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WAGE DYNAMICS NETWORK

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by Ernestas Virbickas

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2 Bank of Lithuania, Gedimino pr. 6, LT-01103 Vilnius, Lithuania, e-mail: evirbickas@lb.lt

Wage Dynamics Network

This paper contains research conducted within the Wage Dynamics Network (WDN). The WDN is a research network consisting of economists from the European Central Bank (ECB) and the national central banks (NCBs) of the EU countries. The WDN aims at studying in depth the features and sources of wage and labour cost dynamics and their implications for monetary policy. The specific objectives of the network are: i) identifying the sources and features of wage and labour cost dynamics that are most relevant for monetary policy and ii) clarifying the relationship between wages, labour costs and prices both at the firm and macro-economic level.

The WDN is chaired by Frank Smets (ECB). Giuseppe Bertola (Università di Torino) and Julián Messina (World Bank and University of Girona) act as external consultants and Ana Lamo (ECB) as Secretary.

The refereeing process of this paper has been co-ordinated by a team composed of Gabriel Fagan (ECB, chairperson), Philip Vermeulen (ECB), Giuseppe Bertola, Julián Messina, Jan Babecký (CNB), Hervé Le Bihan (Banque de France) and Thomas Mathä (Banque centrale du Luxembourg).

The paper is released in order to make the results of WDN research generally available, in preliminary form, to encourage comments and suggestions prior to final publication. The views expressed in the paper are the author's own and do not necessarily reflect those of the ESCB.

Address
Kaiserstrasse 29
60311 Frankfurt am Main, Germany

Postal address
Postfach 16 03 19
60066 Frankfurt am Main, Germany

Telephone
+49 69 1344 0

Internet
http://www.ecb.europa.eu

Fax
+49 69 1344 6000

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Abstract

This paper investigates the wage and price setting behaviour of Lithuanian firms on the basis of an ad hoc survey "On Price and Wage Setting" undertaken by the Bank of Lithuania. The paper provides survey evidence on the frequency of wage and price changes. The frequency of wage changes turns out to be higher in firms that apply collective pay agreements, while the frequency of price changes appears to be positively affected by the market competition. Labour cost share is not found to be significant in making the impact on the frequency of price changes. This paper also investigates the role of certain technological, institutional and other factors in shaping firms' responses to a negative demand shock, an intermediate input cost shock and a wage shock. A higher labour cost share is found to increase the likelihood of a price increase following a wage shock. Flexible wage components mitigate firms' responses to a slowdown in demand and an intermediate input cost increase. The behaviour of firms following the investigated shocks is also affected by the level of competition. The role of collective pay agreements appears to be rather limited in shaping responses of firms to the shocks.

Keywords: wage setting, price setting, labour costs.

JEL classification: D40, J30.

Non-technical summary

The purpose of this paper is to determine the patterns of wage and price setting in Lithuanian firms, identifying, among others, the technological, institutional and market competition factors that lie behind the behaviour of firms. The paper uses a unique dataset obtained from an ad hoc survey of the Bank of Lithuania "On Price and Wage Setting", conducted within the Wage Dynamics Network.

The analysis is conducted by investigating two subsets of the survey data. The first one relates to the frequency of wage and price changes. Frequency of these changes represents the outcome of wage and price setting and might be viewed as a measure of wage and price rigidity. Therefore this paper explores the survey data to investigate the patterns of wage and price changes.

The other targeted subset of the data relates to the responses of firms to economic shocks. These shocks include a slowdown in demand, an increase in intermediate input cost and an increase in wages. This paper attempts to figure out the role of some of the technological, institutional and other factors in determining the channels of adjustment following these economic shocks. Throughout the analysis particular attention is paid to the relationship between labour costs and prices.

The analysis shows that in Lithuania most of wage changes occur due to reasons other than tenure or inflation. In slightly more than 40 percent of the surveyed firms wages are changed once a year and in approximately the same share of firms wages are changed more than once a year. The frequency of wage changes appears to be higher in firms that apply collective pay agreements.

The survey reveals that in approximately one third of the firms the frequency of price changes does not follow any specific pattern. In approximately one quarter of the firms prices are changed on a quarterly to half yearly basis, and in approximately one fifth of the firms prices are changed once a year. The frequency of price changes is positively affected by the market competition.

It is found out that Lithuanian firms tend to use performance-related bonuses as a form of labour compensation. 73.5 percent of the firms use flexible wage components, which account for 17.1 percent of the total wage bill. Regression analysis reveals that higher flexible wage share mitigates firms' responses to a slowdown in demand and an intermediate input cost increase.

The study points out a relatively low presence of collective pay agreements in Lithuanian firms. Approximately one quarter of the firms apply collective pay agreements signed at the firm level, while collective pay agreements are very rare at the national level. In the surveyed firms collective agreement coverage amounts to 15.7 percent of employees. The role of collective pay agreements is found to be rather limited in shaping the responses of firms to economic shocks.

The analysis shows the importance of competition in the behaviour of Lithuanian firms. It is found out that higher competition level increases the likelihood of price decrease following a negative demand shock. Greater exposure to foreign markets, which is associated with higher competition pressures, tends to lower the likelihood of a price increase in response to cost shocks. Competition and exposure to foreign markets is also found to be important in fostering adjustment through margins.

The survey yields somewhat mixed evidence on the relationship between labour costs and prices. Analysis shows that a considerable share of the surveyed firms would increase prices in response to the wage shock. The labour cost share is found to be an important determinant of price increase in response to this shock. However labour cost share is not found to be significant in affecting the frequency of price changes.

Introduction

Nominal rigidities play an important role in the transmission of economic shocks. A higher degree of wage and price rigidity makes economic adjustment less efficient and less smooth. The level of flexibility of these variables is especially important for a country that belongs to a monetary union or maintains exchange rate fixed, like Lithuania. When adjustment is not possible through the nominal exchange rate, wage and price setting becomes particularly significant for the transmission of shocks.

This paper investigates the wage and price setting behaviour of Lithuanian firms. It uses a unique dataset obtained from an ad hoc survey of the Bank of Lithuania "On Price and Wage Setting" conducted within the Wage Dynamics Network (WDN)[3]. This network is a research project coordinated by the European Central Bank that combines research efforts of a number of EU national central banks. To some extent this project is a follow-up to research conducted within Inflation Persistence Network (IPN). IPN findings suggested that wage persistence is an important factor behind price stickiness in the euro area (Altissimo et al. 2006). This led the WDN to investigate: (1) the sources and features of wage and labour cost dynamics, and (2) the relationship between wages and prices.

Micro studies on wage setting typically consider the extent of downward nominal wage rigidity and possible explanations for this phenomenon. In addition to questions on downward wage rigidity the WDN survey inquired information about the frequency and patterns of wage and price changes, thus extending possibilities to analyse wage and price rigidities and their relationship with the characteristics of firms. The survey also included questions on price, wage and employment reactions to certain economic shocks, thereby allowing to investigate the role of the technological, institutional and competitive environment in wage and price setting and the overall behaviour of firms. Some of the results covering most of the countries that carried out the WDN survey[4] are documented in Babecký et al. (2009a), Babecký et al. (2009b), Bertola et al. (2009), Druant et al. (2009), Galuščák et al. (2009).

The purpose of this paper is to determine the patterns of wage and price setting in Lithuanian firms, identifying, among others, the technological, institutional and market competition factors that lie behind the behaviour of firms. The analysis is conducted by investigating two subsets of the survey

[3] The survey questionnaire is available upon request.
[4] Between the end of 2007 and the first half of 2008 the WDN survey was carried out in 17 EU countries: Austria, Belgium, the Czech Republic, Estonia, France, Germany, Greece, Hungary, Italy, Ireland, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Slovenia, and Spain.

data. The first one deals with the frequency of wage and price changes. Frequency of these changes represents the outcome of wage and price setting and might be viewed as a measure of wage and price rigidity. Therefore this paper explores the survey data to investigate the patterns of wage and price changes. The other targeted subset of the data relates to the responses of firms to economic shocks. These shocks include a slowdown in demand, an increase in intermediate input cost and an increase in wages. This paper attempts to figure out the role of some of the technological, institutional and other factors (such as the labour cost share, the presence of collective pay agreements, the share of flexible wage components and market competition) in determining the adjustment channels following the economic shocks. Throughout the analysis particular attention is paid to the relationship between labour costs and prices. Some of the survey information, for instance, on downward nominal wage rigidity and on the wages of newly hired employees, is left for future investigation.

This paper is organised in the following way. Section 1 provides an overview of the survey conduct and describes some of the features of the employee structure and labour compensation in Lithuanian firms. The frequency of wage and price changes is investigated in Section 2. Section 3 deals with the analysis of the way in which adjustment takes place in response to a negative demand shock, an intermediate input cost shock and a wage shock. The main findings of this study are summarised in the concluding section.

1. Survey conduct and some of the results

The survey of the Bank of Lithuania "On Price and Wage Setting" was conducted in April and May 2008. It was carried out by contacting respondents by mail, telephone and face-to-face. When answering the questions, respondents were asked to refer to their operational activities during the calendar year of 2007. This period was marked by a particularly strong economic expansion, which had been continuing for a number of years. At that time labour market of Lithuania was undergoing exceptionally severe pressures as the level of unemployment was notably low and the vacancy rate was reaching a peak. This was a period of the elevated growth rates of wages and prices.

Firms satisfying certain criteria were stratified according to economic activity (Sections D-K of NACE rev. 1.1)[5] and firm size (as measured by the number of employees, with size brackets of 5-19, 20-49, 50-149, 150-249 and 250 or more employees). Firms operating in agriculture and fishing (Sections A and B of NACE rev. 1.1) were not targeted since many self-employed people work in these activities, for whom wage determination is not a real issue. Mining and quarrying (Section C of NACE rev. 1.1) was excluded due to the relatively small number of firms operating in this activity. Firms operating in public administration, education and health care (Sections L-N of NACE rev. 1.1) were not targeted since wage formation in public services does not have a significant influence on

[5] In this paper, unless otherwise stated, "manufacturing" refers to manufacturing and supply of electricity, gas and water (Sections D and E of NACE rev. 1.1); "construction" and "trade" are self-explanatory (Sections F and G of NACE rev. 1.1); "business services" refer to other market services (Sections H-K of NACE rev. 1.1).

prices in these activities. Small firms (with up to 5 employees) were excluded since many of them are sole proprietorships with simplified operational activities. Sole proprietorships were not targeted. In total 2,810 firms were contacted. The targeted sample was 500 firms. However, some of them provided incomplete answers, so that the responses of only 343 firms were used in the analysis. In other words the realised sample consists of 343 firms. The composition of the realised sample of firms is provided in Appendix 1 (Tables A1-A2).

In terms of number of firms, the realised sample mostly consists of small firms (with up to 19 employees). In this sample there are 97 manufacturing, 27 construction, 104 trade and 115 business services firms. In the realised sample the highest share of employees work in large companies (with 50 or more employees). In this sample most of the employees work in business services and manufacturing.

To ensure that the realised sample reflects as closely as possible the distribution of the total population of firms, in this paper descriptive analysis is based on firms' responses that are weighted by employment-adjusted sampling weights. These weights adjust for the different probability of firms ending up in the realised sample and also adjust the realised sample to make the employees it covers representative of the total population.

Table 1 summarises some of the employee structure and labour compensation features of the surveyed firms. The survey showed that flexible forms of employment are applied for approximately 13 percent of employees. In the surveyed firms 9.1 percent of the employees are part-time permanent workers and 3.8 percent are temporary workers. Flexible forms of employment are more popular in business services, where 14 percent of employees are part-time permanent workers and 5 percent are temporary workers. In other economic activities the use of such forms of employment is less popular.

According to the survey, in terms of occupational groups most of the employees fall into the categories of low-skilled and high-skilled blue-collar employees. Low-skilled blue-collar employees account for more than half of the employees in manufacturing, while high-skilled blue-collar employees constitute more than 40 percent of the employees in construction. Another substantial share of employees is made up of high-skilled white-collar employees, who are more widely employed by business services firms.

The survey showed that quite a sizable share of firms use flexible forms of remuneration. More than one third of the firms use piece-rate remuneration and another 16.4 percent of the firms use hourly remuneration as the main form of employee compensation. Piece-rate remuneration is more popular in construction and manufacturing, while hourly wages are more common in business services. The firms also indicated rather widespread use of performance-related bonuses. Flexible wage components (performance-related bonuses) are used by 73.5 percent of the firms, and they account for 17.1 percent of the total wage bill. The highest share of wages paid through performance-related bonuses is observed in construction as well as in trade and business services.

Approximately half of the surveyed firms use a policy that adapts changes in base wages to inflation. Except in business services, wage changes are mostly adapted to past rather than expected

inflation. Relatively widespread use of this policy during the reference period of the survey (the year of 2007) may tentatively be explained by the rather high inflation rate at that time. The latter might also explain relatively more popular use of informal (non-automatic) rules to account for inflation when adjusting wages.

The survey also pointed out rather low presence of collective pay agreements in the investigated firms. It was found out that approximately one quarter of the firms apply collective pay agreements signed at the firm level, while collective pay agreements are very rare at the national level. In the surveyed firms the coverage by these agreements amounts to 15.7 percent of employees. The presence of collective pay agreements and the highest coverage are mostly observed in business services.

Table 1. Selected indicators of the surveyed firms (percent)

	Manufac-turing	Construc-tion	Trade	Business services	Total
Employees by employment status:					
share of full-time permanent employees	90.4	93.5	88.4	81.0	87.1
share of part-time permanent employees	5.4	3.2	9.8	14.0	9.1
share of temporary employees	4.2	3.3	1.7	5.0	3.8
Employees by occupational group:					
share of low-skilled blue-collar employees	51.3	31.8	30.3	32.0	37.2
share of high-skilled blue-collar employees	25.6	40.5	24.9	25.2	27.4
share of low-skilled white-collar employees	6.8	5.9	8.5	6.5	6.9
share of high-skilled white-collar employees	10.8	15.3	20.0	29.8	20.2
Labour compensation principles:					
share of firms paying hourly base wages	16.9	8.6	8.0	24.1	16.4
share of firms paying piece-rate base wages	45.7	68.2	27.8	24.5	37.4
share of firms paying monthly base wages	37.4	23.3	63.7	50.0	45.6
Use of performance-related bonuses:					
share of firms paying bonuses	70.7	92.1	72.7	68.8	73.5
share of bonuses in total wage bill	10.0	27.4	18.5	18.1	17.1
Use of policies to adapt changes in wages to inflation:					
share of firms in which wage changes are automatically linked to					
past inflation	8.4	2.0	3.3	10.5	7.1
expected inflation	1.0	6.3	1.4	6.1	3.6
share of firms in which there is no formal rule however wage changes take into account					
past inflation	30.3	38.9	34.1	9.8	25.0
expected inflation	7.3	9.8	11.4	19.5	12.9
share of firms that do not use such policies	53.0	43.0	49.9	54.5	51.5
Application of collective pay agreements:					
share of firms applying collective pay agreements signed at the national level	0.2	2.0	1.1	0.9	0.9
share of firms applying collective pay agreements signed at the firm level	21.9	8.6	23.1	32.1	24.0
share of employees covered by collective pay agreements	15.4	5.4	16.5	19.6	15.7

Notes: Responses are employment-weighted and rescaled to exclude non-responses.
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's calculations.

2. Frequency of wage and price changes

The frequency of wage and price changes might be viewed as a measure of wage and price rigidity (studies on these issues include Blinder et al. 1998, Bils and Klenow 2004, Vermeulen et al. 2007, Dhyne et al. 2006, Fabiani et al. 2006, Druant et al. 2009). A shorter period during which wage or price is not changed might imply that wage or price is more flexible, i.e. wage or price setting is more sensitive to economic shocks. On the other hand, a longer period during which wage or price is not changed, i.e. longer wage or price duration, need not necessarily imply greater rigidity. It might be due to the absence of economic shocks. Thus, the frequency of wage and price changes is not a perfect measure of nominal rigidities. Nevertheless, the frequency of these changes does represent the outcome of wage and price setting, which heavily depends on the degree of flexibility in the decision-making on wages and prices.

The WDN survey explicitly asked the firms how frequently the base wage is typically changed. Respondents were asked to indicate whether change occurs (1) more than once a year, (2) once a year, (3) once every two years, (4) less frequently than once every two years or (5) change never occurs or pattern is not known. The survey asked the respondents to provide information on the frequency of wage changes due to tenure, due to inflation and due to reasons other than tenure and inflation.

As shown in Table 2, the surveyed Lithuanian firms reported that most of wage changes occur due to reasons other than tenure and inflation. This was the answer given by 78.9 percent of the firms. Due to reasons other than tenure and inflation wage is typically changed once a year or more frequently than once a year. This pattern of frequency of wage changes is quite similar across economic activities.

Due to inflation wages are changed in 60.7 percent of the firms. Due to this reason change in wages mostly occurs once in a year. This is observed in all economic activities. As reported by the firms, the least common are wage changes due to tenure. This is observed in slightly more than half of the surveyed firms. Due to tenure wage changes typically occur once a year or less frequently than once a year. Thus, due to tenure wages are changed less frequently than due to inflation and due to reasons other than tenure and inflation. A somewhat different wage setting pattern is observed in construction, where due to tenure wages are typically changed more frequently than once a year.

To get a perception on how frequently wages are changed in general, wage change frequencies across all investigated reasons were combined into one variable by assigning each firm the highest frequency of wage change irrespective the reason behind the change. It turned out that in Lithuania in slightly more than 40 percent of the surveyed firms wages are changed once a year and in approximately the same share of firms wages are changed more than once a year. A somewhat higher frequency of wage changes is observed in construction and manufacturing, while the frequency is somewhat lower in business services.

Table 2. Frequency of wage changes
(share of firms; percent)

	Wage change occurs:			
	more frequently than once a year	once a year	less frequently than once a year	never/don't know
Due to tenure:				
manufacturing	7.6	15.7	21.6	55.1
construction	19.7	18.4	9.5	52.4
trade	10.4	25.8	22.0	41.8
business services	3.1	28.4	19.6	49.0
total	8.3	22.8	19.3	49.7
Due to inflation:				
manufacturing	17.5	33.2	11.4	37.9
construction	21.6	51.2	4.0	23.3
trade	16.3	28.9	12.8	42.1
business services	16.2	27.4	11.4	45.0
total	17.3	32.7	10.7	39.3
Due to other reasons:				
manufacturing	29.0	37.0	8.2	25.8
construction	31.5	59.9	0.0	8.6
trade	29.4	29.6	16.0	25.1
business services	30.5	35.1	14.7	19.7
total	30.0	37.9	11.0	21.1
Due to all reasons:				
manufacturing	43.6	45.0	5.8	5.5
construction	54.8	43.2	2.0	0.0
trade	40.6	45.8	8.5	5.1
business services	38.0	41.6	10.2	10.3
total	42.5	43.7	7.4	6.3

Notes: Responses are employment-weighted and rescaled to exclude non-responses; frequencies of wage changes "due to all reasons" are calculated by assigning each firm the highest frequency of wage change irrespective the reason behind the change.
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's calculations.

Compared to the other countries, which conducted the surveys within the WDN, wages in Lithuania seem to be changed more frequently (Druant et al. 2009). As in Lithuania, in both euro area and non-euro area EU countries wages are typically changed once a year. However, in Lithuania a considerably larger part of firms change wages more frequently than once a year. One should keep in mind that in the case of the Lithuanian survey the respondents were asked to provide information based on their operational activities in 2007, a period of particularly strong economic growth and elevated inflation. This could have contributed to relatively high frequency of wage changes in Lithuania.

The WDN survey also explicitly asked the firms how frequently the price of the firm's main product is typically changed. Firms were asked to indicate whether change occurs (1) daily, (2) weekly, (3) monthly, (4) quarterly, (5) half yearly, (6) once a year, (7) once every two years, (8) less frequently than once every two years, (9) never or (10) there is no defined pattern.

The survey results show that in Lithuania in approximately one third of the firms the frequency of price changes does not follow any specific pattern. In approximately one quarter of the firms prices are changed on a quarterly to half yearly basis, and in approximately one fifth of the firms prices are changed once a year. Prices seem to be changed more frequently in manufacturing and less frequently in business services.

In comparison to the other countries, which undertaken the surveys within the WDN, prices in Lithuania appear to be changed more frequently (Druant et al. 2009). In both euro area and non-euro area countries prices are typically changed once a year while, as mentioned above, in Lithuania they are typically changed on a more frequent basis. It should be noted that some studies show that the frequency of price increases is positively associated with the level of inflation (Vermeulen et al. 2007, Dhyne et al. 2006). Elevated inflation during the reference period of the survey could have contributed to the higher frequency of price changes in Lithuania.

Table 3. Frequency of price changes
(share of firms; percent)

	Price change occurs:				
	daily to monthly	quarterly to half yearly	once a year	less frequently than once a year	never/no pattern
Manufacturing	6.8	39.0	13.7	13.9	26.6
Construction	2.0	37.0	28.2	0.0	32.8
Trade	18.9	15.5	15.0	2.1	48.5
Business services	6.8	21.3	26.0	20.9	25.1
Total	8.7	27.3	20.4	11.9	31.6

Notes: Responses are employment-weighted and rescaled to exclude non-responses.
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's calculations.

It should be noted that the surveyed firms included companies that make products and provide services not only for final consumers. Therefore, the frequency of price changes revealed by the WDN survey reflects changes in both producer and consumer prices.

Wages or prices might adjust less sensitively in response to economic shocks if adjustments occur in a predefined pattern. Wages or prices might become less flexible if they are changed in a time-dependent way. Therefore, along with questions about the frequency of wage and price changes, the WDN survey also asked the firms whether wage and price changes occur in any particular month(s).

The survey revealed that in Lithuania 16.9 percent of the firms typically change wages in a particular month, while prices are changed in a particular month by 14.9 percent of the firms. In almost two thirds of the time-dependent firms wages are typically changed in January, while the first month of the year was indicated as the month in which prices are typically changed by almost half of the time-dependent firms. Other peaks occur at the beginning of the other quarters of the year, i.e. in April, July, and October. Adjustment of wages and prices appears to be more time-dependent in construction firms.

As documented in Druant et al. (2009), time-dependence of wage and price changes in Lithuania stands at a relatively low level compared to the other countries that carried out the WDN survey. It is considerably lower than on average in euro area countries, where wages and prices are typically changed in a particular month(s) in more than 60 percent and more than 40 percent of the firms respectively. It is also somewhat lower than on average in non-euro area countries.

Table 4. Share of firms reporting that wage and price changes occur in a particular month(s) (percent)

	Wage change	Price change
Manufacturing	15.1	10.7
Construction	23.6	23.6
Trade	10.1	13.9
Business services	19.8	15.6
Total	16.9	14.9

Notes: Responses are employment-weighted and rescaled to exclude non-responses.
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's calculations.

The frequency of wage and price changes might be affected by a number of factors related to the firm's production technology, labour compensation settings, market competition and some other factors. To better understand the frequency of wage and price changes, these frequencies are modelled using ordered probits. Both models (i.e. the model of the frequency of wage changes and the model of the frequency of price changes) include three sets of explanatory variables: one accounting for differences in production technologies; another reflecting labour compensation arrangements; and a third proxying market competition.

The set of explanatory variables that account for the differences in production technologies includes:

labour share – this is the share of the total costs of a firm that are incurred due to the hiring of employees (it includes wages, individual or company performance-related bonuses, social contributions, training expenses, etc.); this variable is expressed as a percentage;

trade firms and *services firms* – these are economic activity dummy variables; the dummy variable *trade firms* takes the value 1 if the firm is a trade firm (Section G of NACE rev. 1.1); the dummy variable *services firms* takes the value 1 if the firm is any other market services firm (Sections H-K of NACE rev. 1.1); otherwise these variables take the value 0; the reference category is manufacturing firms (Sections D-F of NACE rev. 1.1);

firms 20-49 and *firms 50 or more* – these are firm size dummy variables; these dummy variables take the value 1 if the number of employees in a firm is between 20 and 49 or 50 or more respectively and takes the value 0 otherwise; the reference category is those firms that employ up to 19 employees.

Labour compensation arrangements are reflected by two variables. One of them accounts for the presence of wage bargaining institutional setup. This variable – *collective pay agreements* – is constructed as a dummy variable that takes the value 1 if the firm applies a collective pay agreement signed outside the firm or signed at the firm and takes the value 0 if no collective pay agreement is applied. Another variable represents the use of flexible wage components. The variable *flexible wage share* is the share of total wage bill, which is due to individual or company performance-related bonuses. The latter variable is expressed as a percentage.

Market competition is captured by two variables. The variable *competition* is generated using the answers to the question whether the firm decreases its own price following the price decrease of the product of the main competitor. This variable is a dummy variable that takes the value 1 if the firm is "very likely" to decrease its price and takes the value 0 if the firm is "likely" or "not likely" to

decrease the price or responds "not at all". One more variable to capture competition pressures is related to the exposure of the firm to foreign markets. A higher share of revenue arising from sales in foreign markets might imply a more competitive environment. Therefore the *foreign sales share* is another way to proxy the intensity of the competition in the product market. The latter variable is expressed as a percentage.

In addition to the factors described above, the model of the frequency of wage changes also accounts for the presence of an institutional setting that adapts changes in base wages to inflation. The explanatory variable *policy to account for inflation* is constructed as a dummy variable that takes the value 1 if such kind of setting is used in a firm (i.e. wage changes are automatically linked to inflation or there is no formal rule however wage changes take into account inflation) and takes the value 0 if there is no such setting.

Apart from the three sets of explanatory variables outlined above, the model of the frequency of price changes also includes a variable reflecting price regulation. The explanatory variable *price regulation* is constructed as a dummy variable that takes the value 1 if a firm does not have an autonomous price setting policy (the price is regulated by the state, set by a parent company or set by a main customer(s)) and takes the value 0 if the price is set following the main competitors or the price is set according to the costs and a self-determined profit margin.

In both models (i.e. in the model of frequency of wage changes and in the model of frequency of price changes) the dependent variable[6] is the categorical variable that increases with the frequency of wage and price changes: 1 = wage or price is changed less frequently than once a year, 2 = wage or price is changed once a year, 3 = wage or price is changed more frequently than once a year. As in the analysis above, the variable that reflects the frequency of wage changes is constructed by assigning each firm the highest frequency of wage change irrespective the reason behind the change.

Estimation results are provided in Appendix 3. For simplicity purposes, the analysis is limited to the marginal effects on the highest probability cell. In particular, Table A3 provides only the marginal effects on the probability that wage or price change occurs more frequently than once a year.

Regression analysis shows that the frequency of wage changes is affected by the institutional features of the firms. In particular, the frequency of wage changes is more likely to be higher in firms that apply collective pay agreements and in firms that adapt changes in base wages to inflation. The statistically significant role of the presence of collective pay agreements is in line with the fact that most of these agreements are signed at the firm level (rather than the national level), which enable to bargain for wages on a more frequent basis. As the changes in wages mostly reflect upward revisions, the presence of these agreements, along with the other factors, mostly contributes to more frequent increases in wages. Analysis also shows that wages are more likely to be changed more frequently in larger firms compared to smaller ones.

[6] The survey questions used to construct the dependent variables are provided in Appendix 2.

The frequency of price changes is found to be positively affected by market competition. It is affected negatively by price regulation. Analysis shows that services firms tend to change prices less frequently than manufacturing firms. Contrary to the IPN findings on price setting in the euro area (Vermeulen et al. 2007) and the WDN findings based on a broader range of countries (Druant et al. 2009), the labour cost share does not appear to be significant in affecting the frequency of price changes in Lithuanian firms.

To check the robustness of the results described above, both regressions were estimated using different definitions of the dependent variables. The dependent variables were constructed as binary variables: 0 = wage or price is changed less frequently than once a year or once a year, 1 = wage or price is changed more frequently than once a year. Robustness analysis revealed that, contrary to the results described above, it cannot be concluded that wages are changed more frequently in firms that adapt changes in base wages to inflation and in larger firms. It also turned out that under different definition of the dependent variable it is not possible to conclude that the presence of price regulation affects the frequency of price changes.

3. Response to economic shocks

For a better understanding of wage and price setting and the overall behaviour of firms, the survey included several questions on the possible adjustment channels that may be used when responding to economic shocks. The responses to these questions, combined with the available covariates, might reveal the role of certain facilitators as well as impediments stemming from characteristics of firms when reacting to changes in economic environment.

The survey asked respondents how relevant certain strategies are when the firm faces three types of shocks: (1) an unanticipated slowdown in demand; (2) an unanticipated increase in the cost of an intermediate input, which affects all the firms in the market; and (3) an unanticipated permanent increase in wages (e.g. due to the renewal of the collective pay agreement or due to an increase in the minimum monthly wage) affecting all the firms in the market. Firms were asked to indicate whether a reduction or increase in prices, a reduction in margins, a reduction in output and a reduction in costs is (1) not relevant, (2) of little relevance, (3) relevant, (4) very relevant in response to the shocks or (5) they don't know.

As shown in Table 5, the most popular response to a shock is to use a combination of strategies. In response to a slowdown in demand firms tend to choose cost reduction together with other strategies. Firms report that in face of this shock they would be least willing to lower the prices thus indicating some degree of downward price stickiness. Following both of the cost shocks change in prices is more common reaction among the firms. Nevertheless, combinations of increases in prices with other types of strategies are more widely used implying that higher intermediate input costs and higher wages are only partially passed on to the prices. In the case of both kinds of the cost shocks firms clearly avoid reducing output. This points to an active search for efficiency gains.

Table 5. Distribution of the responses of firms to different types of shocks
(share of firms for which the use of certain combinations of responses is "relevant" or "very relevant"; percent)

Combination of responses to a shock	Type of shock:		
	slowdown in demand	increase in the cost of an intermediate input	increase in wages (e.g. due to increase in the minimum monthly wage)
Price	0.2	5.6	6.2
Margin	1.3	2.0	3.7
Output	1.8	0.0	0.0
Costs	2.1	5.7	6.6
Price / margin	3.7	8.0	12.9
Price / output	0.3	1.1	0.1
Price / costs	3.9	11.2	9.5
Margin / output	5.0	0.0	0.3
Margin / costs	7.0	1.8	9.4
Costs / output	12.9	1.5	0.9
Price / margin / output	4.0	1.4	0.3
Price / margin / costs	9.5	21.6	21.6
Price / output / costs	1.6	4.6	2.2
Margin / output / costs	11.5	3.8	3.4
Price / margin / output / costs	29.1	20.4	15.7
None	6.1	11.2	7.2
Price / any combination	52.3	73.8	68.5
Margin / any combination	71.1	59.1	67.4
Output / any combination	66.2	32.9	22.9
Costs / any combination	77.6	70.8	69.3

Notes: Responses are employment-weighted and rescaled to exclude non-responses; "price" indicates price decrease or price increase, "margin" indicates margin decrease, "output" indicates output decrease and "costs" indicates a reduction in costs.
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's calculations.

Those respondents, who indicated that a reduction in costs was of any relevance following the shocks, were asked to identify particular ways of cost cutting. Possible answers included (1) a reduction in base wages, (2) a reduction in the flexible wage components, (3) a reduction in the number of permanent employees, (4) a reduction in the number of temporary employees, (5) a reduction in the number of hours worked per employee and (6) a reduction in non-labour costs.

As shown in Table 6, cost cutting ways are quite similar in response of each of the shocks. As expected, firms very rarely cut costs by reducing base wages. This confirms a widespread perception that nominal cuts in base wages are very seldom. Although (as already mentioned) performance-related bonuses account for a quite significant share of the total wage bill, adjustment through flexible wage components is reported as being less important than adjustment through employment. In response to each of the shocks adjustment through reduction in non-labour costs is considered as the most important.

Table 6. Use of cost cutting strategies in response to different types of shocks (share of firms for which cost-cutting is "of little relevance", "relevant" or "very relevant"; percent)

Type of cost cutting response	Type of shock:		
	slowdown in demand	increase in the cost of an intermediate input	increase in wages (e.g. due to increase in the minimum monthly wage)
Reduction in base wages	3.0	1.3	-
Reduction in flexible wage components	11.3	12.6	8.5
Reduction in the number of permanent employees	10.9	7.9	13.5
Reduction in the number of temporary employees	12.8	11.3	14.6
Reduction in the number of hours worked per employee	6.1	2.7	3.2
Reduction in non-labour costs	55.8	64.2	60.2

Notes: Responses are employment-weighted and rescaled to exclude non-responses.
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's calculations.

The channels of adjustment used to respond to economic shocks may be determined by a number of characteristics of firms including the ones investigated in the analysis of frequency of wage and price changes. To keep the analysis focused, the responses to each of the shocks are modelled using ordered probits that include only three sets of explanatory variables, related to production technologies, labour compensation arrangements and market competition, as described in the previous section. The dependent variable in all the models is the categorical variable that increases with the intensity of strategy use: 1 = use of the strategy (i.e. price change, margin decrease, output decrease or reduction in costs) is not relevant, 2 = use of the strategy is of little relevance, 3 = use of the strategy is relevant, 4 = use of the strategy is very relevant.

Estimation results are provided in Appendix 3 (Tables A4-A6). These tables provide only the marginal effects on the probability that a firm's response to a particular shock is "very relevant". Thus, as in the previous section, the analysis is limited to the marginal effects on the highest probability cell.

As shown in Tables A4-A6, the investigated set of explanatory variables does not describe satisfactorily the features of firms that respond to the shocks by lowering costs and the characteristics of firms that reduce output following wage shock. Therefore no inferences are based on the latter probits.

Regression analysis reveals that pricing decisions are significantly affected by the level of competition. In the case of a negative demand shock competition increases the likelihood of a price decrease. In the case of both of the cost shocks the likelihood of a price increase is lowered if a firm's exposure to foreign markets is higher. It should be noted that, following a permanent increase in wages, a higher labour cost share increases the probability of a price increase, as a higher labour share implies that labour costs affect the marginal costs more strongly. This is an important finding of the survey identifying the link between labour costs and prices. The latter result is also obtained in the cross-country analysis covering most of the countries that have conducted surveys within the WDN (Bertola et al. 2009).

Another set of findings relates to the use of flexible wage components. As mentioned above, performance-related bonuses account for quite a significant part of labour costs, although adjustment through bonuses is reported as being less important than adjustment through some other channels. Nevertheless, regression analysis reveals that a higher flexible wage share mitigates the responses to a slowdown in demand (it lowers the likelihood of margin and output decreases) and to an intermediate input cost increase (it makes the likelihood of a price increase and a margin decrease lower).

As could be expected, the role of collective pay agreements appears to be mostly insignificant in response to the investigated shocks. This is consistent with the relatively rare use of these agreements in Lithuanian firms. Nevertheless, the presence of collective pay agreements is found to be important in the case of a wage shock. Collective pay agreements increase the likelihood of margin decrease following this shock.

Ordered probit estimates highlight the importance of competition in the behaviour of Lithuanian firms. In several regressions higher levels of competition and a greater exposure to foreign markets are associated with more sensitive reaction to shocks. In addition to the above-mentioned role of competition and the foreign sales share in pricing decisions, these covariates point to a greater likelihood of margin decrease.

Regression analysis shows that trade and services firms are less likely to lower the margin in response to all the investigated shocks compared to the manufacturing firms. Trade and/or services firms also tend to respond less sensitively by changing prices and output following certain shocks. Larger firms appear to be more likely than smaller ones to lower the output when they face a slowdown in demand or an increase in the intermediate input cost.

To check the robustness of the estimation results all the regressions were also estimated using different definitions of the dependent variables. In particular, dependent variables were constructed as binary variables: 0 = use of the strategy (i.e. price change, margin decrease, output decrease, reduction in costs) is not relevant or of little relevance, 1 = use of the strategy is relevant or very relevant. It was found out that under different definition of the dependent variable it is not possible to conclude (in contrary to the above-described results) that a higher flexible wage share is statistically significant in lowering the likelihood of a price increase following an intermediate input cost shock. Robustness analysis revealed that it cannot be concluded that trade firms are less likely to lower the output compared to manufacturing firms in response to an increase in the intermediate input cost. Additionally, this analysis showed that the investigated set of variables is not statistically significant in explaining firms' adjustment of margins following a permanent increase in wages.

Conclusions

Analysis of ad hoc survey data revealed a number of characteristics of the wage and price setting behaviour of Lithuanian firms. This study showed that in Lithuania most of wage changes occur due to reasons other than tenure or inflation. In slightly more than 40 percent of the surveyed firms wages are changed once a year and in approximately the same share of firms wages are changed more than once a year. The frequency of wage changes appears to be higher in firms that apply collective pay agreements.

The survey showed that in approximately one third of the firms the frequency of price changes does not follow any specific pattern. In approximately one quarter of the firms prices are changed on a quarterly to half yearly basis and in approximately one fifth of the firms prices are changed once a year. The frequency of price changes is positively affected by the market competition.

It was found out that Lithuanian firms tend to use performance-related bonuses as a form of labour compensation. 73.5 percent of the firms use flexible wage components that account for 17.1 percent of the total wage bill. Regression analysis revealed that a higher flexible wage share mitigates firms' responses to a slowdown in demand by lowering the likelihood of a margin decrease and output decrease. It also mitigates responses to an intermediate input cost rise by making the likelihood of margin adjustment lower.

The presence of collective pay agreements is found to be relatively low. Approximately one quarter of the firms apply collective pay agreements signed at the firm level, while collective pay agreements are very rare at the national level. In the surveyed firms 15.7 percent of employees are covered by these agreements. The role of collective pay agreements is found to be rather limited in shaping the responses of firms to economic shocks.

Regression analysis pointed to the importance of competition behind the behaviour of Lithuanian firms. It was found that a higher level of competition increases the likelihood of a price decrease following a negative demand shock. Greater exposure to foreign markets, which is associated with higher competition pressures, appeared to be significant in lowering the likelihood of price increase in response to cost shocks. Competition and exposure to foreign markets were also found to be important in fostering adjustment through margins.

The survey yielded somewhat mixed evidence on the relationship between labour costs and prices. Analysis showed that a considerable share of the surveyed firms would increase prices in response to the wage shock. The labour cost share appeared to be an important determinant of price increase in response to this shock. However the labour cost share was not found to be significant in affecting the frequency of price changes.

Appendices

Appendix 1. Realised sample composition of firms and employees

Table A1. Realised sample composition of firms by economic activity and firm size (number of firms)

	Firms that employ:			Total
	up to 19 employees	20 to 49 employees	50 or more employees	
Manufacturing	51	22	24	97
Construction	7	12	8	27
Trade	74	19	11	104
Business services	74	26	15	115
Total	206	79	58	343

Notes: The realised sample consists of the firms that have replied to the survey.
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's calculations.

Table A2. Realised sample composition of employees by economic activity and firm size (number of employees)

	Firms that employ:			Total
	up to 19 employees	20 to 49 employees	50 or more employees	
Manufacturing	568	705	3,444	4,717
Construction	83	409	951	1,443
Trade	731	570	975	2,276
Business services	686	782	3,379	4,847
Total	2,068	2,466	8,749	13,283

Notes: The realised sample consists of the firms that have replied to the survey.
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's calculations.

Appendix 2. Survey questions that were used to construct the dependent variables

How frequently is the base wage of an employee belonging to the main occupational group in your firm typically changed? Please tick an option for each of the three types of wage changes listed below

	More than once a year	Once a year	Once every two years	Less frequently than once every two years	Never/ don't know
Wage changes due to tenure	□ 1	□ 2	□ 3	□ 4	□ 5
Wage changes due to inflation	□ 1	□ 2	□ 3	□ 4	□ 5
Wage changes apart from tenure and/or inflation	□ 1	□ 2	□ 3	□ 4	□ 5

Under normal circumstances how often is the price of the firm's main product typically changed? Please choose a single one option

More than once a year:		
- daily	□	1
- weekly	□	2
- monthly	□	3
- quarterly	□	4
- half yearly	□	5
Once a year	□	6
Once every two years	□	7
Less frequently than once every two years	□	8
Never	□	9
There is not a defined pattern	□	10

How relevant are each one of the following strategies when your firm faces an unanticipated slowdown in demand? Please tick an option for each line

	Not relevant	Of little relevance	Relevant	Very relevant	Don't know
Reduce prices	□ 1	□ 2	□ 3	□ 4	□ 5
Reduce margins	□ 1	□ 2	□ 3	□ 4	□ 5
Reduce output	□ 1	□ 2	□ 3	□ 4	□ 5
Reduce costs	□ 1	□ 2	□ 3	□ 4	□ 5

How relevant are each one of the following strategies when your firm faces an unanticipated increase in the cost of an intermediate input (e.g. an increase in the price of gas, wood or agricultural products) affecting all firms in the market? Please tick an option for each line

	Not relevant	Of little relevance	Relevant	Very relevant	Don't know
Increase prices	□ 1	□ 2	□ 3	□ 4	□ 5
Reduce margins	□ 1	□ 2	□ 3	□ 4	□ 5
Reduce output	□ 1	□ 2	□ 3	□ 4	□ 5
Reduce costs	□ 1	□ 2	□ 3	□ 4	□ 5

How relevant are each one of the following strategies when your firm faces an unanticipated permanent increase in wages (e.g. due to the renewal of a collective pay agreement or due to an increase in the minimum monthly wage) affecting all firms in the market? Please tick an option for each line

	Not relevant	Of little relevance	Relevant	Very relevant	Don't know
Increase prices	□ 1	□ 2	□ 3	□ 4	□ 5
Reduce margins	□ 1	□ 2	□ 3	□ 4	□ 5
Reduce output	□ 1	□ 2	□ 3	□ 4	□ 5
Reduce costs	□ 1	□ 2	□ 3	□ 4	□ 5

Appendix 3. Estimation results from ordered probit regressions

Table A3. Explanations for the frequency of wage and price changes
(marginal effects for ordered probit models; the table provides only marginal effects on the probability that wage or price change occurs more frequently than once a year)

	Frequency of wage change	Frequency of price change
Labour share	0.000	0.000
Trade firms	-0.043	-0.002
Services firms	-0.070	-0.179**
Firms 20-49	0.160**	-0.045
Firms 50 or more	0.166**	-0.093
Collective pay agreements	0.153**	-0.037
Flexible wage share	0.002	0.000
Competition	0.067	0.207**
Foreign sales share	-0.001	0.001
Policy to account for inflation	0.108**	-
Price regulation	-	-0.264**
Pseudo R-squared	0.048	0.053
Wald statistic	29.370	19.750
Prob. (Wald statistic)	0.001	0.032
Number of observations	292	198

*Notes: * coefficient is statistically significant at the level of 10 percent, ** significant at the level of 5 percent, *** significant at the level of 1 percent; p-values are computed using Huber-White robust standard errors.*
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's estimations.

Table A4. Explanations for responses to a slowdown in demand
(marginal effects for ordered probit models; the table provides only marginal effects on the probability that the response is "very relevant")

	Type of response to a shock:			
	price decrease	margin decrease	output decrease	cost reduction
Labour share	0.001	0.002**	0.000	0.001
Trade firms	-0.011	-0.100***	-0.088***	-0.002
Services firms	-0.058***	-0.115***	-0.082***	0.006
Firms 20-49	-0.014	0.039	0.119***	0.067
Firms 50 or more	0.014	0.008	0.110**	0.068
Collective pay agreements	0.028	0.035	0.016	-0.056
Flexible wage share	0.000	-0.002**	-0.002***	0.000
Competition	0.137***	0.111**	0.051	0.049
Foreign sales share	0.000	0.000	0.000	-0.001
Pseudo R-squared	0.039	0.041	0.050	0.010
Wald statistic	25.970	33.580	33.750	6.400
Prob. (Wald statistic)	0.002	0.000	0.000	0.699
Number of observations	295	298	294	298

*Notes: * coefficient is statistically significant at the level of 10 percent, ** significant at the level of 5 percent, *** significant at the level of 1 percent; p-values are computed using Huber-White robust standard errors.*
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's estimations.

Table A5. Explanations for responses to an increase in the cost of an intermediate input (marginal effects for ordered probit models; the table provides only marginal effects on the probability that the response is "very relevant")

	Type of response to a shock:			
	price increase	margin decrease	output decrease	cost reduction
Labour share	0.000	0.000	0.000	0.000
Trade firms	-0.137***	-0.079***	-0.028**	0.015
Services firms	-0.177***	-0.108***	-0.019	-0.054
Firms 20-49	0.015	-0.022	0.014	0.075
Firms 50 or more	-0.037	0.023	0.048**	0.059
Collective pay agreements	0.073	0.040	0.014	0.018
Flexible wage share	-0.002**	-0.002**	0.000	0.000
Competition	0.076	0.064	0.016	-0.025
Foreign sales share	-0.002***	0.001**	0.000	0.000
Pseudo R-squared	0.045	0.046	0.023	0.011
Wald statistic	32.520	32.230	17.500	7.690
Prob. (Wald statistic)	0.000	0.000	0.041	0.566
Number of observations	295	293	283	294

*Notes: * coefficient is statistically significant at the level of 10 percent, ** significant at the level of 5 percent, *** significant at the level of 1 percent; p-values are computed using Huber-White robust standard errors.*
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's estimations.

Table A6. Explanations for responses to a permanent increase in wages (marginal effects for ordered probit models; the table provides only marginal effects on the probability that the response is "very relevant")

	Type of response to a shock:			
	price increase	margin decrease	output decrease	cost reduction
Labour share	0.002**	0.000	0.000	0.001
Trade firms	-0.121***	-0.077**	-0.012	-0.024
Services firms	-0.043	-0.069**	0.004	-0.064*
Firms 20-49	0.040	0.033	-0.007	0.030
Firms 50 or more	0.027	0.010	0.015	0.059
Collective pay agreements	0.001	0.070*	0.029	-0.013
Flexible wage share	-0.001	0.000	0.000	0.000
Competition	-0.021	0.075*	0.014	0.033
Foreign sales share	-0.002***	0.001	0.000	0.001
Pseudo R-squared	0.036	0.027	0.016	0.012
Wald statistic	23.750	21.910	10.520	7.020
Prob. (Wald statistic)	0.005	0.009	0.310	0.635
Number of observations	300	295	283	296

*Notes: * coefficient is statistically significant at the level of 10 percent, ** significant at the level of 5 percent, *** significant at the level of 1 percent; p-values are computed using Huber-White robust standard errors.*
Sources: The survey of the Bank of Lithuania "On Price and Wage Setting" and author's estimations.

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