., one can question the strength of market forces that restrict wages in a decentralized wage bargaining system if companies have some market power or if the public sector is considered. In the latter case, fiscal discipline can be a key factor contributing to wage moderation, but under centralized bargaining in public sector, the government will be negotiating with a large share of the electorate, reducing the government's bargaining power.

An important theoretical contribution explicitly addressing intersectoral wage linkages in an open economy is known as the *Scandinavian model of wage determination* (or *Scandinavian model of inflation* because it was originally developed to describe price dynamics in Norway, see Aukrust, 1977). This model distinguishes between exposed and

[4] Note that strong cooperation can be achieved even without a high extent of formal centralization, e.g., through wage leadership (Knell and Stiglbauer, 2009b).

sheltered sectors of an economy with a fixed exchange rate and assumes that wage increases in the exposed sectors are transmitted to wages in the sheltered sectors. Wages in the exposed sectors, however, are determined by international prices for the output produced in these sectors and productivity. Drawing strongly on Aukrust (1977), D'Adamo (2011) sketches a theoretical framework for the analysis of intersectoral wage linkages in an open economy with three sectors: the tradable (exposed) sector and private and government sheltered sectors.

Such a classification allows for a more nuanced discussion of potential wage spillovers from sheltered sectors that may be detrimental to export competitiveness: If wages in the public sector are set without considering productivity developments in the exposed sectors, for the reasons indicated above, and if there is a tendency toward wage equalization, this may result in cost pressures on the exporting industries. The potential adverse effects of wage leadership from a private sheltered sector characterized by less a competitive environment may become particularly relevant if a country experiences a boom in a private sheltered sector, drawing resources, i.e., labor, from other sectors and thus placing pressure on exporters. A theoretical reference describing a comparable situation is Corden and Neary (1982). They analyze structural change in an open economy in which booming and lagging sub-sectors within a traded goods sector coexist (a situation often referred to as the "Dutch disease"). A more general version of their model (Corden, 1984) describes a case in which the booming sector's product is not (fully) exported, where the same resource moving effect exists as in the basic model, driven by an increasing marginal product of labor in the booming sector. Potentially relevant examples are the booming tourism sector (Holzner, 2011, includes a recent review of literature on the Dutch disease with booming tourism sector) or, e.g., a situation in which demand for domestic real estate increases in the presence of substantial foreign capital inflows channeled through the domestic banking system, which could lead to booms in the domestic financial and real estate (including construction) sectors.

A number of related empirical studies investigate the relative importance of internal (firm or sector) conditions and external factors in determining wages, using panel analysis methods with firms or sectors as cross-sectional units. When a macroeconomic wage variable is used to capture external factors, these studies can be interpreted as a test of intersectoral wage linkages. For example, using data for the Netherlands, Graafland and Lever (1996) explore the relative importance of internal and external determinants of sectoral wages and find that the latter dominate. They interpret the strong influence of the macro wage on sectoral wages as evidence of the important role of wage leadership and following patterns. This argument is also stressed in a study on wage formation within Canadian industry groups by Bemmels and Zaidi (1990). Their results also reveal significant intersectoral wage spillovers. The only similar study of which we are aware, which analyzes economies in Central and Eastern Europe (CEE) is that by Stockhammer and Onaran (2009). They investigate the relative role of sectoral (productivity) and national (macroeconomic wage) factors in wage formation in six CEE countries using data from the manufacturing sectors. The results reveal that national factors dominate, though not equally in all of the countries.

Another group of related contributions presents more explicit tests of the wage leadership hypothesis for different sectors in an economy, principally by using time series methods. They often use the Scandinavian model of wage determination as the primary theoretical reference. In many Western European countries (e.g., Austria, Germany, Denmark or Sweden), wage bargaining is conducted at the sectoral level, with wage leading sectors (typically manufacturing) concluding the first wage increase agreement and establishing the norm for negotiations in other sectors (so called *pattern bargaining*, see, e.g., Calmfors and Larsson, 2009). A number of empirical studies then test for the wage leadership of certain sectors in these countries where such a system is more or less institutionalized. For example, Knell and Stiglbauer (2009a, 2009b) find evidence of a wage leading role of the metal sector in Austria that is found to be more sensitive to macroeconomic conditions (expectations) than

the other sectors. In a study on Sweden, Friberg (2007) finds significant intersectoral wage causalities but no indications of the unique wage leading role of the internationally exposed sector. Interestingly, he finds evidence that the wage causality runs from certain sheltered sectors (other than the public sector) toward the manufacturing sector. Few recent studies are explicitly focused on investigating the potential wage leadership of the public sectors in a number of European countries (see e.g. Lamo et al., 2008; or Afonso and Gomes, 2008). As for the similar contributions on CEE countries, D'Adamo (2011) tests for linkages in wage formation between exposed, private and public sheltered sectors in ten EU transition countries. The results are not homogenous across countries, but he concludes that sheltered (private and/or public) sectors are often wage leaders or have at least short run effects on wages in the exposed sectors. Christou et al. (2007) investigates the intersectoral influence of wage developments in the private and public sectors of the Romanian economy. Their results reveal that private sector wages lead public sector wages throughout the period under observation (1993-2006). For the later part of the period (1998-2006), they found bi-directional causality. In addition, they find that wages in SOE are significant for the wage developments in the private sector, but the opposite does not hold.

## III. Empirical analysis

### Sample and relevant developments

We use Croatian data for 50 areas of economic activity according to NCEA Rev. 1.1, i.e., sectors 15-93 (manufacturing and services) as listed in Table A1 in the Appendix, over the period between 1998 and 2007. Methodologically consistent data on wages are also available for 2008 but not for all other variables. The econometric analysis is performed for the full sample and for groups of sectors separately. The main groups are "exporting sectors" (also referred to as "exposed sectors") and "sheltered sectors". The latter is then divided into "private sheltered sectors" and "government and SOE". The individual sectors are assigned to

groups according to the share of public sector employees and external trade data for that sector. A problem with this approach is that it requires the determination of "cut-off" points in terms of the public sector employment share or the exporting activities of single sectors, beyond which a sector will be considered private/public and/or exposed/sheltered.[5] As there is no objective criterion in this context, different "cut-off" points can be applied depending on the data and considering the need for a sufficient number of cross-sectional observations in all groups of sectors (for the panel analysis).

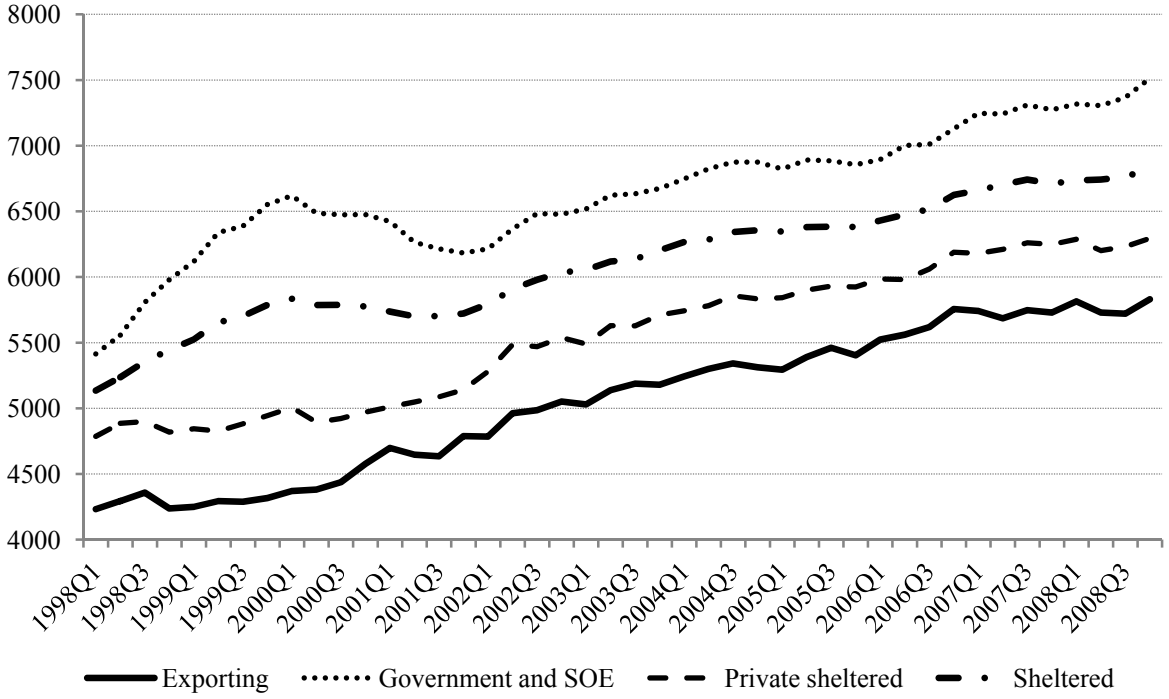
After examining the data, we elect to assign all manufacturing activities to exporting sectors, except for "37 Recycling" (which registered no exports) and "22 Publishing, printing and reproduction of recorded media" that had an average exports to gross value added (GVA) ratio of 14.6% (never above 17.5%). The lowest corresponding average ratio in a single sector assigned to the group of exporting sectors amounted to 45.5% ("30 Manufacture of office machinery and computer"), but it reached values of over 70% in some years.[6] This categorization leaves us with a sufficient number of cross-sectional observations within the group of exporters. In the classification according to the share of public sector employees, we use the criterion of 50% of employees in an individual sector being employed in publicly owned entities as a "cut-off" point between "private sheltered" and "government and SOE" groups of sectors. There is only one exporting sector, "23 Manufacture of coke, refined petroleum products and nuclear fuel", in which the share of public sector employees exceeds 50% (it amounts to 66% on average but only 15% toward the end of the observed period). Thus, we do not construct a separate group of public exporting sectors, and this economic activity is assigned to the group of exporters. Details on the definitions of groups of sectors can be found in Table A2 in the Appendix.

[5] Aukrust (1977, p.109-110) defines exposed industries as those that are exposed to strong competition from abroad, either because they export most of their products or they sell their products domestically under strong foreign competition. He states that there is no clear-cut line of division between the two groups, and arbitrary decisions cannot be completely avoided.

[6] The same classification is implied using an openness indicator that includes imports along with exports, as sector 37 registers no imports and sector 22 has an average share of imports plus exports in GVA of only 35% (the lowest corresponding ratio in a single sector included in the exporting group equals 81%).

Figure 1 presents real gross wages by groups of sectors. It should be noted that, in the period 1994-99, immediately following the implementation of the stabilization program in Croatia, real wages increased at higher rates than the real GDP. The crisis in 1999 was an introduction of changes in wage policy, especially in the public sector, and hence after 2000, overall real wage increases were held below real GDP growth (Nestić, 2009). This implies a potential wage leading role of the public sector in the Croatian wage setting process. However, this claim has been derived based on the overall macroeconomic data, without considering specific sectoral developments and has not been thoroughly tested.

Figure 1: Weighted average real gross wages by groups of sectors, seasonally adjusted, HRK




As shown in Figure 1, the diverging wage developments in the first part of the observed period were primarily due to a strong increase in government and SOE sector wages in 1998-99. Real wage growth in this group became negative in 2000-01, which was a part of the policies that Croatia implemented in the context of its request for financial support from the IMF at the time. Parallel to these developments, real wages in the private sheltered and exporting groups of sectors began increasing at a higher pace. After 2002, wages in different groups of sectors began moving in a more parallel fashion.

Table 1 presents percent changes in some important variables by groups of sectors. Growth in real GVA was the strongest in private sheltered sectors, accompanied by the largest increase in employment. Labor productivity gains (defined as the change in real GVA and employment ratio) in exporting sectors were partly caused by declining employment. Because the government and SOE sectors did not substantially contribute to new employment over the period under study, one can conclude that the boom among private sheltered sectors may have drawn labor from (some) exporting industries, although real gross wages growth across all groups of sectors was of similar magnitude.[7] The resulting difference between labor productivity and real gross wage growth was positive for all groups except for the government and SOE sectors.[8]

Table 1: Growth of some relevant variables by groups of sectors, 1998-2007, in %

| | (1) Real GVA | (2) Employment | (3) Labor productivity | (4) Real gross wages | (3) – (4) |
|---|---|---|---|---|---|
| Exporting sectors | 31.57 | -7.17 | 41.74 | 33.34 | 8.39 |
| Sheltered sectors | 64.87 | 21.37 | 35.84 | 26.29 | 9.55 |
| Private sheltered | 87.54 | 39.59 | 34.35 | 28.10 | 6.25 |
| Government and SOE | 33.05 | 5.34 | 26.30 | 27.34 | -1.04 |

**Panel analysis**

We primarily rely on panel analysis in our econometric investigation of sectoral wage dynamics and intersectoral wage linkages. We use annual data for the period between 1998 and 2007. Our basic empirical model specification can generally be written as follows:

$$\Delta w_{it} = \alpha + \beta_1 \Delta w_{it-1} + \beta_2 \Delta w^{os}_{(-i)t} + \beta_3 \Delta u_t + \beta_4 \Delta lp_{it} + e_{it} \quad (1)$$

[7] It must be noted that the developments within groups of sectors can be very heterogeneous for individual economic activities. Indeed, descriptive statistics for individual exporting sectors, shown in Table A3 in the Appendix, reveal substantially divergent developments in different industries for some important variables, which must be taken into consideration when interpreting the results.

[8] We acknowledge the difficulties in measuring the GVA of government sectors that largely provide non-market services. We refrain from further discussion of this issue because we do not have alternative measures that could be used in this paper.

where *i* denotes individual sectors according to NCEA Rev. 1.1 (at the level of divisions), and *t* denotes time. The constant term is denoted by α, and the βs are the coefficients of the independent variables, while disturbances are denoted by $e_{it}$ and are assumed to be uncorrelated across sectors. We use real data, deflated by consumer price index, which enables us to exclude inflation from the independent variables. The dependent variable is the growth rate of real gross wages by individual sectors $\Delta w_{it}$, which is also included as an independent variable with a lag: $\Delta w_{it-1}$. The second independent variable is the growth of the weighted average real gross wage in sectors other than *i* and is denoted by $\Delta w^{os}_{(-i)t}$ (*os* stands for *other sectors*). Depending on the (sub)sample and specification, sectors other than *i* may refer to (a) all sectors other than *i* or sectors other than *i* within a group of sectors, in which case the value of this variable depends on *i* and is denoted by $\Delta w^{os}_{-it}$, or (b) sectors in different groups of sectors to which *i* does not belong (in which case the variable is cross-sectionally invariant and should be denoted in Eq. 1 as $\Delta w^{os}_{t}$). We further include change in the unemployment rate $\Delta u_t$ and the real growth of sectoral labor productivity $\Delta lp_{it}$. We also add two additional control variables: the ratio of exports to GVA in sector *i* (in regressions for the full sample and for exporting sectors), denoted by $exp_{it}$, and the public employment share in sector *i* $pub_{it}$ (see Table A4 in the Appendix for an exact description of the variables).

Our empirical model mostly resembles those in Graafland and Lever (1996) and Bemmels and Zaidi (1990), which also use sectoral data for a single country. There are a few differences with respect to the inclusion and definition of some variables, the most important of which are discussed in the remainder of this section. Studies adopting similar approaches (e.g., Graafland and Lever, 1996; or Stockhammer and Onaran, 2009) use the macroeconomic wage rate as an explanatory variable to capture the effect of external forces in wage formation. We elect to employ growth in the weighted average real wage in sectors other than *i* (or in other groups of sectors). In this way, we avoid the potential endogeneity problem that would arise if wage growth in sector *i* were to significantly affect the growth of the

macroeconomic wage (or of the weighted average wage for groups of sectors). The simple correlation coefficient between the growth in the macroeconomic wage and growth in the weighted average wage in sectors other than *i* amounts to 0.95 for the full sample. With respect to the other macroeconomic variables used in related studies, we also include the change in the unemployment rate because it should (further) capture external forces affecting wage formation by specifically representing the labor market conditions. We do not use any other variable that does not vary across sectors, as we have only eight observations over time (we lose two due to differencing and lagging) that seems insufficient to reliably differentiate between the effects of more cross-sectionally invariant variables.

It should be noted that the real gross wage growth rates of individual sectors are generally not highly correlated with the growth rates of the weighted averages of real wages (whether in the full sample or in subsamples). Partial exceptions are the wage growth rates of individual sectors in the government and SOE group (see Table A5 in the Appendix). Thus, it is not in any way obvious, from simple correlation coefficients, that wage developments outside of individual sectors affect the growth rates of wages in single sectors.

We first estimated our model for the full sample and different subsamples using a pooled OLS estimator and testing for heteroskedasticity and serial correlation in the error term.[9] The null hypothesis of constant variance was strongly rejected, while serial correlation was present in some subsamples. Thereafter, we estimated the static version of our model (without the lagged dependent variable) for different samples using fixed and random effects estimators and tested for the significance of individual effects. Both the F test for fixed effects and the Breusch-Pagan Lagrangian multiplier test for random effects indicated the insignificance of individual effects. This implied that we can estimate our dynamic model, as presented in Eq. 1, by using a feasible Generalized Least Square (FGLS) linear panel data estimator robust to heteroskedasticity. Because serial correlation appeared to be a problem in

[9] We used the Breusch–Pagan/Cook–Weisberg test for heteroskedasticity and checked for serial correlation by regressing the residuals on their lagged values and their lagged values and a constant.

some subsamples, we run regressions using FGLS in which we assumed an AR1 process in the errors in such cases.[10]

The remainder of this section presents and discusses the results of FGLS panel data estimations for all sectors and different groups of sectors. The results for the full sample are presented in Table 2. In the first three specifications, we drop the growth in the weighted average real wage in all sectors except *i*, to determine the effect of its inclusion. In some specifications, we add exports and public employment variables.

Table 2: Results of FGLS panel estimations for all sectors

| Variables | Dependent variable: real gross wages growth ($\Delta w_{it}$) | | | | | |
|---|---|---|---|---|---|---|
| other sectors: | none | none | none | all except *i* | all except *i* | all except *i* |
| $\Delta w_{it-1}$ | 0.093** | 0.090** | 0.086** | 0.085** | 0.081** | 0.080** |
| | (0.040) | (0.040) | (0.040) | (0.040) | (0.040) | (0.039) |
| $\Delta w^{os}_{-it}$ | - | - | - | 0.442*** | 0.446*** | 0.458*** |
| | | | | (0.106) | (0.106) | (0.106) |
| $\Delta u_t$ | -0.318*** | -0.320*** | -0.268** | -0.305*** | -0.306*** | -0.249** |
| | (0.121) | (0.121) | (0.122) | (0.116) | (0.116) | (0.116) |
| $\Delta lp_{it}$ | 0.068*** | 0.068*** | 0.066*** | 0.063*** | 0.063*** | 0.061*** |
| | (0.013) | (0.013) | (0.014) | (0.013) | (0.013) | (0.013) |
| $exp_{it}$ | - | 0.001 | - | - | 0.001 | - |
| | | (0.002) | | | (0.002) | |
| $pub_{it}$ | - | - | -0.011** | - | - | -0.012*** |
| | | | (0.005) | | | (0.005) |
| constant | 2.442*** | 2.408*** | 2.801*** | 1.392*** | 1.343*** | 1.719*** |
| | (0.209) | (0.229) | (0.247) | (0.326) | (0.340) | (0.349) |
| Wald $\chi^2$ | 34.623 | 34.382 | 39.197 | 54.024 | 53.697 | 60.351 |
| obs. | 400 | 400 | 400 | 400 | 400 | 400 |

Notes: ***, ** and * denote significance at 1, 5 and 10% levels, respectively. Standard errors in ( ).

The results reveal that the lagged dependent variable is always highly significant, and that higher sectoral labor productivity increases lead to higher real wage growth. Wages also grow faster in sectors with a smaller share of public sector workers and in times of declining unemployment. The exports variable is never significant. The growth of the weighted average wage in other sectors is highly significant, with a coefficient of approximately 0.45, implying strong wage spillover effects. Its inclusion slightly reduces the estimated coefficients of most of the other variables, but it does not affect their significance.

[10] Another issue that we addressed was the potential endogeneity of labor productivity variable. We experimented with a number of different possible instruments using up to two lags of the instrumented variable, and the corresponding test after performing GMM IV estimation revealed that the null hypothesis of the variable being exogenous could never be rejected.

Tables 3 and 4 contain the estimation results for the subsamples of exporting and sheltered sectors, respectively. The results are obtained assuming an AR1 process in the error term. One notices systematic differences in the results for the two subsamples.

Table 3: Results of FGLS panel estimations for exporting sectors

| Variables | Dependent variable: real gross wages growth ($\Delta w_{it}$) | | | | | |
|---|---|---|---|---|---|---|
| other sectors: | none | all except *i* | exp. except *i* | sheltered | priv. sheltered | government and SOE |
| $\Delta w_{it-1}$ | 0.240*** | 0.234*** | 0.222*** | 0.236*** | 0.206*** | 0.240*** |
| | (0.066) | (0.066) | (0.066) | (0.066) | (0.065) | (0.066) |
| $\Delta w^{os}_{(-i)t}$ | | 0.228 | 0.442** | 0.106 | 0.478*** | -0.060 |
| | | (0.192) | (0.190) | (0.158) | (0.151) | (0.105) |
| $\Delta u_t$ | -0.041 | -0.018 | -0.179 | -0.022 | 0.142 | -0.057 |
| | (0.210) | (0.209) | (0.212) | (0.211) | (0.210) | (0.210) |
| $\Delta lp_{it}$ | 0.103*** | 0.100*** | 0.097*** | 0.102*** | 0.088*** | 0.104*** |
| | (0.023) | (0.023) | (0.022) | (0.023) | (0.023) | (0.022) |
| $exp_{it}$ | -0.002 | -0.002 | -0.001 | -0.002 | -0.002 | -0.002 |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| $pub_{it}$ | 0.012 | 0.013 | 0.002 | 0.013 | 0.006 | 0.010 |
| | (0.024) | (0.024) | (0.024) | (0.024) | (0.023) | (0.024) |
| constant | 2.363*** | 1.844*** | 0.704 | 2.167*** | 1.161* | 2.424*** |
| | (0.470) | (0.653) | (0.867) | (0.555) | (0.596) | (0.499) |
| Wald $\chi^2$ | 36.861 | 38.513 | 40.097 | 37.541 | 47.303 | 37.290 |
| obs. | 168 | 168 | 168 | 168 | 168 | 168 |

Notes: ***, ** and * denote significance at 1, 5 and 10% levels, respectively. Standard errors in ( ).

Table 4: Results of FGLS panel estimations for sheltered sectors

| Variables | Dependent variable: real gross wages growth ($\Delta w_{it}$) | | | |
|---|---|---|---|---|
| other sectors: | none | all except *i* | exporting | sheltered except *i* |
| $\Delta w_{it-1}$ | 0.008 | -0.007 | 0.024 | -0.010 |
| | (0.050) | (0.048) | (0.051) | (0.048) |
| $\Delta w^{os}_{(-i)t}$ | - | 0.557*** | 0.383** | 0.405*** |
| | | (0.130) | (0.155) | (0.107) |
| $\Delta u_t$ | -0.360** | -0.389** | -0.419*** | -0.352** |
| | (0.163) | (0.152) | (0.162) | (0.154) |
| $\Delta lp_{it}$ | 0.049*** | 0.043*** | 0.045*** | 0.045*** |
| | (0.016) | (0.016) | (0.016) | (0.016) |
| $pub_{it}$ | -0.012** | -0.013** | -0.013** | -0.013** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| constant | 3.055*** | 1.709*** | 1.657** | 2.296*** |
| | (0.375) | (0.477) | (0.690) | (0.412) |
| Wald $\chi^2$ | 18.198 | 38.025 | 24.132 | 33.765 |
| obs. | 232 | 232 | 232 | 232 |

Notes: ***, ** and * denote significance at 1, 5 and 10% levels, respectively. Standard errors in ( ).

Changes in the unemployment rate and the share of public sector employees are insignificant in the subsample of exporters, unlike for the sheltered sectors. Two sector-specific variables, labor productivity and the lagged wage growth, are highly significant in all the specifications for the group of exporting sectors. The coefficients for both of these variables are considerably higher than for the full sample and the subsample of sheltered sectors. The

exports variable is not significant. With respect to the intersectoral wage linkages, the growth rates of the weighted average wage in exporting sectors other than *i*, as well as of the private sheltered sectors, significantly affect wage growth in single exporting industries. The corresponding coefficients for the overall sheltered and government and SOE groups of sectors are insignificant. However, wage growth in all other sectors, in exporting sectors and in sheltered sectors other than *i*, positively and significantly affect wages in individual sheltered sectors.

We next present the separate regression results for the subsamples of private sheltered (Table 5) and government and SOE sectors (Table 6). The estimates for private sheltered sectors were obtained assuming an AR1 process in the error term. Again, we note systematic differences in the results. Wage developments in individual private sheltered sectors are significantly affected by changes in the unemployment rate,[11] labor productivity and wage developments in all sectors other than *i*, exporting sectors and private sheltered sectors other than *i*. Wage developments in the government and SOE sectors do not have a significant effect on wages in individual private sheltered sectors. There is no significant persistence in wage growth in private sheltered sectors, and the coefficient of the public employment share variable is also insignificant. Regarding the results for the subsample of government and SOE sectors, they are less stable with respect to the lagged wage growth and labor productivity variables across different specifications. The share of public sector employees becomes significant, with a higher (negative) coefficient than in any other (sub)sample, while the change in unemployment becomes insignificant across all specifications. Wage growth in sectors other than *i*, private sheltered sectors and government and SOE sectors other than *i* was highly significant, unlike wage developments in the exporting sectors.

[11] We note that the change in unemployment is not significant in the specification with wage growth in other private sectors. This may be due to a comparatively high simple correlation coefficient between these two variables (above 0.3). Excluding the change in unemployment from this regression does not affect the results for other variables, except that the coefficient of the labor productivity variable is slightly lower but insignificant.

Table 5: Results of FGLS panel estimations for private sheltered sectors

| Variables | Dependent variable: real gross wages growth ($\Delta w_{it}$) | | | | |
|---|---|---|---|---|---|
| other sectors: | none | all except *i* | exporting | priv. sheltered except *i* | government and SOE |
| $\Delta w_{it-1}$ | -0.050 | -0.064 | -0.039 | -0.071 | -0.052 |
| | (0.061) | (0.060) | (0.062) | (0.059) | (0.062) |
| $\Delta w^{os}_{(-i)t}$ | - | 0.431*** | 0.491** | 0.523*** | 0.092 |
| | | (0.163) | (0.196) | (0.139) | (0.104) |
| $\Delta u_t$ | -0.442** | -0.476** | -0.440** | -0.153 | -0.449** |
| | (0.205) | (0.196) | (0.204) | (0.205) | (0.211) |
| $\Delta lp_{it}$ | 0.043** | 0.044** | 0.035* | 0.032* | 0.043** |
| | (0.019) | (0.019) | (0.019) | (0.019) | (0.019) |
| $pub_{it}$ | 0.000 | 0.000 | -0.010 | -0.008 | 0.000 |
| | (0.020) | (0.020) | (0.020) | (0.020) | (0.019) |
| constant | 2.953*** | 1.898*** | 1.339* | 1.736*** | 2.785*** |
| | (0.472) | (0.607) | (0.811) | (0.561) | (0.513) |
| Wald $\chi^2$ | 9.652 | 17.533 | 14.859 | 24.616 | 9.857 |
| obs. | 136 | 136 | 136 | 136 | 136 |

Notes: ***, ** and * denote significance at 1, 5 and 10% levels, respectively. Standard errors in ( ).

Table 6: Results of FGLS panel estimations for government and SOE sectors

| Variables | Dependent variable: real gross wages growth ($\Delta w_{it}$) | | | | |
|---|---|---|---|---|---|
| other sectors: | none | all except *i* | exporting | priv. sheltered | government and SOE except *i* |
| $\Delta w_{it-1}$ | 0.127 | 0.174** | 0.169* | 0.209** | 0.117 |
| | (0.088) | (0.084) | (0.093) | (0.085) | (0.085) |
| $\Delta w^{os}_{(-i)t}$ | - | 0.917*** | 0.370 | 0.766*** | 0.427*** |
| | | (0.229) | (0.268) | (0.190) | (0.125) |
| $\Delta u_t$ | -0.275 | -0.316 | -0.433 | -0.165 | -0.151 |
| | (0.285) | (0.262) | (0.294) | (0.265) | (0.275) |
| $\Delta lp_{it}$ | 0.069** | 0.023 | 0.071** | 0.032 | 0.044 |
| | (0.032) | (0.030) | (0.031) | (0.026) | (0.033) |
| $pub_{it}$ | -0.040** | -0.040** | -0.039** | -0.041*** | -0.039** |
| | (0.016) | (0.016) | (0.016) | (0.015) | (0.016) |
| constant | 5.013*** | 2.649* | 3.446* | 2.804* | 4.379*** |
| | (1.403) | (1.532) | (1.777) | (1.433) | (1.477) |
| Wald $\chi^2$ | 16.543 | 30.259 | 19.254 | 36.030 | 25.905 |
| obs. | 96 | 96 | 96 | 96 | 96 |

Notes: ***, ** and * denote significance at 1, 5 and 10% levels, respectively. Standard errors in ( ).

It should be noted that we experimented with defining the government and SOE sector to include activities where the share of public sector employees is at least 90%, i.e., a broad private sheltered sector that includes activities with a corresponding share below 90%. The primary conclusions from the results in Table 5 also hold for a broader subsample of private sheltered sectors. The same is true with respect to the corresponding conclusions if, in tables 3-5, the independent weighted average real wage growth variables for the private sheltered and government and SOE groups of sectors are defined using the 90% share as a criterion.

We also experimented with the dynamic linear panel estimator from Arellano and Bond (1991). We formulated the model in log levels, i.e., shares of variables, and used a one-step estimator. Diagnostic tests implied that the estimates were not reliable and we disregarded these results that partly confirm our findings presented above. The two-step estimator performed even worse. Altering the set of instruments was not helpful.

**Time series analysis**

As a robustness check for a part of the panel analysis results, we further investigate the wage leadership of exporting vs. sheltered sectors using time series methods (as in Friberg, 2007; Lindquist and Vilhelmsson, 2006; D'Adamo, 2011; or Christou et al., 2007). We are able to use quarterly data on average wages between the first quarter of 1998 and the fourth quarter of 2008. Although we have an additional year of data, the number of observations is still relatively small, and the results have to be interpreted with some caution. Similar to Christou et al. (2007), we first specify an unrestricted bivariate vector autoregressive (VAR) model using the quarterly growth rates of seasonally adjusted data for the weighted average real gross wages in exporting and sheltered industries (denoted by $\Delta w_t^e$ and $\Delta w_t^s$, respectively). Subsequently, we specify a system with three equations and variables: exporting, private sheltered and government and SOE wage growth (denoted by $\Delta w_t^e$, $\Delta w_t^{ps}$ and $\Delta w_t^g$, respectively). In both models, we derive our conclusions based on the results of Granger causality/Block exogeneity tests. The VAR model with lag order p and k variables can generally be written as:

$$\mathbf{W}_t = \boldsymbol{\mu} + \mathbf{A}_1\mathbf{W}_{t-1} + \mathbf{A}_2\mathbf{W}_{t-2} + \cdots + \mathbf{A}_p\mathbf{W}_{t-p} + \mathbf{e}_t \qquad (2)$$

where $\mathbf{W}_t$ is a $(k \times 1)$ vector of variables, $\boldsymbol{\mu}$ is a $(k \times 1)$ vector of constants, each $\mathbf{A}$ is a $(k \times k)$ matrix of regression coefficients and $\mathbf{e}_t$ is a $(k \times 1)$ vector of error terms.

In the first VAR model (VAR1), $k = 2$ and $\mathbf{W}_t = [\Delta w_t^e, \Delta w_t^s]'$. In the second VAR model (VAR2), $k = 3$ and $\mathbf{W}_t = [\Delta w_t^e, \Delta w_t^{ps}, \Delta w_t^g]'$. For both models, we first test for the stationarity of the data using the augmented Dickey Fuller test (ADF). All series are found to

be I(0). We then select the optimal number of lags using different criteria and reasoning with respect to the context of this study.[12] In determining the lag order, we estimate a VAR with eight lags, thus restricting the maximal optimal number of lags to eight. After estimating the models with the selected lag order, we perform the Jarque-Bera test of the multivariate normality of the residuals ($H_0$: residuals are normally distributed) and the Lagrange multiplier autocorrelation tests of residuals ($H_0$: no serial correlation at lag order h for every $h \leq 8$). The results of the procedure tests are presented in the notes below Table 7, which summarizes the results of Granger-causality/Block exogeneity tests for both models.

Table 7: Results of Granger-causality/Block exogeneity tests in VAR models

| **Model VAR1 (p=6)** | | |
|---|---|---|
| Hypothesis: | $\chi^2$ test statistic | p-value |
| $\Delta w_t^e$ does not Granger-cause $\Delta w_t^s$ | 20.540 | 0.002 |
| $\Delta w_t^s$ does not Granger-cause $\Delta w_t^e$ | 3.407 | 0.756 |
| **Model VAR2 (p=6)** | | |
| Hypothesis: | $\chi^2$ test statistic | p-value |
| $\Delta w_t^{ps}$ does not Granger-cause $\Delta w_t^g$ | 3.985 | 0.679 |
| $\Delta w_t^e$ does not Granger-cause $\Delta w_t^g$ | 10.084 | 0.121 |
| $\Delta w_t^{ps}$ and $\Delta w_t^e$ do not jointly Granger-cause $\Delta w_t^g$ | 21.254 | 0.047 |
| $\Delta w_t^g$ does not Granger-cause $\Delta w_t^{ps}$ | 4.732 | 0.579 |
| $\Delta w_t^e$ does not Granger-cause $\Delta w_t^{ps}$ | 14.698 | 0.023 |
| $\Delta w_t^g$ and $\Delta w_t^e$ do not jointly Granger-cause $\Delta w_t^{ps}$ | 23.335 | 0.025 |
| $\Delta w_t^{ps}$ does not Granger-cause $\Delta w_t^e$ | 7.250 | 0.298 |
| $\Delta w_t^g$ does not Granger-cause $\Delta w_t^e$ | 8.618 | 0.196 |
| $\Delta w_t^{ps}$ and $\Delta w_t^g$ do not jointly Granger-cause $\Delta w_t^e$ | 15.572 | 0.212 |

Notes: For VAR1: AIC, LR and FPE imply six lags, SIC and HQ suggest zero and one. $H_0$ of the JB test cannot be rejected (p-value equals 0.941). The $H_0$ of the LM test cannot be rejected except for h=6 (rejected at the 10% significance level). For VAR2: All criteria imply six lags except for SIC, which suggests zero. $H_0$ of the JB test cannot be rejected (p-value equals 0.473). The $H_0$ of the LM test cannot be rejected except for h=5 (rejected at the 10% significance level).

The results for VAR1 show that we cannot reject the null hypothesis that sheltered sector wage growth does not Granger-cause exporting sector wage growth. The hypothesis of non-causality in the other direction is easily rejected. Thus, the results imply that the causality runs from exporting to sheltered sectors wages, but not vice versa. Regarding the VAR2 model, the

[12] We use: the Akaike information criterion (AIC); the Schwarz information criteria (SIC); Hannan-Quinn (HQ); Likelihood ratio tests (LR) and Final prediction error (FPE).

hypothesis that wage dynamics in private sheltered sectors or exporting sectors (considered separately) do not Granger-cause wages in the government sector cannot be rejected. However, the null hypothesis that these two sectors' wages do not jointly cause wages in the government sector is rejected at the 5% significance level. Similarly, the hypothesis that wage developments in exporting sectors, separately and jointly with government sector wages, do not Granger-cause wages in the private sheltered sectors is rejected. Finally, wages in the other two sectors do not affect wages in the exporting sector in the Granger sense.

In the next step, we perform a cointegration analysis exploring whether there is a long-term relationship between wages in different groups of sectors and whether, and how, wages adjust to deviations from the long-term equilibria. The Vector Error Correction (VEC) model of order p with k variables can be written as:

$$\mathrm{d}\mathbf{W}_t = \boldsymbol{\mu} + \boldsymbol{\pi}\mathbf{W}_{t-1} + \boldsymbol{\pi}_1\mathrm{d}\mathbf{W}_{t-1} + \boldsymbol{\pi}_2\mathrm{d}\mathbf{W}_{t-2} + \cdots + \boldsymbol{\pi}_p\mathrm{d}\mathbf{W}_{t-p} + \mathbf{e}_t \qquad (3)$$

where $\mathbf{W}_t$ is a $(k \times 1)$ vector of variables, $\boldsymbol{\mu}$ is a $(k \times 1)$ vector of constants, d denotes the first difference operator, each $\boldsymbol{\pi}$ is a $(k \times k)$ matrix of regression coefficients and $\mathbf{e}_t$ is a $(k \times 1)$ vector of error terms. In the first VEC model (VEC1), $k = 2$ and $\mathbf{W}_t = [w_t^e, w_t^s]'$, where $w_t^e$ and $w_t^s$ denote seasonally adjusted weighted average real gross wages in the exporting and sheltered sectors, respectively. In the second VEC model (VEC2), $k = 3$ and $\mathbf{W}_t = [w_t^e, w_t^{ps}, w_t^g]'$, where $w_t^{ps}$ and $w_t^g$ represent seasonally adjusted weighted average real gross wages in the private sheltered and government and SOE sectors, respectively.

The empirical approach again begins by employing ADF tests, which reveal that all of the series, i.e., the levels of weighted average real gross wages, are I(1). We then employ unrestricted VAR models with variables in levels (as recommended by Enders 2010, p. 401) to determine the optimal lag orders of five for the first, and four for the second model.[13] Next, we perform Johansen cointegration tests. We use a model with an intercept and no trend (in

[13] We refer to the VAR model described in Eq. 2 in which each Δw is replaced with w. For the VAR1 with levels of wages, AIC, LR and FPE point to an optimal lag order of five, while SIC and HQ suggest two lags. In the VAR2 model with levels of wages, AIC, FPE and HQ suggested eight lags, LR four and SIC one lag. We elect to proceed with four lags as an intermediate case, as selecting eight lags would be more data demanding.

the cointegrating equation and VAR), as suggested by the SIC criteria for both VEC1 and VEC2. The results are presented in Table 8 and show that we cannot reject the null hypothesis of at most one cointegrating vector at the 5% significance level (in the VEC1 model, the p-value is only marginally higher than 0.05).

Table 8: Results of the Johansen cointegration tests

| **Model VEC1 (p=5)** | | | | |
|---|---|---|---|---|
| Rank of $\boldsymbol{\pi}$ | Trace statistic | p-value | Max. eigenvalue stat. | p-value |
| 0 | 21.150 | 0.006 | 17.336 | 0.016 |
| 1 | 3.814 | 0.051 | 3.814 | 0.051 |
| **Model VEC2 (p=4)** | | | | |
| Rank of $\boldsymbol{\pi}$ | Trace statistic | p-value | Max. eigenvalue stat. | p-value |
| 0 | 42.434 | 0.001 | 28.167 | 0.004 |
| 1 | 14.265 | 0.076 | 9.428 | 0.252 |
| 2 | 4.837 | 0.028 | 4.837 | 0.028 |

We then estimate the VEC1 and VEC2 models, with the chosen lag order, including the long-term relationship found above. The coefficients of the cointegrating vector are normalized to the wages in the exporting sectors. The estimates are presented in Table 9.

Table 9: Estimated coefficients of the VEC models

| **Model VEC1 (p=5)** | | | | | | |
|---|---|---|---|---|---|---|
| Variables | Standardized cointegrating vector - $\boldsymbol{\beta}'$ | | | Standardized adjustment coefficients - $\boldsymbol{\alpha}$ | | |
| $w_t^e$ | 1.000 | - | - | -0.147 | (0.183) | [-0.805] |
| $w_t^s$ | -1.276 | (0.046) | [-28.037] | 0.185 | (0.068) | [2.738] |
| **Model VEC2 (p=4)** | | | | | | |
| Variables | Standardized cointegrating vector - $\boldsymbol{\beta}'$ | | | Standardized adjustment coefficients - $\boldsymbol{\alpha}$ | | |
| $w_t^e$ | 1.000 | - | - | -0.659 | (0.403) | [-1.635] |
| $w_t^{ps}$ | -0.978 | (0.039) | [-25.362] | 0.545 | (0.332) | [1.641] |
| $w_t^g$ | -0.048 | (0.050) | [-0.968] | 0.563 | (0.411) | [1.371] |

Notes: Standard errors in ( ) and t-statistics in [ ]. The $H_0$ of the JB test cannot be rejected (p-value equals 0.486 for VEC1 and 0.784 for VEC2). The $H_0$ of the LM test cannot be rejected for any $h \leq 8$ for both models.

For the VEC1 model, the adjustment coefficient of the sheltered sector wages is significant (t-statistic of 2.738), unlike the corresponding coefficient for exporting sector wages. Thus, $w_t^e$ is found to be weakly exogenous, and sheltered sector wages adjust to the equilibrium errors. This is confirmed by performing Likelihood ratio (LR) tests on restrictions

$\alpha = 0$, for both sectors' wages separately: the p-values equal 0.383 for exporting, and 0.006 for the sheltered sectors. In the VEC2 model, the t-statistics for $w_t^e$ and $w_t^{ps}$ adjustment coefficients suggest that these two coefficients are at the border of being significant at the 10% level, while the corresponding coefficient for government sector wages becomes insignificant. The p-values in the LR tests of restrictions $\alpha = 0$, for all three sectors' wages separately, equal 0.076 for exporting, 0.078 for private sheltered, and 0.117 for government sector wages. This implies that exporting and private sheltered sector wages adjust to deviations from the equilibrium, unlike government sector wages, although the small difference in p-values suggests that this conclusion should be interpreted with caution.

Table 10: Results of Granger-causality/Block exogeneity tests in VEC models

| **Model VEC1 (p=5)** | | |
|---|---|---|
| Hypothesis: | $\chi^2$ test statistic | p-value |
| $dw_t^e$ does not Granger-cause $dw_t^s$ | 15.179 | 0.010 |
| $dw_t^s$ does not Granger-cause $dw_t^e$ | 3.576 | 0.612 |
| **Model VEC2 (p=4)** | | |
| Hypothesis: | $\chi^2$ test statistic | p-value |
| $dw_t^{ps}$ does not Granger-cause $dw_t^g$ | 7.939 | 0.094 |
| $dw_t^e$ does not Granger-cause $dw_t^g$ | 7.119 | 0.130 |
| $dw_t^{ps}$ and $dw_t^e$ do not jointly Granger-cause $dw_t^g$ | 17.419 | 0.026 |
| $dw_t^g$ does not Granger-cause $dw_t^{ps}$ | 1.891 | 0.756 |
| $dw_t^e$ does not Granger-cause $dw_t^{ps}$ | 12.598 | 0.013 |
| $dw_t^g$ and $dw_t^e$ do not jointly Granger-cause $dw_t^{ps}$ | 17.254 | 0.028 |
| $dw_t^{ps}$ does not Granger-cause $dw_t^e$ | 3.937 | 0.415 |
| $dw_t^g$ does not Granger-cause $dw_t^e$ | 6.001 | 0.199 |
| $dw_t^{ps}$ and $dw_t^g$ do not jointly Granger-cause $dw_t^e$ | 10.538 | 0.229 |

In the final step, Granger-causality tests are repeated for the VEC models, checking for the short-run causality in the regressions including the long-term relationship variable. The results for both models, as presented in Table 10, confirm the findings from our unrestricted VAR models in Table 7. The only slight difference is that in the new results for the VEC2

model, the null hypothesis of no Granger causality running from private sheltered sector wages to wages in the government sector can be rejected at the 10% significance level.

## IV. Conclusions

This study explores the determinants of sectoral wage dynamics in Croatia, including intersectoral wage linkages. Given the unsatisfactory developments in the country's external trade, wage formation in the exporting sectors receives particular focus. The results of the panel estimations for the full sample reveal that external factors, primarily the wage dynamics in other sectors, play a comparatively more important role than sector specific factors in the wage formation in individual sectors. This is in line with findings of related research, e.g. Graafland and Lever (1996), or Stockhammer and Onaran (2009). The results for different subsamples are characterized by a large degree of heterogeneity. Overall, exporters are wage leaders, and sectoral labor productivity is a comparatively more important wage determinant for exporting than for the other sectors. Again, this corresponds to the Scandinavian model of wage determination (see Aukrust, 1977) and empirical findings from D'Adamo (2011) for some CEE countries. The only significant external factors for individual exporting industries are wage developments in other sectors within the exporting group and in private sheltered sectors. The finding that private sheltered sector wages affect wage growth in the exporting sectors is not confirmed by the Granger causality tests in our time series analysis. Given the diverging developments in individual exporting sectors, a potential explanation for the divergent results may be that wages in each sector of the exporting industry (dependent variable) all have equal weights in the panel estimations, while in the time series approach, we examine the impact of wages in other groups of sectors on growth in the weighted average of real gross wages in the exporting sectors. Although the exporting sectors are found to be overall wage leaders, the above findings and discussion may imply that wage increases in some, more successful exporting industries, and potentially also in private sheltered sectors,

do exert pressure on wages in other, less successful exporting sectors through some form of negative externality. This may be interpreted as a channel for the restructuring process within the exporting group of sectors and viewed as a positive development.

If such an interpretation is correct, one could consider introducing greater coordination in the wage setting system in Croatia to control for the intensity of the wage pressures, i.e., the speed of restructuring. The reason is that the overall export performance and, consequently, the trade balance need not improve if export growth in some sectors does not overcompensate for losses in less successful exporting industries. Given the country's commitment to a fixed exchange rate policy (due to high euroization), its political determination to join the European Union and eventually to adopt the Euro, policy options other than currency devaluation must be considered to improve the Croatian balance of trade. Reducing wages in the public sector does not appear to be a very useful tool in this context, as wages in the government and SOE sectors are never found to significantly influence wages in the rest of the economy. Moreover, higher share of public sector employees is associated with lower real wage growth rates. An instrument that may be able to generate improvements is a more coordinated wage setting system where the wage-increase norm is set while explicitly considering productivity developments in a broader group of exporting sectors, relieving the less successful exporters of the wage pressure from more successful ones. This would provide the successful exporters with an option to use the (additional) profits for investment in expanding production capacities, creating new employment and further increasing exports. A wage setting system with a similar feature is in place in Austria, where the wage leading metal sector bases its negotiations on broader productivity developments in the economy (which tend to be lower than in metal sector) when setting the norm for wage increases (Knell and Stiglbauer, 2009b). Additionally, one should analyze the determinants of labor productivity of the exporting industries and consider implementing some productivity enhancing policy measures.

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# Appendix

**Table A1: List of sectors (NCEA 2002)**

| | |
|---|---|
| D | Manufacturing |
| 15 | Manufacture of food products and beverages |
| 16 | Manufacture of tobacco products |
| 17 | Manufacture of textiles |
| 18 | Manufacture of wearing apparel; dressing and dyeing of fur |
| 19 | Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear |
| 20 | Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials |
| 21 | Manufacture of pulp, paper and paper products |
| 22 | Publishing, printing and reproduction of recorded media |
| 23 | Manufacture of coke, refined petroleum products and nuclear fuel |
| 24 | Manufacture of chemicals and chemical products |
| 25 | Manufacture of rubber and plastic products |
| 26 | Manufacture of other non-metallic mineral products |
| 27 | Manufacture of basic metals |
| 28 | Manufacture of fabricated metal products, except machinery and equipment |
| 29 | Manufacture of machinery and equipment n.e.c. |
| 30 | Manufacture of office machinery and computer |
| 31 | Manufacture of electrical machinery and apparatus n.e.c. |
| 32 | Manufacture of radio, television and communication equipment and apparatus |
| 33 | Manufacture of medical, precision and optical instruments, watches and clocks |
| 34 | Manufacture of motor vehicles, trailers and semi-trailers |
| 35 | Manufacture of other transport equipment |
| 36 | Manufacture of furniture; manufacturing n.e.c. |
| 37 | Recycling |
| E | Electricity, gas and water supply |
| 40 | Electricity, gas, steam and hot water supply |
| 41 | Collection, purification and distribution of water |
| F | Construction |
| 45 | Construction |
| G | Wholesale and retail trade, repair of motor vehicles; motorcycles and personal and household goods |
| 50 | Sale, maintenance and repair of motor vehicles, motorcycles; retail sale of automotive fuel |
| 51 | Wholesale trade and commission trade, except of motor vehicles and motorcycles |
| 52 | Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods |
| H | Hotels and restaurants |
| 55 | Hotels and restaurants |
| I | Transport, storage and communication |
| 60 | Land transport; transport via pipelines |
| 61 | Water transport |
| 62 | Air transport |
| 63 | Supporting and auxiliary transport activities; activities of travel agencies |
| 64 | Post and telecommunications |
| J | Financial intermediation |
| 65 | Financial intermediation, except insurance and pension funding |
| 66 | Insurance and pension funding, except compulsory social security |
| 67 | Activities auxiliary to financial intermediation |
| K | Real estate, renting and business activities |
| 70 | Real estate activities |
| 71 | Renting of machinery and equipment without operator and of personal and household goods |
| 72 | Computer and related activities |
| 73 | Research and development |
| 74 | Other business activities |
| L | Public administration and defense; compulsory social security |
| 75 | Public administration and defense; compulsory social security |
| M | Education |
| 80 | Education |
| N | Health and social work |
| 85 | Health and social work |
| O | Other community, social and personal service activities |
| 90 | Sewage and refuse disposal, sanitation and similar activities |
| 91 | Activities of membership organization n.e.c. |
| 92 | Recreational, cultural and sporting activities |
| 93 | Other service activities |

**Table A2: Definitions of groups of sectors**

| | |
|---|---|
| Exporting sectors: | sectors in which the average value of exports over the whole period exceeds 40% of gross value added – all manufacturing sectors except for 22 and 37. |
| Sheltered sectors: | all sectors 15-93 except for exporting sectors. |
| Private sheltered sectors: | sheltered sectors in which average public employment does not exceed 50% of total employment – sheltered sectors except for 40-41; 60; 63-64; 73; 75-85; 90-92. |
| Government and state owned enterprises (SOE): | sheltered sectors in which average public employment exceeds 50% of total employment – 40-41; 60; 63-64; 73; 75-85; 90-92. |

**Table A3: Descriptive statistics for growth of variables in exporting sectors, 1998-2007, in%**

| | Single sectors | | | | | All exporting sectors (total or weighted average) |
|---|---|---|---|---|---|---|
| | Average | Median | St. dev. | Max. | Min. | |
| (1) Real GVA | 44.94 | 46.45 | 36.18 | 108.50 | -24.05 | 31.57 |
| (2) Real exports | 122.91 | 99.17 | 151.18 | 698.16 | -57.01 | 68.32 |
| (3) Employment | -4.82 | -6.91 | 28.59 | 62.16 | -49.77 | -7.17 |
| (4) Labor productivity | 59.53 | 50.42 | 51.02 | 243.45 | 3.93 | 41.74 |
| (5) Real gross wages | 37.04 | 31.38 | 28.38 | 138.27 | 2.65 | 33.34 |
| (6) = (4) – (5) | 22.50 | 12.75 | 56.43 | 221.21 | -49.35 | 8.39 |

**Table A4: Definitions of variables**

| | |
|---|---|
| $\Delta w_{it-1}$ | growth of real gross wages (in sector *i* and period *t*); in %; by single sectors; deflated using consumer price index (CPI); source: Croatian Bureau of Statistics (CBS). |
| $\Delta w^{os}_{(-i)t}$ | growth of weighted average real gross wages (in period *t*) in all other sectors except for sector *i* (in the whole sample, or in a subsample); by single sectors; or in other groups of sectors to which sector *i* is not assigned (in this case the variable is cross-section invariant); in %; deflated using CPI; source: CBS. |
| $\Delta u_t$ | change in unemployment rate (ILO methodology, persons above 15 years of age); in %; source: CBS. |
| $\Delta lp_{it}$ | growth of real labor productivity (in sector *i* and period *t*) as defined by real gross value added divided by the number of employees; in %; by single sectors; deflated using consumer price index; source: CBS. |
| $exp_{it}$ | ratio of exports and gross value added (in sector *i* and period *t*); in %; by single exporting sectors; source CBS. |
| $pub_{it}$ | share of employees in publicly owned entities in total employment (in sector *i* and period *t*); in %; by single sectors; source: CBS. |

**Table A5: Simple correlation coefficients**

| Weighted average real gross wage growth for: | Real gross wage growth in single sectors in (sub)sample of: | | | | |
|---|---|---|---|---|---|
| | All sectors | Exporting | Sheltered | Private sheltered | Government and SOE |
| All sectors | 0.04 | -0.13 | 0.15 | 0.01 | 0.51 |
| All except *i* | 0.00 | -0.12 | 0.08 | -0.03 | 0.36 |
| Exporting | 0.13 | 0.32 | 0.00 | 0.10 | -0.24 |
| Sheltered | 0.01 | -0.16 | 0.13 | -0.02 | 0.49 |
| Private sheltered | 0.14 | 0.20 | 0.11 | 0.14 | 0.03 |
| Government and SOE | -0.04 | -0.22 | 0.09 | -0.07 | 0.47 |