UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

SANTIAGO BONILLA CÁRDENAS

THE IMPACT OF ECONOMIC AND POLICY SHOCKS ON ORGANIZATIONAL HIERARCHIES OF FIRMS

DOCTORAL DISSERTATION

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THE IMPACT OF ECONOMIC AND POLICY SHOCKS ON ORGANIZATIONAL HIERARCHIES OF FIRMS

Summary

One of the cornerstones of microeconomics is the assumption that, as rational agents, firms decide how much labor and capital to combine in order to minimize costs. This optimizing behavior is taught throughout the world to undergraduate students, who not often realize that a key simplification of that model is taking labor as a homogeneous factor. In reality, however, firms must decide not only how much of labor, but what kind of employees they need in terms of skill/knowledge, and how to organize them in their ranks. This is how the theory of knowledge-based hierarchies rises, with the purpose of analyzing the process in which firms create layers of management in order to produce more efficiently according to their needs and the current economic environment. In these hierarchies, the less-knowledgeable workers dedicate to routine tasks, while the more knowledgeable handle more complex problems and direct others.

In Chapter 1 I use employer-employee matched data of Slovenian manufacturing firms from 1997 to 2011 in order to empirically establish their main characteristics in terms of management layers. To test the main predictions of knowledge-based theories of organizational hierarchies, each worker is mapped into one of four possible hierarchical layers according to their ISCO-88 occupational code. I then analyze the dynamics of hours of work and wages when Slovenian firms grow in terms of value added, both when they decide to change their number of layers and when they do not. The results of Chapter 1 show that Slovenian firms tend to hire less hours of work and to pay higher wages in higher layers. When firms grow and decide to change their number of layers, they tend to change hours and wages differently across layers. Workers in newly added layers receive higher wages, while average wages in pre-existing layers decrease. When firms reduce their layers, workers in pre-existing layers tend to benefit. These patterns are confirmed using education and experience as direct measures of knowledge.

Chapter 2 focuses on how economic policy shocks affect organizational hierarchies. Using the same data set of Slovenian manufacturing firms, and taking advantage of significant minimum wage and payroll tax changes that took place in Slovenia between 2005 and 2010, the effects that these types of shocks have on changes in organizational layers in firms are estimated using multinomial logistic models. The theory behind this is that those exogenous changes in labor costs will induce firms to change the mix of skilled/unskilled labor they use in their ranks, thus motivating them to modify their hierarchical structure whenever these shocks are strong enough. I build minimum wage and payroll tax shocks at each period using the legislation that would apply next year, assuming that every firm keeps the same structure of employment for the next year. These exogenous measures are then used to estimate the average marginal effects of said shocks on the likelihood of firms dropping/adding layers, keeping the same structure, or exiting the market. The results show that both types of shocks are statistically significant to explain firms' decisions of transitioning in terms of layers over time.

Chapter 3 studies how foreign demand shocks can also affect the organizational choices of firms regarding hierarchies. According to the theory of knowledge-based hierarchies, sufficiently large changes in firm size will be accompanied by changes in their hierarchical structure; but ever since a significant part of these changes in size are endogenous – i.e. motivated by managers' decisions that in turn will affect the hierarchical organization of the firm – any direct estimation of the effects of firm size on organization will be biased due to endogeneity. That is the motivation behind Chapter 3, where I instrument changes in value added by exogenous foreign demand shocks that I build using the Bartik framework. This two-stage approach allows me to estimate unbiased estimates of the effects of exogenous changes in firm size on their probability of undergoing different layer transitions. I find that, while the estimates are not all highly significant, most of them have the proper sign, and support the predictions of the knowledge-based hierarchies theory.

Keywords: management layers, hierarchies, wages, international trade, minimum wage, payroll tax, shocks, employment, skills.

UČINKI EKONOMSKIH ŠOKOV IN ŠOKOV EKONOMSKIH POLITIK NA HIERARHIČNO ORGANIZACIJO PODJETIJ

Povzetek

Eden izmed temeljev mikroekonomije je predpostavka, da podjetja kot racionalni akterji odločajo o tem, koliko delovne sile in kapitala potrebujejo za to, da so njihovi stroški čim manjši. O tem optimizirajočem vedenju se učijo dodiplomski študenti po vsem svetu, ki se le redko zavedajo, da se v najbolj poenostavljeni obliki pri tem modelu delovna sila obravnava kot homogen dejavnik. V resnici pa se morajo podjetja odločiti ne samo, koliko zaposlenih, ampak tudi kakšne zaposlene potrebujejo z vidika znanj in spretnosti ter kako jih organizirati. S tem je povezana teorija na znanju temelječih hierarhij, katere namen je analizirati proces, s katerim podjetja oblikujejo različne organizacijske ravni, da bi bila njihova proizvodnja učinkovitejša z vidika njihovih potreb in trenutnega ekonomskega okolja. V teh hierarhijah se delavci z manj znanja posvečajo rutinskim opravilom, bolj usposobljeni pa se ukvarjajo z bolj zapletenimi nalogami in usmerjajo druge delavce.

V prvem poglavju so na podlagi primerjave podatkov uparjenih slovenskih proizvodnih podjetij in njihovih zaposlenih, ki se nanašajo na obdobje med letoma 1997 in 2011, empirično proučene glavne značilnosti organizacijske ravni teh podjetij. Da bi preverili glavne domneve teorij na znanju temelječih organizacijskih hierarhij, je vsak delavec razvrščen v eno izmed štirih možnih hierarhičnih ravni na podlagi njegove šifre po mednarodni klasifikaciji poklicev ISCO-88. Nato je analizirana dinamika delovnih ur in plač, ko se dodana vrednost podjetij veča ter se odločijo spremeniti število hierarhičnih ravni ali pa ne. Izsledki prvega poglavja kažejo, da v slovenskih podjetjih zaposleni na višjih ravneh opravijo manj delovnih ur in prejemajo višje plače. Ko podjetja rastejo in se odločijo spremeniti število organizacijskih ravni, število delovnih ur in plače spreminjajo različno po posameznih ravneh. Zaposleni na dodanih ravneh prejmejo višje plače, medtem ko se povprečne plače zaposlenih na že obstoječih ravneh zmanjšajo. Ko pa podjetja zmanjšajo število organizacijskih ravni, imajo zaposleni na že obstoječih ravneh od tega korist. Navedeni vzorci so potrjeni na podlagi izobrazbe in izkušenj kot neposrednih meril znanja.

Drugo poglavje se osredotoča na to, kako šoki v ekonomski politiki vplivajo na organizacijsko hierarhijo. Na podlagi že omenjenih podatkovnih nizov o slovenskih proizvodnih podjetjih ter ob upoštevanju precejšnjih sprememb v minimalni plači in davku na plače v Sloveniji med letoma 2005 in 2010 so proučeni vplivi tovrstnih šokov na spremembe organizacijskih ravni v podjetjih z uporabo logističnih modelov za več različnih izbir. Zaradi tovrstnih eksogenih sprememb stroškov dela podjetja spreminjajo mešanico svoje kvalificirane in nekvalificirane delovne sile, ko pa so ti šoki dovolj močni, podjetja spremenijo tudi svojo hierarhično strukturo. V tem poglavju so na koncu vsakega proučevanega obdobja na podlagi zakonodaje, ki bo veljala naslednje leto, oblikovani šoki v minimalni plači in davku na plače ob predpostavki, da vsako podjetje naslednje leto obdrži enako strukturo zaposlenih. Na podlagi opisanih eksogenih mer so ocenjeni povprečni mejni učinki navedenih šokov na verjetnost, da podjetja zmanjšajo ali povečajo število organizacijskih ravni, obdržijo enako strukturo ali pa zapustijo trg. Izsledki kažejo, da sta obe vrsti šokov statistično značilni pri pojasnjevanju odločitev podjetij, da sčasoma spremenijo svoje organizacijske ravni.

Tretje poglavje se osredotoča na to, kako lahko šoki v tujem povpraševanju vplivajo tudi na organizacijske odločitve podjetij. V skladu s teorijo na znanju temelječih hierarhij dovolj velike spremembe v velikosti podjetij spremljajo tudi spremembe v njihovi hierarhični strukturi. Ker je precejšen del sprememb v velikosti podjetja endogenih (tj. posledica odločitev menedžerjev, ki vplivajo tudi na hierarhično organizacijo podjetja), je kakršna koli neposredna ocena vplivov velikosti podjetja na njegovo organizacijo pristranska. V tretjem poglavju je zato uporabljena metoda instrumentalnih spremenljivk za dodano vrednost, pri čemer so instrumenti oblikovani na podlagi eksogenih povpraševalnih šokov, skladno z Bartikovim pristopom. Opisana dvostopenjska metoda omogoča nepristransko oceno vplivov sprememb v velikosti podjetij, ki nastanejo zaradi eksogenih dejavnikov, na verjetnost različnih sprememb v organizacijski strukturi podjetij. Izsledki kažejo, da čeprav vse dobljene ocene statistično niso zelo značilne, je predznak večine ocen v skladu s teoretičnimi modeli, večina pa tudi potrjuje predvidevanja teorije na znanju temelječih hierarhij.

Ključne besede: ravni upravljanja, hierarhije, plače, mednarodna trgovina, minimalna plača, davek na plače, šoki, zaposlovanje, znanja in spretnosti

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INTRODUCTION

Background

In order to produce, firms demand labor as one of the key production inputs. This input is not homogeneous, as it varies within a firm, and between different firms in an economy. Since workers differ in terms of level and field of education, specific skills and work experience, the human resource management decisions are of the uttermost importance: firms need to decide the composition of their workforce according to characteristics of their own, as well as changes in the economic environment. For instance, suppose a small single-layered firm is starting to grow. Naturally, new problems will arise as it expands its production process, which is why more and better qualified workers will probably be hired. As the expansion continues, the company might decide it is better to organize in a new way by having now 2 layers: a bottom layer of production workers carrying the most routine tasks, and a new layer of supervisors comprised only by a couple more experienced and educated workers, who will deal with more complex problems whenever they arise. If the expansion in production and sales carries on, the firm might decide to hire more and better qualified workers, both in the bottom layer as in the supervisory level, since more and more sophisticated problems might start to appear. This process of growth may reach once again a threshold when the firm decides to add yet another layer of management, hence transforming into a 3-layered firm: the bottom layer of production workers performing the routine tasks, the second layer of supervisors handling problems of higher complexity, and the top layer of general managers tackling the most complex decisions of the company. Of course, the expansion process does not necessarily finish here, as the firm continues to adapt according to changes in the environment it faces. I intend to illustrate with the previous example how firms can change their hierarchical structure when experiencing expansions/contractions. In addition, it should be noted how, when doing so, firms might also be shifting knowledge across their organization. This managing of the amount of labor and its quality could be visible in terms of changes in the number of working hours and wages across the hierarchical structure of firms, and this is precisely one of the issues that I seek to address in the present work. Next, I present some basic terminology that will be repeatedly used throughout my dissertation:

- **Hierarchical layer**: the concept of hierarchical layer refers to a relatively homogeneous set of workers that roughly share the same level of knowledge and degree of responsibilities within the firm.
- **Transition**: this is the process by which a firm adds or drops hierarchical layers from one period to the next one. For instance, if a firm with 2 total layers decides to add one layer of management, then the employees in the newly added 3rd layer will supervise those in the 2nd layer, and the latter ones will supervise those in layer 1 (the bottom layer). This has consequences in the number of hours of work employed in each of the preexisting layers (1 and 2), and the wages of those working in said layers.

- **Shocks**: there are many ways to construct shocks in economic variables, but they all involve an exogenous source of variation in said variable. For example, if government authorities decide to change the legal minimum wage, then the change in the share of minimum wage workers on the wage bill is not a shock, as it contains the (endogenous) reaction of firms to that new legislation, who can vary the number of minimum wage workers in their ranks as a result of the new legislation. However, if we fix the number of minimum wage workers in the year previous to the new legislation, and compute the expected rise in labor costs with the new legislation assuming that firms would keep the same employment structure, then that variation is an exogenous shock.

Research Questions Addressed in the Dissertation

There are still many unanswered questions regarding the topic of hierarchical organization: do firms expand just by replicating their operations to a larger scale, or do they instead reorganize their employees in teams, as in our previous example? And in each case, how are workers and firms affected by such decision? The study of hierarchical layers has led authors to find several important features on how firms manage their inner structure. Some researchers focus on how firms respond to different types of shocks (Guadalupe & Wulf, 2010; Caliendo et al., 2015a; Davidson et al., 2017; Caliendo et al., 2017; Bastos et al., 2018; Cruz et al., 2018), such as trade liberalizations, foreign acquisitions, competitiveness enhancing programs, information and communication technologies, and productivity shocks. Other scholars investigate in turn the effects that reorganization decisions have on various firm variables (Tåg, 2013; Caliendo et al., 2015b; Tåg et al., 2016; Spanos, 2016), including value added, wages, export performance, and even the likelihood of former employees becoming entrepreneurs. Hence, the field of knowledge-based hierarchies is a relatively yet unexplored one, especially in terms of empirical research, which is the main motivation for my dissertation. Using a thorough employer-employee matched data set of Slovenian manufacturing firms from 1997 to 2011 I will be addressing the following research questions throughout the next chapters:

- **Is there meaning behind the organization of employees in hierarchical layers?**

  Following the methodology used by Caliendo et al. (2015b), Chapter 1 uses employee-level information on ISCO 88 occupational code to map each worker into one of 4 possible hierarchical layers that each firm can have, thus obtaining a data set suitable for testing the theoretical implications of the model of hierarchical organization by Caliendo & Rossi-Hansberg (2012). I firstly find that higher layers are associated with higher wages, at all percentiles within each layer, and that larger firms in terms of value added are also larger in terms of their number of layers, have higher wages, and employ more hours of work, which is in line with what Caliendo et al. (2015b) find for French firms. Nonetheless, I find some evidence that Slovenian firms tend to pay higher wage premia in higher layers, in comparison to French firms.

- **How do changes in value added affect the hierarchical structure of firms?**

  The Slovenian data analyzed in Chapter 1 suggest that, as in the case of French firms in

Caliendo et al. (2015b), the probability of firms adding layers increases with their value added, with the probability of adding 1 layer being larger than that of adding more than 1. I also find that, in general, firms that decide to add (reduce) more layers at a certain transition period tend to grow faster (slower) in value added than their counterparts that decide to reduce (increase) or keep the same number of layers. In Chapter 3 I utilize the framework by Friedrich (2022) and use a two-stage estimation method to instrument changes in value added in order to find its unbiased effect on the probabilities of firms changing their hierarchical structure.

- **How are wages and hours of work affected when firms change their hierarchical structure?**

  In Chapter 1 I explore firm dynamics in terms of hours of work and wages when they grow in size, both with and without changing their number of layers. When firms grow in value added and keep the same number of layers in Slovenia, I observe that they hire more hours of work and increase wages at all layers. However, according to the estimated elasticities and compared to French firms in Caliendo et al. (2015b), I note that Slovenian firms tend to adjust more in terms of hours of work than in wages. Now, when firms grow by changing their organizational structure, the patterns I find also coincide with those observed in French firms in Caliendo et al. (2015b): firms that add (drop) a layer of management increase (decrease) hours of work, but decrease (increase) average wages in preexisting layers. This is fully consistent with the theoretical prediction by Caliendo & Rossi-Hansberg (2012), as firms that decide to add (drop) a layer of management must be, at the same time, transferring knowledge by reducing (increasing) it at all layers that pre-date the corresponding transition. Again, my estimates suggest that Slovenian firms rely relatively heavily on hours of work than on wages to perform said adjustments when compared to French firms in Caliendo et al. (2015b). I also employ worker education and experience as more direct measures of knowledge in Chapter 1, in the same manner as Caliendo et al. (2015b), in order to explore how firms redistribute those resources as they change their layer structure. My results show that the theory by Garicano (2000) holds well in Slovenian firms: in the vast majority of cases, when undergoing transitions that add (drop) layers of management, Slovenian firms decrease (increase) either average education or average experience in all preexisting layers, as they transfer knowledge to (from) the newly added (dropped) top layers. In fact, Slovenian firms seem to transfer knowledge across layers via worker education and experience more than average wages reveal.

- **How do changes in minimum wage and payroll tax policy affect the hierarchical structure of firms?**

  One of the yet unexplored fields within knowledge-based hierarchies, according to Garicano & Rossi-Hansberg (2015), is the effect that exogenous changes in economic policy might have on the way firms organize their employees. In Chapter 2 I build measures of exogenous increases in labor costs due to minimum wage legislation, as well as due to new payroll tax policy, in order to estimate how the hierarchical structure of firms varies before such changes. My results confirm the hypothesis that economic policy shocks like those do have a significant effect on firm organization: I find that a 1 percentage point increase in the expected minimum wage labor costs augments the likelihood of firms reducing in size and/or exiting the market, while decreasing their probability of adding layers. The effects of payroll tax shocks on transition likelihood, on the other hand, appear to be highly dependant on the current hierarchical size of the firm.

- **How do changes in foreign product demand affect the hierarchical structure of firms?**

  Another potential way in which firms' hierarchical structure might be affected is through the impact that international trade has on their sales. A great deal of the sales/output that firms exhibit reflect their own decisions in terms of management, so that the changes we see in firm value added are not solely caused by external occurrences, but might be part of an internal choice by the head of the company. Econometrically speaking, this creates a bias in the estimation of the effects of changes in value added on firm organization, which can only be dealt with when instrumenting said changes by an exogenous source of variation in them. In Chapter 3 I use foreign sources of variation in value added changes, by instrumenting them with Bartik-type (see Goldsmith-Pinkham et al., 2020; Bartik, 1991) international trade shocks. This way, I obtain unbiased estimates of the effects of changes in firm size on their likelihood of transitioning.

There are, of course, many more interesting questions related to the use of knowledge-based hierarchies in firms. For instance, one could consider different types of internal organizational schemes, involving hierarchies, which firms can adopt with varying levels of (de)centralization. Some authors (see Siggelkow & Levinthal, 2003; Mookherjee, 2006; Čudanov et al., 2009) study the incidence of pervasiveness of interactions among firms' divisions, the adoption of information and communications technologies (ICTs), and coordination costs, on the level of (de)centralization within firms. The role of mergers or firm break-ups on CEO span of control, depth of firm hierarchical organization, or on the employee composition within the newly merged hierarchies constitutes another question worth studying (see Rajan & Wulf, 2006; Smeets et al.; Ziss, 2007). Other pieces of research focus on the relationship between changing the number of knowledge-based hierarchies to organize production, and firm results such as performance in terms of productivity (see Colombo & Delmastro, 2002; Caliendo et al., 2015a; Littler et al., 2003), as well as the level of wage inequality both within and between hierarchies (see Hunnes, 2009; Kacperczyk & Balachandran, 2018; Friedrich, 2022). While all these research paths within the topic of organizational hierarchies are immensely rich in terms of the possibility of new findings, my present work focuses specifically on the previously mentioned research questions. The other research paths I briefly discuss are left as motivation for future research.

Structure of the Dissertation

In Chapter 1 I contrast the key hypotheses of the knowledge-based hierarchies proposed by Garicano (2000) and Caliendo & Rossi-Hansberg (2012). In section 1.1 and 1.2 I provide an overview and introduction to the chapter. Section 3 contains a brief review of the most relevant literature on organizational hierarchies. Section 4 describes the sources of data and variables I use in the empirical estimations and Section 5 contains summary statistics. I present the key empirical findings in Section 6. I briefly address the differences I find in organizational structure between Slovenia and France in section 7. In section 8 we conclude.

In Chapter 2 I take advantage of large changes in minimum wages and payroll tax legislation occurred in Slovenia between 2005 and 2011 to estimate the effects that exogenous shocks in both policies have on the probabilities of different transition alternatives that firms face. In section 2.1 and 2.2 I present an overview and a brief introduction to the chapter. In section 2.3 I summarize the most relevant literature on minimum wages, payroll tax and knowledge-based hierarchies. Section 2.4 provides some institutional background on minimum wage and payroll tax policy in Slovenia. In section 2.5 I provide summary statistics of the data set, and in section 2.6 I present our estimation results. Section 2.7 concludes.

Chapter 3 deals with the effects that changes in firm size have on their hierarchical organization. Given that changes in firm size are likely endogenous to other unobservable variables, estimates of their effect on firm organization will be biased. Thus, Chapter 3 focuses on obtaining unbiased estimations by instrumenting changes in value added by foreign exogenous changes in demand. Section 3.1 and 3.2 provide overview and introduction to the potential problem of using changes in value added as a direct measure of changes in firm size in estimations. Section 3.3 reviews the relevant theory in the field of knowledge-based hierarchies and international trade shocks. Section 3.4 presents the Bartik methodology, which I use to build exogenous trade shocks. In section 3.5 I provide some basic descriptives of the data set. In section 3.6 I present the estimation results, and Section 3.7 concludes.

Section 4 presents the final discussion and conclusions of the dissertation.

1 Organizational Hierarchies in the Slovenian Manufacturing Sector[1]

1.1 Overview

In this chapter I study organizational hierarchies in a transition country. Using employer-employee matched data for a set of Slovenian manufacturing firms, I find strong support for the key hypotheses of the knowledge-based hierarchies proposed by Garicano (2000) and Caliendo & Rossi-Hansberg (2012). According to these theories, firms should organize in consecutively ordered layers with less hours and higher wages in higher layers. Following Caliendo et al. (2015b), who were the first ones to test the predictions of knowledge-based theories of organizational hierarchies, I am able to directly compare my results to those obtained for French manufacturing firms. I find that Slovenian firms exhibit lower consistency with consecutive ordering of organizational layers, have on average fewer organizational layers and change them less frequently.

1.2 Introduction

Firms facing decisions regarding organization of production must deal with questions like how many and what kind of workers to hire, and what roles should they play. When facing rising demand, firms must decide whether to replicate their operations to a larger scale or instead reorganize their employees in teams. Similarly, when facing declining demand, they decide whether to reduce the number of workers, or change the organization of teams. The theories of knowledge-based hierarchies provide nuanced answers to such questions that often depart from traditional theory of labor demand with homogeneous workers.

In the seminal work Garicano (2000) develops a theory, which predicts that firms should organize their workforce in hierarchical layers, with the less-knowledgeable workers dedicated solely to the most routine tasks, while the more-knowledgeable ones deal only with more complex problems that might appear in production and give directions to the others regarding these harder tasks.[2] Caliendo & Rossi-Hansberg (2012) consider these decisions within the general equilibrium context featuring heterogeneous firms, which allows the authors to derive further theoretical insights that relate firm organization and its characteristics. A firm facing an increase (decrease) in demand or productivity, may add (drop) layers, as having many layers of management with more knowledgeable managers

[1]This chapter is co-authored with Sašo Polanec. The authors would like to thank the Slovenian Statistical Office for allowing us to access, use and analyze the data in a secure room. A version of this chapter was published on *Eastern European Economics* in 2021. I am grateful for the valuable comments by the members of the doctoral committee, prof. dr. Anže Burger, prof. dr. Jozef Konings, and prof. dr. Rok Spruk.

[2]At the core of this cost minimization decision is the trade off between increasing returns to specialization (due to economies of scale in the use of knowledge) and matching problems to workers, which gets increasingly difficult with specialization.

at the top, but much less knowledgeable employees in the bottom layers, allows it to have lower production costs. Changes in the number of layers are expected only when production costs fall with adding or dropping layers. If changes in value added are too small, firms may instead respond by changing the number of working hours.

In this chapter I investigate whether the predictions of the theoretical model developed by Caliendo & Rossi-Hansberg (2012) also hold for Slovenian manufacturing firms. I examine the differences between firms with different number of hierarchical layers, and investigate the consequences of adding/dropping layers of management due to expansions/contractions in value added, as opposed to the case when they keep the same hierarchical structure. For this purpose I use a comprehensive annual employer-employee matched data set of Slovenian manufacturing firms covering the period 1997–2011. Using employee-level information on ISCO 88 4-digit occupation code, I map each worker into one of four possible hierarchical layers that each firm can have, thus obtaining a data set that is suitable for testing the implications of the model by Caliendo & Rossi-Hansberg (2012). In my empirical analysis I follow closely the empirical methodology used by Caliendo et al. (2015b), who analyze employer-employee data for French manufacturing firms, which makes many of my results directly comparable to those reported in their paper.

My findings mostly confirm the theory of Caliendo & Rossi-Hansberg (2012) and are aligned with the results obtained by Caliendo et al. (2015b) for French manufacturing firms. First of all, I observe that Slovenian firms pay higher wages in higher layers; larger firms in terms of value added are also larger in terms of number of layers and hours of work, and pay higher wages. Second, I find that the probability of firms adding layers increases with value added, and that the probability of adding 1 layer is larger than that of adding more than 1 layer. Third, I note that firms adding more layers at a certain transition period tend to grow faster than their counterparts that diminish or preserve the same number of layers. In comparison to French firms, Slovenian firms tend to pay higher wage premia in higher layers and have fewer organizational layers.

More to the point, I also explore firm dynamics in terms of hours of work and wages when firms grow in size, both with and without changing their number of layers. When firms grow in value added and keep the same number of layers, I observe that they hire more hours of work and increase wages in all layers. However, according to my estimated elasticities and compared to French firms in Caliendo et al. (2015b), I note that Slovenian firms tend to adjust more in terms of hours of work rather than in wages. Now, when firms grow by changing their organizational structure, the patterns I find also coincide with those observed for French firms in Caliendo et al. (2015b): firms that add (drop) a layer of management increase (decrease) hours of work, but decrease (increase) average wages in pre-existing layers. This is fully consistent with the theoretical prediction by Caliendo & Rossi-Hansberg (2012), as firms that decide to add (drop) a layer of management must be, at the same time, transferring knowledge upward (downward) by reducing (increasing) it in all layers that pre-date the corresponding transition. Again, my estimates suggest that Slovenian firms rely relatively more heavily on hours of work than on wages to perform said adjustments when compared to French firms.

Finally, I employ worker education and experience as more direct measures of knowledge, in the same manner as Caliendo et al. (2015b), in order to explore how firms redistribute those resources as they change their layer structure. My results show that the theory holds well in Slovenian firms: in the vast majority of cases, when undergoing transitions that add (drop) layers of management, Slovenian firms decrease (increase) either average education or average experience in all pre-existing layers, as they transfer knowledge to (from) the newly added (dropped) top layers. In fact, Slovenian firms seem to transfer knowledge across layers via worker education and experience more than average wages reveal.

The structure of this chapter is as follows. Section 3 contains a brief review of the most relevant literature on organizational hierarchies. Section 4 describes the sources of data and variables I use in my empirical estimations and Section 5 contains summary statistics. I present my key empirical findings in Section 6. I briefly address the differences I find in organizational structure between Slovenia and France in section 7. In section 8 I conclude.

1.3 Theoretical Background on Organizational Hierarchies

The study of organizations has been present in economics literature for a long time, with early works aiming mostly to explain the distribution of pay and firm size. One of the earliest investigations studies how managers monitor their subordinates using hierarchies Calvo & Wellisz (1978). This and several subsequent studies, however, feature neither an equilibrium approach for firms and the economy nor do they involve labor heterogeneity. Equilibrium analysis was initially introduced in a model developed by Garicano (2000), which represents a cornerstone in the theory of knowledge-based hierarchies. In his model, firms minimize the costs of producing output by organizing their employees in teams, with the less-knowledgeable workers dedicated solely to the most routine tasks, while the more-knowledgeable ones deal with more complex problems that might appear in production processes. Thus, knowledge-based hierarchies arise in the firm, with labor specialization leading to a more efficient allocation of working time, and the organizational problem lies in determining the proper quantities and distribution of knowledge, as well as the ways of communication within hierarchies. However, one of the simplifying assumptions made by Garicano (2000) is that all workers have the same learning and communication abilities. This assumption is relaxed in the models developed by Garicano & Rossi-Hansberg (2006, 2012), which assume ex-ante heterogeneity of workers embedded in a dynamic framework. This allows them to study the effects of communication and information technologies on economic growth through their impact on firm organization and innovation. Caliendo & Rossi-Hansberg (2012) use the same model of knowledge-based hierarchies, this time allowing heterogeneity in the demand that firms face, to analyze the effect of international trade on firm organization. By calibrating the model to U.S. data and running simulations, they find that due to bilateral trade liberalization exporting firms will increase the number of management layers. Hence, the theory of knowledge-based hierarchies allows researchers to gain a better understanding of how firms organize internally, using layers of management in order to solve the problems that emerge in the production processes. More recently, Chen (2017) builds an industry equilibrium model in which firms use hierarchies as a means to gain efficiency in monitoring employees in the production process. Ke et al. (2018) use a theoretical model based on Shapiro & Stiglitz (1984) to examine the impact of various internal policy decisions by firms aimed at increasing worker motivation within their ranks. One of the implications of their model is that firms tend to increase turnover rates at top layers and create more top positions in order to keep strong promotion incentives among workers.

In terms of empirical research, the study of organizational hierarchies in firms has been gaining momentum, especially after the development of theories featuring worker and firm heterogeneity (see Garicano & Rossi-Hansberg, 2006, 2012; Caliendo & Rossi-Hansberg, 2012).[3] As mentioned, this new research focuses on the effects of demand shocks, especially of foreign demand shocks, foreign acquisitions, competitiveness programs, information and communication technologies, and trade costs, on organizational hierarchies; it also studies the effects of changes in organizational hierarchies on firm performance, like productivity and entrepreneurship.[4]

A few studies analyze the relation between organizational structures, demand shocks and wages, in order to test the theoretical predictions by Caliendo & Rossi-Hansberg (2012). As this work is tightly related to them, I start my survey with these studies. Tåg (2013) uses linked employer-employee data from the Swedish manufacturing sector to find that firms with more organizational layers tend to be larger in terms of number of workers and value added, exhibit higher wages, and when they add a new top layer of management, bottom layers experience a decrease in average wages, whereas the opposite happens when firms drop said top layer. Caliendo et al. (2015b) provide similar results using a comprehensive employer-employee data set for French manufacturing firms. They provide a vast set of empirical tests that relate organizational structure, in terms of total number of organizational layers, to firm size, in terms of value added and working hours, and wages. For example, they compare the adjustment of wages and hours of work in firms that change their number of layers (i.e. adding or dropping one or more layers), as opposed to firms that keep the same number of layers across periods. They find that firms that grow in terms of value added without changing their hierarchical structure tend to increase wages in all layers, while firms that expand by adding one layer of management tend to decrease average wages in pre-existing layers. As my work closely follows theirs, I discuss their results along with mine below in order to avoid repetition.

Several recent empirical studies of organizational hierarchies exploit possibly exogenous variation in either trade costs or foreign demand. Guadalupe & Wulf (2010) analyze the impact of increased

[3]Meagher (2001), using surveys of Australian employees, was one of the first to document wage premia for higher hierarchical positions.

[4]This review of empirical literature is by no means comprehensive. Bastos et al. (2018) examine the impact of foreign acquisitions on organizational structures of Portuguese firms. Tåg et al. (2016) analyze the relation between Swedish firms' hierarchical structure and the likelihood of their former employees becoming entrepreneurs. Caliendo et al. (2015a) study the effects of firm reorganizations caused by expansions on the productivity of firms. Cruz et al. (2018) investigate the impact of competitiveness enhancing program for small and medium enterprises in Brazil on firms' internal organization. Bloom et al. (2014) examine the impact of information technologies and communication technologies on the organizational structure of firms, whereas Gumpert (2018) studies how changes in communication costs affect their organizational structure.

product market competition brought by the 1989 Canada-United States Free Trade Agreement on the depth of hierarchies and span of control in a set of large US manufacturing firms. They find that, for a firm with average tariffs before 1989, trade liberalization induced an increase in CEO span of control and a reduction in the number of management levels. Spanos (2016), also using French employer-employee data for the manufacturing sector combined with firm-transaction-level trade data, studies the relation between export performance and the organizational structure of firms. He finds a positive relationship between the total number of organizational layers and export performance: firms with more hierarchical layers tend to sell a greater value on average, to more destinations, and comprising a wider variety of products. Caliendo et al. (2017) further examine how French firms' decisions of becoming exporters affect their organizational structure in terms of hierarchies. These authors find that, relative to non-exporters, exporter firms are larger, hire more hours of work, pay higher wages and exhibit more layers of management, and, in addition, new exporters are more likely to add new layers than non-exporters. Davidson et al. (2017) also examine the relation between the degree of global engagement (i.e. international commercial relations) of firms and the skill mix of the workforce they employ. Using employer-employee data on Swedish firms, the authors find that an increase in export shares in firms has the effect of shifting their labor structure towards more skilled personnel (i.e. professionals in finance, sales, computing and engineering).

1.4 Data Sources and Description of Variables

1.4.1 Data Sources

My empirical analysis of organizational hierarchies is conducted using data for Slovenian manufacturing firms that operated during the period 1997—2011. I use three distinct data sets to construct a matched employer-employee data set, using unique firm and individual identifiers. My main source of data, maintained and provided by the Slovenian Statistical Office, is the Slovenian Employment Registry (henceforth SER), which contains information on all registered employment contracts between employers and employees.[5] The former is obliged to report initiation and termination dates of contracts, which allows me to identify the matches between firms and workers, and to determine job tenure. Employers are also obliged to report detailed information on occupation (4-digit ISCO 88 and ISCO 08 occupational codes), educational attainment (ISCED codes), gender, hours worked, and type of employment contract (definite vs. indefinite) for all initiated contracts and any changes to these characteristics. From the events in the registry I construct annual data of employment spells. The most important information for studying organizational hierarchies is the occupation of employees, which is used to allocate workers to different organizational layers, as described in the next subsection.

The second source of data is the Slovenian Financial Authority (henceforth SFA), which collects

[5]Employment contracts are registered with the Health Insurance Institute of Slovenia. The employment registry is maintained by the Statistical Office based on these records.

personal-income tax filings and also contains information on labor incomes. Unlike typical personal-income tax data reported by employees, which lack information on the identity of employers paying wages, I use SFA data that is reported by employers.[6] Hence, the data on gross wages used in my empirical analysis contains both personal and firm identifiers that can be matched to employment spells. Incomes combined with employment spells allow me to calculate the hourly gross wages that were paid to employees by individual employers.

The last source of data is the Agency of the Republic of Slovenia for Public Legal Records and Related Services (henceforth AJPES). All registered firms are obliged to report annual balance sheets and income statements to AJPES, from which I extract information on annual sales, costs of material inputs and services, and total hours worked by all employees. These allow me to calculate the measures of firm-level demand/size — value added and total hours worked.

1.4.2 Description of Variables

The main focus of this chapter is to study how firms organize their labor into different organizational layers and how these organizations change when firms expand or contract. Hence, it is essential to map workers with different occupations into organizational layers. I follow Caliendo et al. (2015b) and map 4-digit ISCO 88 or ISCO 08 codes into four occupational layers $l \in L = \{1, 2, 3, 4\}$, where workers in the bottom layer (layer 1) perform the ordinary tasks in production, while higher layers deal with problems of increasing complexity. In particular, I distinguish between:

- Occupational layer 1: blue-collar qualified and nonqualified workers (assemblers, machine operators, drivers, laborers, office clerks, etc).
- Occupational layer 2: professionals and technicians at the supervisory level (engineers, safety and quality inspectors, technical supervisors, etc).
- Occupational layer 3: senior staff (production and operations department managers, chief financial officers, etc).
- Occupational layer 4: Firm owners, directors and chief executives (CEOs and general managers).[7]

The mapping from occupational codes to layers is, however, not unique and depends on the total number of occupations within a firm. For example, if a firm in a given year has employees with occupational codes 2 and 4, then the total number of layers is $L = 2$, and employees with occupa-

[6] Personal incomes reported by payees (firms, government entities etc.) were originally used for tax-inspection purposes, that is, to identify potential misreporting of personal incomes by individuals. More recently, these data have become the main source of individuals' personal incomes, while individuals are no longer obliged to file personal income statements.

[7] I identify firm owners who are actually employed as managing directors using information on basis for social insurance.

tional code 2 (4) belong to layer $l = 1$ ($l = 2$). So, as in Caliendo et al. (2015b) all firms have at least 1 layer and can take the decision of adding layers, up to a maximum of 4[8].

Aside from the organizational layer each employee belongs to and the total number of layers in each firm and year, the main variables I use throughout my empirical analysis are: firm-level measures of demand/size—value added and number of working hours, and hourly gross wage for each worker.[9] Using employer and employee identifiers, I am able to construct firm-level totals and averages per year, which I use in this empirical analysis. For the final exercise in this chapter, I also use years of formal education for each worker and use them to construct a measure of potential experience.[10]

My analysis is conducted on a sample of firms from the manufacturing sector. Namely, for the period 1997–2008 I include firms that reported main economic activity within 2-digit industry code 15–37, according to NACE Rev.1.[11] As firms' income statements were reported in Slovenian Tolars prior to 2007, I convert those to Euros using a fixed exchange rate of 239.64 Tolars per Euro. In order to calculate real wages and value added, I deflate nominal values using the consumer price index with base in 2004 (the year in which the exchange rate was fixed).

I restrict the sample to employer-year observations that reported positive sales, total labor costs and costs of materials and services, which are used to calculate value added. Due to my focus on organizational hierarchies, I restrict the sample to firms with at least one employee. For this set of firm-year observations I only preserve employer-employee-year observations for which I have information on annual gross wage paid by employer to employee. The final sample used in this empirical analysis is described in Table 1.1. In my main analysis I use 3.3 million firm-worker-year observations for almost 72 thousand firms. On average, these firms pay a wage around 5 EUR (in 2004 prices), hire around 82 thousand hours of work, have on average 2.3 total organizational layers, and produce around 1 million EUR in real value added. The samples of observations for the two direct measures of knowledge (years of education and potential years of experience) are slightly smaller due to missing values. Average years of schooling and work experience for workers with available information are 10.5 and 23 years, respectively.

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[8]Note that this method of mapping employees into layers according to their occupation and total variety of occupations within the firm considers hierarchical layers in discrete terms. This method allows one to compute several descriptive measures within each layer, treating all employees inside each hierarchical layer as somewhat homogenous units. However, one could consider a different approach in future research endeavors, where a continuous measure of hierarchical layers might be obtained according to employees' characteristics. This alternative approach would then be used to check for the robustness of the findings with the traditional method by Caliendo et al. (2015b).

[9]Note that my entire empirical analysis relies on gross wages as these are specified in employment contracts. For brevity I refer to these as wages.

[10]Potential years of experience (X) is calculated as $X = A - T - 6$, where A is age of individual, T is the number of years spent in formal education and 6 is the statutory school entry age in Slovenia. The number of years of schooling is calculated using ISCED codes of the highest completed level of education. Namely, primary school is given 8 years of schooling, high school is attributed 12 years of schooling, bachelor's degree is given 16 years of schooling and PhD degree corresponds to 20 years of schooling.

[11]During the 2009–2011 period, firms reported industry codes according to NACE Rev.2 codes. I used a concordance between the two classifications for firms entering the sample after 2008, and the NACE Rev.1 code reported in 2008 for continuing firms.

Table 1.1: Summary statistics for the sample of Slovenian manufacturing firms, 1997–2011

Variable	Firm-worker-year Observations	Firm-year Observations	Mean	S.d.
Wage	3'302,751	71,730	5.05	2,69
Total Hours	3'302,751	71,730	82,488	337,089
Total Layers	3'302,751	71,730	2.28	1.01
Value Added	3'302,751	71,730	1,011	6,399
Experience	2'975,299	66,535	23.22	10.19
Education	3'151,241	71,275	10.49	2.66

Note: This table presents the total number of firm-worker-year and firm-year observations for each variable. Means and standard deviations are calculated from firm-level values. Firm-level values for variables that are observed at the level of individual workers (i.e. wage, experience and education) are averages calculated at the level of firms. Value added is reported in thousands of 2004 Euros, whereas hourly wage is reported in 2004 Euros.

1.5 Summary Statistics on Layers and Other Key Variables

The basic prediction of the theories of knowledge hierarchies (see Garicano, 2000; Garicano & Rossi-Hansberg, 2006, 2012; Caliendo & Rossi-Hansberg, 2012) states that in order to minimize production costs, firms position their workers within hierarchies based on their level of knowledge. Assuming that wages reflect the level of knowledge associated with employees' occupations, we should observe that workers in higher layers earn higher average wages. Table 1.2 compares average hourly wages and selected percentiles of wage distributions across layers. Evidently, higher layers are indeed associated with higher average wages and wages in all percentiles of wage distributions. This finding is consistent with the evidence reported by Caliendo et al. (2015b) for French manufacturing firms. Due to differences in average productivity between Slovenian and French firms, direct comparisons of wages are not meaningful.[12]

Table 1.2: Hourly Wage Distribution by Layers

Layer	Average Hourly Wage	p.5	p.10	p.25	p.50	p.75	p.90	p.95
1	4.54	2.39	2.76	3.35	4.17	5.27	6.61	7.69
2	6.14	2.65	3.05	4.00	5.52	7.48	9.67	11.55
3	11.65	3.44	4.07	6.05	9.68	14.78	20.99	26.27
4	22.05	4.71	6.33	10.63	18.85	29.27	41.38	49.95

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents average hourly wage and hourly wage in the corresponding percentile (in 2004 Euros), by layer. I use firm-level average values as units of observation. The mean hourly wage and percentiles in every layer are calculated for the sample of all firms and across all years of observations within my sample.

[12] The average hourly wage of Slovenian firms is roughly one quarter of that paid by French firms.

Table 1.3: Dynamics of Main Variables by Year

Year	Active firms	Average: Number of Layers	Hourly Wage	Value Added	Total Hours
1997	4,007	2.27	4.09	1,056	101,685
1998	4,166	2.24	4.17	987	96,529
1999	4,206	2.25	4.32	1,034	97,079
2000	4,404	2.27	4.39	1,052	95,329
2001	4,518	2.29	4.61	1,066	90,975
2002	4,674	2.33	4.73	1,070	90,548
2003	4,738	2.33	4.85	1,075	87,633
2004	4,823	2.35	4.88	1,026	85,231
2005	4,986	2.33	5.05	1,005	81,865
2006	5,138	2.32	5.26	1,049	78,548
2007	5,289	2.32	5.56	1,061	74,943
2008	5,443	2.30	5.70	979	73,382
2009	5,378	2.24	5.58	890	67,196
2010	5,222	2.21	5.80	875	64,594
2011	4,738	2.20	6.01	979	65,923

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: The average values are calculated from the firm-level values for my sample of firms. Average value added is reported in thousand (2004) Euros and average hourly wage is given in 2004 Euros. Total hours are calculated as the sum of hours for all employees in a firm in a given year.

Table 1.3 shows the dynamics of the number of firms and the average values of the main variables of interest. The number of firms increases until the onset of the economic crisis of late 2008. Regarding hierarchies, the average number of layers is between 2.20 and 2.35 over this entire period, which is slightly lower than the values reported by Caliendo et al. (2015b) for French firms (2.51–2.60). This comparison suggests that Slovenian firms are less hierarchically organized. This is somewhat surprising as the average number of working hours in French firms (69–78 thousand hours) is slightly lower than that in Slovenian firms. It is also interesting to observe that the average number of layers in Slovenia declines during the economic crisis, falling from 2.32 in 2007 to 2.20 in 2011.

One of the main predictions of theoretical models on knowledge-based hierarchies is that larger firms should find it optimal to choose more layers and pay higher average wages. Both of these features are evident in my sample of firms. Table 1.4 shows averages of value added, total hours of work and hourly wage, as well as median hourly wage, calculated separately for firm-year observations with different total number of layers. While the main patterns are broadly consistent with those documented for French firms, there are some important differences. Average hourly wages in Slovenian firms monotonically increase with total number of layers, while this is not the case for French firms.[13] Namely, average hourly wage increases with total number of layers by roughly 10 percent for Slovenian firms, whereas in France, it is the highest for firms with only one layer, and increases

[13]The rankings of median hourly wage, however, hold also for French firms.

Table 1.4: Description of Main Variables by Total Number of Layers

			Average		
Number of Layers	Firm-Years	Median Hourly Wage	Hourly Wage	Value Added	Total Hours
1	19,140	3.88	4.39	41.30	3,552
2	22,872	4.35	4.84	182.57	17,131
3	19,853	5.03	5.44	855.53	80,899
4	9,865	5.65	6.05	5,125.46	390,363

Source: Own calculations based on data from SER, SFA and AJPES.

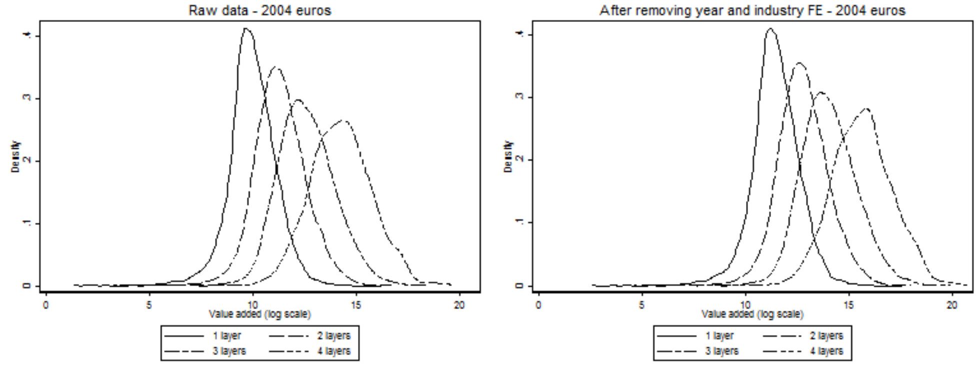
Note: This table presents the number of observations (firm-years) and the average values for the referenced variables by total number of layers. Median and average hourly wage are given in 2004 Euros, whereas average value added is reported in thousands of 2004 Euros.

modestly between firms with 2–4 layers. I attribute this difference to the higher wage premia for higher layers, and is likely related to the relative scarcity of college educated persons who are the predominant group of workers in the third and fourth layers.[14]

Figures 1.1, 1.2 and 1.3 present kernel density plots of the distributions for value added, total hours of work and average hourly wage (all in logs), for 1-, 2-, 3- and 4-layered firms. I follow the same procedure as Caliendo et al. (2015b), and report densities for both raw data and transformed variables after removing year and industry fixed effects. In Figure 1.1 we again see how firms with more layers of management are also larger in terms of value added, even after controlling for year and industry fixed effects. In addition, Figure 1.2 shows that firms with more layers also tend to hire more hours of work. The relation between average hourly wage and number of layers in the firm, as presented in Figure 1.3, appears less striking, although more layers are clearly related to higher wages. These distributions for Slovenian firms exhibit qualitatively similar patterns for French firms in measures of firm size (value added and total hours), while the distributions for average hourly wages bear some important differences. Wage distributions in Slovenian firms are less skewed and feature thinner upper tails than in French firms. French one-layered firms exhibit particularly a thick upper tail, which may explain the non-monotonic ranking of average hourly wages in France.

[14]Bartolj et al. (2013) show that Slovenia had relatively poor educational attainment at the start of the economic transition from socialist to market economy, which leads to relatively high returns to college degrees during the period 1994–2008, a period that partly overlaps with my sample.

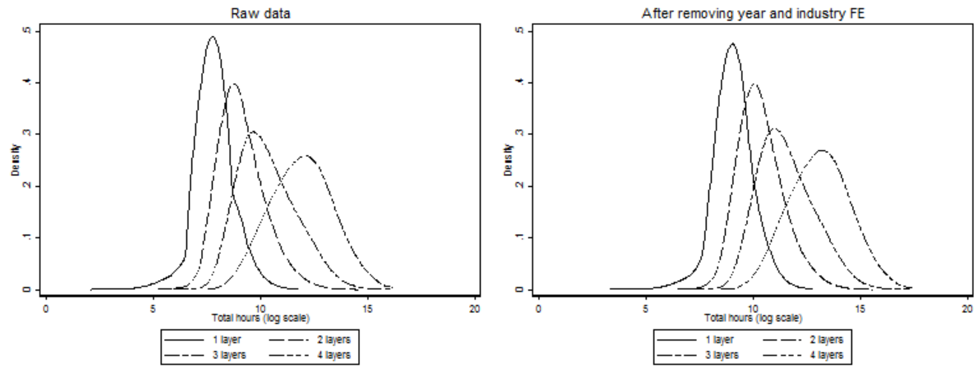
Figure 1.1: Distribution of Value Added by Total Number of Layers.



Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This figure depicts the distribution of logarithm of value added by total number of layers. The left panel uses raw data in order to estimate kernel densities by groups of firm-year observations with the same number of layers. The right panel shows the distributions of value added after removing year and industry fixed effects. To do so, I run a linear regression of the logaritm of value added on indicator variables for the number of layers in the firm, the two-digit NACE industry codes, and the year. I take firms with 1 layer of management in Food and Beverage Production (2-digit code 15) in the year 1997 as the base group. Then, I use the residuals of the previous regression, the median value added for the base group and the estimated coefficients for the number of layer dummies in order to estimate the log value added free of industry and year fixed effects. Finally, I compute the kernel-density estimates for the distribution of my log value added estimates, using the number of layers of each firm as the grouping variable.

Figure 1.2: Distribution of Working Hours by Total Number of Layers.



Source: Own calculations based on data from SER, SFA and AJPES.

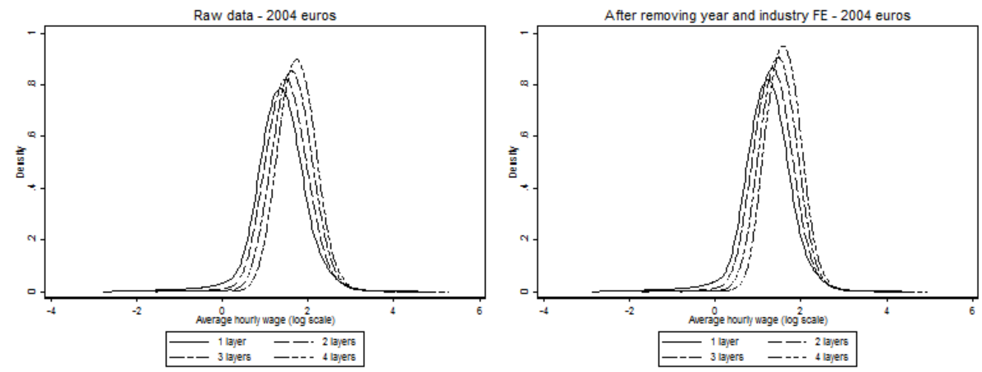
Notes: This figure presents kernel density estimates of the distribution of (log) working hours by total number of layers. The left panel uses raw data, whereas the right panel uses hours after removing industry and year fixed effects. To build it I use the same methodology as in Figure 1.1, after computing total working hours used in each firm-year.

1.6 The Empirics of Organizational Hierarchies in Slovenia

1.6.1 Consecutively Ordered Layers and Hierarchical Behavior

Next, I analyze layer management in Slovenian manufacturing firms. Specifically, I test whether firms' behavior is consistent with theoretical predictions by Caliendo & Rossi-Hansberg (2012) regarding the choices of number of hours in different layers, and how wages and working hours change

Figure 1.3: Distribution of Average Wage by Total Number of Layers.



Source: Own calculations based on data from SER, SFA and AJPES.
Notes: This figure presents kernel density estimates of the distribution of firm-level (average) hourly wage (in logarithm) by total number of layers. The left panel uses raw data, whilst the right panel removes industry and year fixed effects. To build it I use the same methodology as in Figure 1.1, after computing average hourly wage for each firm-year.

when firms choose to add layers. The first prediction states that hours in layers are *consecutively ordered*. Algebraically, $n_L^1 \geq \ldots \geq n_L^l \geq \ldots \geq n_L^L$ for all L, where n_L^l is the number of working hours at layer l in a firm with L total layers, where $l, L = 1, 2, 3, 4$ and $l \leq L$. This means that firms are hierarchical in the way they manage working hours, using more hours of work at the bottom layer, and employing less labor as we climb to higher layers. The second hypothesis states that, given the level of demand a firm faces, w_L^l (i.e. hourly wage at layer l in a firm with L total layers) should decrease and n_L^l should increase, at all l, if L increases. This means that as firms add layers of management, we should find that wages in pre-existing layers decrease, while the number of working hours increases in such layers, given that the tasks of solving more demanding problems get transferred to the new top layer. I examine whether this behavior, observed in French firms (Caliendo et al., 2015b), also holds in my sample of firms.

I first investigate whether Slovenian firms choose to organize in layers that are consecutively ordered. According to Caliendo et al. (2015b) a firm has such ordering if it has the proper types of occupations in each of its layers. Namely, if a firm has only 1 layer, then its employees must belong to occupation 1; if a firm has 2 layers, its employees must belong to occupation 1 and 2; if it has 3 layers, its employees must belong to occupations 1, 2 and 3; and if a firm has all 4 layers, then it must include all 4 types of occupation. Table 1.5 presents the percentages of firm-year observations fulfilling this feature, separately by the total number of layers. Taking all observations in my sample into account, I find that 55.36 percent of them fulfill the condition of having consecutively ordered layers, which is quite high. The degree of fulfillment further increases above 90 percent once I weigh firms by value added or hours of work. However, when compared to French firms these proportions are significantly lower, since the corresponding unweighted and weighted proportions of consecutively ordered firms in French firms are 82 percent and 96 percent, respectively. The proportions of consecutively ordered firms in Slovenia are lower in all but 4-layered firms, which suggests that discrepancies are quite common. This finding is consistent with the fact that French firms have on average more layers, which are more likely to be consecutively organized, but nevertheless somewhat surprising in the light of the Slovenian socialist heritage, which featured large hierarchies.[15] It suggests that particularly new firms tend to deviate from the hypothesized consecutive ordering. Further inspection of the data shows that main departures are primarily related to the classification of managers/executives in small firms, who may be the only employee in firms (and often perform multiple tasks), or may directly manage employees in the first layer. These may be considered as misclassified, as the tasks of such managers may not correspond to those in the top layer.[16]

Table 1.5: Firm-Year Observations with Consecutively Ordered Layers

	Firm-Year Observations With				
	1 Layer	2 Layers	3 Layers	4 Layers	All obs.
Unweighted	49.27	56.18	38.12	100	55.36
Weighted by Value Added	62.17	79.27	72.62	100	91.98
Weighted by Hours of Work	68.30	80.84	72.66	100	90.95

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents the percentages of firm-year observations that fulfill the condition of having consecutively ordered layers, where observations are grouped by number of layers. I also present the percentages of fulfillment, weighted by value added and by total hours of work hired.

Next, I examine whether firms exhibit hierarchical behavior with respect to the total hours of work they hire. According to the aforementioned theory, a firm with L total layers satisfies a hierarchy in hours between layers l and $l+1$, with $l = 1, \ldots, L-1$, if the number of working hours employed in layer l is larger or equal than the hours of work hired in layer $l+1$. For instance, a firm with 4 layers satisfies all hierarchies in hours of work if it hires more hours of work in the bottom layer than in the second layer, more hours of work in the second layer than in the third one, and more hours of work in the third layer than in the top layer.

Table 1.6 shows that the majority of firms in my sample satisfy hierarchical behavior with respect to hours of work. For instance, more than 71% of firms with 4 layers of management satisfy hierarchical order in all of their layers.[17] Slovenian firms with 3 and 4 layers—in comparison to French firms (Caliendo et al., 2015b)—tend to exhibit higher shares of firms with consistent ranking (based on all layers) by 8 and 14 percentage points, respectively, whereas in firms with only 2 layers the percentage is lower by 5 points. These numbers suggest that larger firms in particular tend to strongly comply with hierarchical patterns for hours.

Regarding hierarchical patterns for wages — according to Caliendo et al. (2015b) — a firm with total number of layers L satisfies a hierarchy in wages between layers l and $l+1$, if the average wage in layer $l+1$ is higher than or equal to the average wage in layer l. The results in Table 1.7

[15] I also investigate a subsample of firms with socialist heritage, defined as those that existed already prior to 1988—a year of deregulation of entry of privately-owned firms—and find them to be larger, to have four layers and thus to fully comply with the consecutive ordering of layers. The share of such firms (including their spin offs) is, however, relatively small in comparison to post-1988 entrants.

[16] Note that employers can select only one occupation in the registration forms for each employee, which may not fully correspond to the actual job description.

[17] The numbers are even higher when the percentages are weighted by firm value added. These are omitted for brevity, but available upon request.

Table 1.6: Firm-Year Observations with Hierarchies in Terms of Hours

Number of Layers	$N_L^l \geq N_L^{l+1}$ For all l	$N_L^1 \geq N_L^2$	$N_L^2 \geq N_L^3$	$N_L^3 \geq N_L^4$
2	81.72	81.72	...	...
3	72.23	84.40	87.06	...
4	71.24	88.71	96.26	82.94

Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table presents the percentages of firms that fulfill the condition of having hierarchies in terms of working hours. A firm satisfies a hierarchy in hours between layers l and $l+1$ if the number of working hours in layer l is at least as large as the number of working hours in layer $l+1$. The second column reports the percentage of firms that satisfy hierarchies in hours at all layers at once, while columns 3 to 5 report this only at layer $l = 1, 2, 3$. The percentages are presented according to the number of layers in the firm, as the first column indicates.

suggest that firms do exhibit such hierarchies regarding wages, albeit the percentage of 4-layered firms satisfying this condition in all layers is not as high as it is regarding hierarchies in hours of work. In comparison to French firms these numbers tend to be similar in 3-layered firms, but higher (lower) in 4 (2)-layered firms.

Table 1.7: Firm-Year Observations with Hierarchies in Terms of Wages

Number of Layers	$w_L^{l+1} \geq w_L^l$ For all l	$w_L^2 \geq w_L^1$	$w_L^3 \geq w_L^2$	$w_L^4 \geq w_L^3$
2	73.68	73.68	...	...
3	62.61	75.15	85.40	...
4	64.34	91.52	88.15	80.84

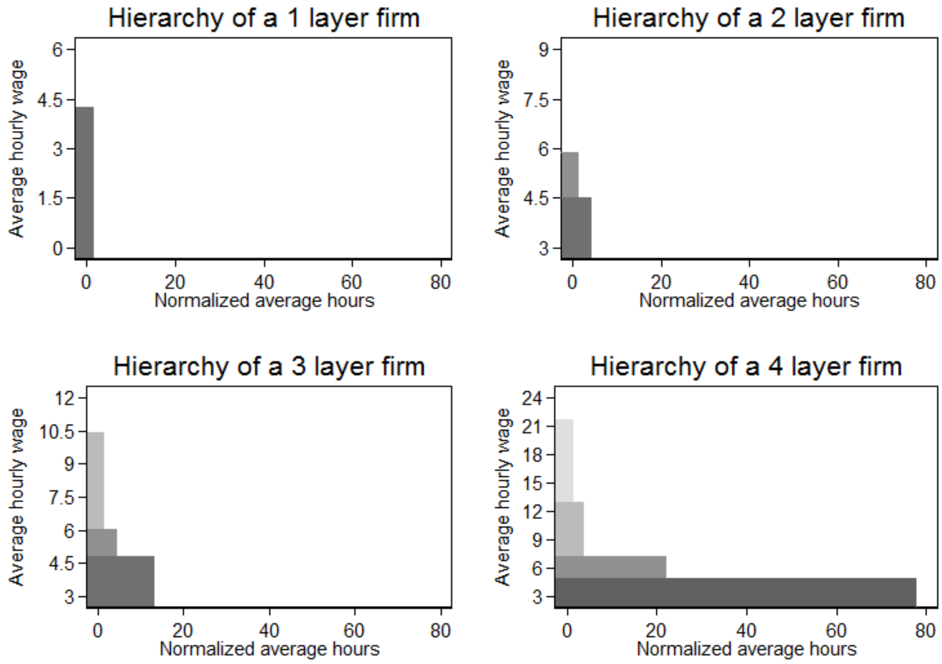
Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table presents the percentages of firms that fulfill the condition of having hierarchies in wages. A firm satisfies a hierarchy in wages between layers $l+1$ and l if the average wage in layer $l+1$ is at least as large as the average wage in layer l. The second column reports the percentage of firms that satisfy hierarchies in wages at all layers simultaneously, while columns 3 to 5 report this only at layer $l = 1, 2, 3$. The percentages are presented according to the number of layers in the firm, as the first column indicates.

The hierarchical organization within firms can also be presented graphically. Figure 1.4 presents a clearer view of the hierarchies of 1, 2, 3, and 4-layered firms in terms of normalized average hours of work (normalized by total hours in the top layer) and average wages. It can be inferred that firms use more hours of work in lower layers and pay lower average wages. As we move upward in the hierarchy, firms use less hours of work and pay higher average wages.

The fact that firms organize employees with different levels of knowledge into different hierarchies, as described above, should also be reflected in wage inequality across layers within firms. Namely, it should increase as they add new layers of management (see Garicano & Rossi-Hansberg, 2006). To investigate that, I follow the method used by Caliendo et al. (2015b). I regress the log-hourly wage of workers in each firm-year on a constant and dummy variables for all layers (excluding layer

Figure 1.4: Firm Hierarchies Normalized by Hours in the Top Layer



Source: Own calculations based on data from SER, SFA and AJPES.
Note: This figure presents hierarchies of the average firm with $L = 1, 2, 3, 4$ layers. Following Caliendo et al. (2015b), I only use data for the middle tercile of firm-year observations according to value added, and for each group of firms with $L = 1, 2, 3, 4$ layers I compute average hours of work and average wage at every layer. I normalize average number of hours by dividing them by their value at the top layer. The x-axis measures normalized average hours of work in the L-layered firm at layer $l = 1, ..., L$, while the y-axis measures average hourly wage (in 2004 Euros) at each layer.

1), extract the R^2, and compute the mean across all firms, grouping firms by number of total layers. Hence, for each firm-year $i = 1, \ldots, N$ I estimate:

$$\log w_{i,j} = \alpha_i + \sum_{l=2}^{L} \beta_{i,l} D_{i,j,l} + \epsilon_{i,j} \tag{1.1}$$

where log$w_{i,j}$ is the log hourly wage of employee j in firm-year i, and $D_{i,j,l}$ is a dummy variable for employee j in firm-year i in layer l, which takes the value of 1 if the employee in a given firm-year pair belongs to layer l, and zero otherwise. I also compute the mean R^2 using hours of work and value added as weights of observations with different numbers of layers.

My results, reported in Table 1.8, show that cross-layer wage variation explains almost 43% of mean wage variation in Slovenian firms. When weighing these proportions of variations by hours hired or value added, the share of mean wage variation explained by cross-layer variation falls to around 30%, which suggests there is a negative relation between firm size (captured by hours of work and value added) and variance of wages due to layer variation. These percentages are lower in comparison to French firms, for which Caliendo et al. (2015b) report that cross-layer variation explains around 50% of unweighted and weighted mean wage variation.

Table 1.8: Average Share of Wage Variation Explained by Layer Variation

			Weighted by	
	Firm-Years	Unweighted	Hours of Work	Value Added
All Firms	58,700	42.86	29.12	30.21
Firms with More than 1 Layer	52,052	48.33	29.34	30.42
Firms with 1 Layer	6,648	0.00	0.00	0.00
Firms with 2 Layers	22,361	51.85	26.62	28.83
Firms with 3 Layers	19,826	48.17	29.59	31.17
Firms with 4 Layers	9,865	40.68	29.52	30.29

Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table presents the mean R^2, across all firms and grouped by total number of layers, resulting from the regression $\log w_{i,j} = \alpha_i + \sum_{l=2}^{L} \beta_{i,l} D_{i,j,l} + \epsilon_{i,j}$, for each firm-year $i = 1, \ldots, N$, where $\log w_{i,j}$ is the log hourly wage of employee j in firm-year i, and $D_{i,j,l}$ is a dummy variable for employee j in firm-year i in layer l, which takes the value of 1 if said employee in said firm-year belongs to layer l, and zero otherwise. Thus, R^2 is a measure of wage variation due only to layer variation within firms. I also compute the weighted mean R^2 across firm-years, using hours of work and value added as weights. Note that, for firms with 1 layer, there is no wage variation across layers since there is only one of them.

1.6.2 Firm Size and Layer Transitions

In this section I investigate firms' transitions in terms of number of layers. Using the method employed by Caliendo et al. (2015b), I compute the share of firms that, conditioned on having L layers in a certain year, add/drop, keep the same number of layers, or exit the sample in the next year.

According to Table 1.9, the majority of Slovenian firms—between 76 and 83 percent of them—in any given year tend to keep their number of layers unaltered until the next year, which means their hierarchical structure is slightly more rigid than that of their French counterparts, for which values around 62–71 percent were reported (see Caliendo et al., 2015b). While lower transition probabilities may be partly related to higher exit rates among French firms, a higher rigidity of layers in Slovenia is still observed even when we consider transition probabilities for surviving firms alone. Table 1.9 also reveals that, similar to French firms, the exit rates for Slovenian firms also decline with total number of layers, which is consistent with the commonly observed fact that exit rates decline with firm size. Finally, Table 1.9 shows that when Slovenian firms decide to expand or contract their size in terms of layers, they do so by adding or dropping only one layer: transitions that add or drop more than one layer are not very likely.

Next I investigate how the probability of adding/dropping layers varies with firm size, measured in terms of value added. The theory by Caliendo & Rossi-Hansberg (2012) states that some firms will add new layers of management when receiving positive demand shocks and/or productivity improvements, and the probability of this happening is higher for firms with higher value added. Hence, a positive relation between value added and the probability of adding layers should be observed. To provide descriptive evidence that supports this prediction, Figure 1.5 presents a lowess

Table 1.9: Layer Transition Matrix

Number of Layers at t	Number of Layers at $t+1$ Exit	1	2	3	4	Total
1	10.43	77.06	11.40	1.05	0.06	100
2	6.34	8.37	75.95	8.94	0.39	100
3	4.75	0.95	9.66	78.73	5.91	100
4	4.19	0.28	1.03	11.43	83.08	100

Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table presents the proportion of firms, among all firm-years, that conditioned on having $L = 1, 2, 3, 4$ layers in year t, decide to change/keep their hierarchical structure or exit the market in year $t + 1$.

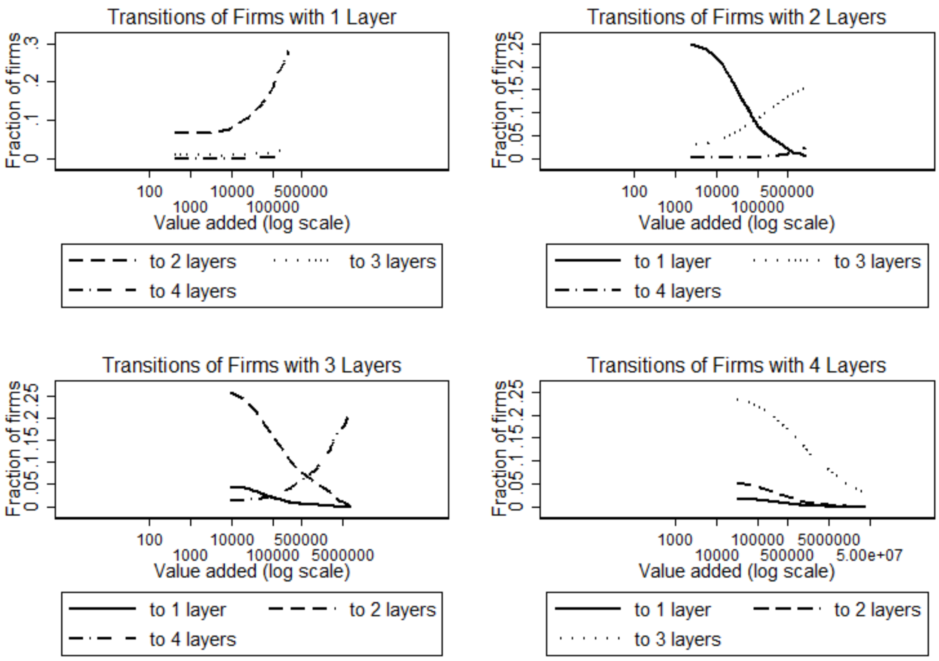
smoothing interpolation of the fraction of firms that change their number of layers as a function of their value added, conditioned on the initial number of layers of the firm, following the same method used by Caliendo et al. (2015b). Supporting the theory by Caliendo & Rossi-Hansberg (2012), Figure 1.5 shows that the probability of adding layers for Slovenian firms increases with value added, and that the probability of adding only one layer is always greater than that of adding more than one. At the same time, the probability of dropping layers decreases with value added. A visual inspection suggests that the behavior of Slovenian and French firms is very similar (see Caliendo et al., 2015b).

1.6.3 Firm Dynamics before Transitions

In this part of my empirical analysis I test an implication of a frictionless extension of the static model of organizational hierarchies to a dynamic setting, as developed by Caliendo & Rossi-Hansberg (2012). According to their theory, firms that are subjected to demand and/or productivity shocks change their number of layers when the cumulative change in value added —since the last change in the total number of layers—is large enough. These premises imply that, conditional on their initial value added, firms that will add layers in period t should, on average, grow faster in terms of value added in comparison to other firms that will not make any layer transition. On the other hand, firms that will drop layers in period t should grow slower in the previous couple of periods than those that will not.

My empirical test again follows Caliendo et al. (2015b), who estimate a dynamic model for value added and include indicator variables for layer switching as additional regressors. The sample is constructed using data on all firms with the layer sequence (L, L, L, L') over time for any L, where $L' = 1, 2, 3, 4$; that is, firms that keep the same hierarchical organization for 3 years in a row, and in the 4th year either make a transition, or maintain the previous number of layers. For these firms

Figure 1.5: Transitions Between Layers and Value Added



Source: Own calculations based on data from SER, SFA and AJPES.
Note: This figure presents lowess smoothing interpolations of the fraction of firms that change their number of layers as a function of their value added, conditional on the initial number of layers of the firm. The x-axis measures value added (in 2004 Euros), while the y-axis measures the fraction of firms with $L = 1, 2, 3, 4$ layers engaging in the respective layer transitions in the next year. I follow Caliendo et al. (2015b) in allocating groups of firm-years (by their total number of layers L) into 100 bins, according to their value added. Then, I compute in each bin the share of firm-years that engage in each type of layer transition in the next year. Finally, I graph the lowess plot of the fraction of firm-years in each type of transition against the average value added in each bin, for all bins.

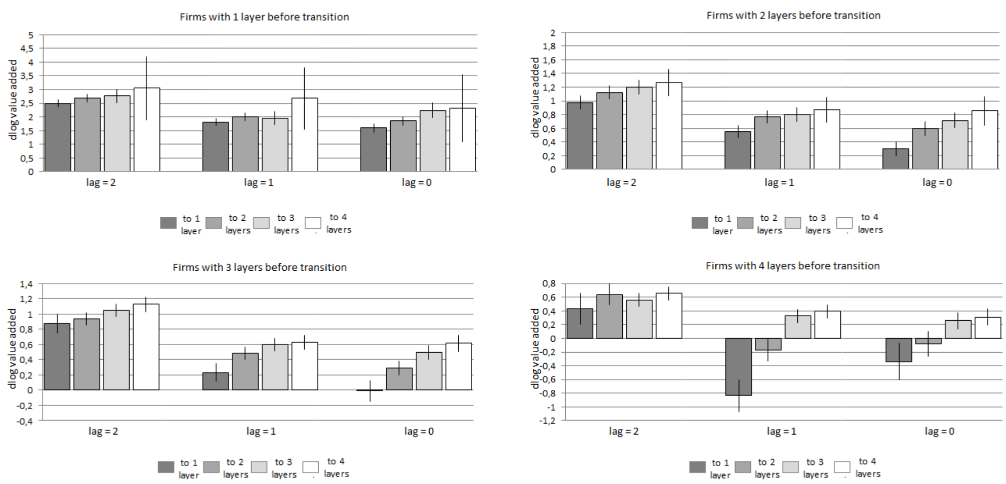
I run the following regression, with varying number of time lags, $k = 0, 1, 2$:

$$\text{dlog}\widetilde{VA}_{i,t-k} = \sum_{L'=1}^{4} \gamma^1_{LL',t-k} D_{LL'} + \gamma^2_{L,t-k} \log VA_{i,t-k} + \epsilon_{i,t-k}. \tag{1.2}$$

where $\text{dlog}\widetilde{VA}_{i,t-k}$ corresponds to the log difference in detrended real value added between periods $t-k$ and t for firm i. To detrend variables I use aggregate trends and, following Caliendo et al. (2015b), divide the original variables by their yearly average among firms belonging to the same group, e.g. $\widetilde{VA}_{i,t-k} = \frac{VA_{i,t-k}}{\overline{VA}_{t-k}}$. $D_{LL'}$ is an indicator variable that assumes a value of 1 if a firm with L total layers in period $t-k$ ends up with L' total layers at the end of the sequence and a value of 0 otherwise. $\gamma^1_{LL',t-k}$ is the corresponding regression coefficient that measures the effect of transitioning from L to L' total layers on the mean growth rate of detrended value added, $k = 0, 1, 2$ periods before the transition occurs, conditioned on the firm's value added at the same period; the effect of initial value added on the detrended growth rate in value added is captured by the regression coefficient $\gamma^2_{L,t-k}$. Finally, $\epsilon_{i,t-k}$ denotes the error term, assumed to be normally distributed with mean zero and variance σ^2_k.

Figure 1.6 shows my estimates for $\gamma^1_{LL',t-k}$, as well as the corresponding 95 percent confidence interval, two periods before, one period before, and for the period of transition, conditioned on the respectively lagged log value added. We can see that firms that add layers at the transition period $k = 0$ grow faster in the preceding periods than firms that keep (or reduce) their number of layers at the transition period. In general, the more layers they add/drop in the transition period, the larger/smaller is their growth in value added in the preceding years, although these differences may not always be statistically significant. I take this evidence as support for the hypothesis that firms need to pass a certain firm-specific threshold regarding their size in order to decide to change their hierarchical structure. It is interesting to note that almost all of my estimated effects for Slovenian firms tend to be significantly higher than those reported by Caliendo et al. (2015b) for French firms. In order to illustrate this point, consider firms with 3 layers before transition and lag 0 in both countries. Slovenian firms that shifted to 2 (4) layers had a productivity growth 20 (10) percentage points lower (higher) than those that kept 3 layers, whereas the corresponding French firms that shifted to 2 (4) layers had a less than 10 (less than 5) percentage points lower (higher) value added growth than those that kept 3 layers. This comparison suggests that Slovenian firms require a greater (relative) change in value added in order to adjust their total number of layers, which is consistent with the fact that Slovenian firms tend to have flatter organizations with a smaller average number of organizational layers.

Figure 1.6: Growth in Value Added before and at Transition Period



Source: Own calculations based on data from SER, SFA and AJPES.
Notes: This figure displays the estimates of regression coefficients $\gamma^1_{LL',t-k}$ (and their 95 percent confidence interval in each case) corresponding to indicator variables for various layer transitions (from $L = 1, 2, 3, 4$ to $L' = 1, 2, 3, 4$ number of layers). These coefficients are obtained from a dynamic equation for real value added: $d\log\widetilde{VA}_{i,t-k} = \sum_{L'=1}^{4} \gamma^1_{LL',t-k} D_{LL'} + \gamma^2_{L,t-k} \log VA_{i,t-k} + \epsilon_{i,t-k}$. The coefficient estimates are reported for $k = 0, 1, 2$ periods before layer transition for each group of firms, according to their number of layers before the transition.

1.6.4 Changes in Hours and Wages as Firms Expand or Contract

One of the theoretical implications of the model by Caliendo & Rossi-Hansberg (2012) is that, for firms that do not change their hierarchical structure, demand and productivity shocks increasing (decreasing) their revenues should increase (decrease) their hours of work and wages in all layers. Hence, in this section I analyze the changes that occur within different layers of management in firms as they expand or contract in terms of firm size. I first investigate the relation between real value added and normalized hours (normalized with respect to the number of hours employed in the top layer), for those firms that keep the same number of layers for two consecutive years. Specifically, I estimate the following equation

$$\text{dlog}\widetilde{n}^{l}_{Li,t} = \beta^{l}_{L}\text{dlog}\widetilde{VA}_{i,t} + \epsilon_{i,t}, \tag{1.3}$$

Here $\text{dlog}\widetilde{n}^{l}_{Li,t}$ denotes log difference of detrended normalized hours of work in layer l for firm i and period t, keeping L total layers, whereas $\text{dlog}\widetilde{VA}_{i,t}$ denotes log difference in detrended real value added for the same firm-year observation. β^{l}_{L} denotes the elasticity of normalized hours of work in layer l for firms with L layers, with respect to value added, for firms that do not change layers in 2 consecutive years. Detrended normalized hours and value added are defined as: $\widetilde{n}^{l}_{Li,t} = \frac{n^{l}_{Li,t}}{\overline{n}_t}$ and $\widetilde{VA}_{i,t} = \frac{VA_{i,t}}{\overline{VA}_t}$, where $\overline{n}_t$ and $\overline{VA}_t$ are yearly average hours and value added, respectively.

My estimates for the elasticity of hours of work with respect to value added, β^{l}_{L}, are shown in Table 1.10. We can see that when firms grow in value added, they hire more hours of work in all layers, i.e. the estimates of β^{l}_{L} are all positive and significant in all cases. I also find that, given the total number of layers in the firm, the increase in hours of work hired is higher in lower layers. My estimates of β^{l}_{L} also satisfy that $\beta^{l}_{L} > \beta^{l'}_{L}$ for $l < l'$, so that as firms grow in value added, they become flatter, employing proportionally more hours of work in the bottom layers. Comparing my results to those for French firms (see Caliendo et al., 2015b), I observe that the elasticities for Slovenian firms tend to be significantly higher. Namely, the range of these elasticities for French firms is between 0.013 and 0.107, while the corresponding elasticities for Slovenian firms are between 0.107 and 0.152. This finding seems expected given the previous result that Slovenian firms are less inclined to change their organizational layers in response to changes in value added. Moreover, a comparison of the range of estimated elasticities between the two countries also suggests important differences in the adjustment of the number of hours across layers, as Slovenian firms exhibit a weaker flattening of organizational hierarchies.

Next, I use a similar estimation equation, only this time to estimate the elasticity of average wages to value added for firms keeping the same number of layers in two consecutive years. I estimate

$$\text{dlog}\widetilde{w}^{l}_{Li,t} = \gamma^{l}_{L}\text{dlog}\widetilde{VA}_{i,t} + \epsilon_{i,t}, \tag{1.4}$$

where $\text{dlog}\widetilde{w}^{l}_{Li,t}$ denotes the yearly log difference in detrended average wage in layer l for firm i keeping L total layers for two consecutive years, and $\log\widetilde{VA}_{i,t}$ is the yearly log difference in detrended value added for firm i at year t. γ^{l}_{L} denotes the elasticity of average wage in layer l for firms with L layers with respect to value added, for firms that do not change layers in 2 consecutive years.

Table 1.11 presents my estimates for the elasticity of wages with respect to value added, γ^{l}_{L}. These results are again in line with the theory by Caliendo & Rossi-Hansberg (2012), as all of my estimates are significant, positive, and satisfy that $\gamma^{l}_{L} < \gamma^{l'}_{L}$ for $l < l'$. This means that, as firms grow in value added without adding layers, they increase wages in all their existing layers, although the

Table 1.10: Elasticities of Normalized Working Hours With Respect to Value Added, for Firms that Keep L Layers in Two Consecutive Years

Number of Layers	Layer	β^l_L	Standard Error	p-Value	Observations
2	1	0.108	0.009	0.000	15,925
3	1	0.139	0.008	0.000	14,525
3	2	0.129	0.010	0.000	14,525
4	1	0.152	0.013	0.000	7,666
4	2	0.135	0.014	0.000	7,666
4	3	0.107	0.016	0.000	7,666

Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table shows my estimates of the elasticity of working hours to value added, β^l_L. These estimates are obtained from the equation $\mathrm{dlog}\tilde{n}^l_{Li,t} = \beta^l_L \mathrm{dlog}\widetilde{VA}_{i,t} + \epsilon_{i,t}$, where $\mathrm{dlog}\tilde{n}^l_{Li,t}$ is the yearly log difference in detrended normalized hours of work, in layer l and total number of layers L, and $\mathrm{d}\log\widetilde{VA}_{i,t}$ is the yearly log difference in detrended value added, both for firm i in year t.

increases are proportionally larger at higher layers. Comparing these results with those obtained for French firms (Caliendo et al., 2015b), I again observe important differences. Wage elasticities for Slovenian firms are relatively small, ranging between 0.019 and 0.068, whereas the corresponding elasticities for French firms are significantly higher, between 0.077 and 0.217. Interpreting these results jointly with the results on the elasticities of hours, we can deduce that among firms that keep layers unchanged, Slovenian firms tend to primarily adjust hours, whereas French firms mainly adjust wages.

Next, I consider the adjustment of firms depending on whether they decrease, increase, or keep the same number of layers of management over consecutive years. The implications of the theory by Caliendo & Rossi-Hansberg (2012) are now different than in the previous case. Firms that grow by adding a new top layer of management should hire more hours of work, but at the same time decrease wages in all pre-existing layers. Table 1.12 presents my estimates for the average differences in log of total hours of work, normalized total hours of work, value added and average firm wage, both including and excluding wages in the newly added/dropped layer, if so. It shows that, over consecutive years, and even after removing time trends in the variables, firms tend to increase their number of working hours, value added and wages when adding layers. This general pattern is consistent with that documented by Caliendo et al. (2015b) for French firms.

The same pattern is evident with respect to working hours and value added even when considering only firms that increase or do not change their number of layers. However, I find that on average firms that increase their number of layers also tend to increase their wages, whilst the theory implies that firms that add a layer of management should decrease wages in bottom layers, since they are reducing knowledge in all pre-existing layers and adding a new top layer in order to deal with uncommon problems. That is the reason why I also compute the average log change in wages only for common layers, i.e. those which firms had both before and after the change. The negative and significant estimates for firms that increase their total layers show that, in accordance with the

Table 1.11: Elasticities of Wages with Respect to Value Added, for Firms that Keep L Layers in Two Consecutive Years

Number of Layers	Layer	γ_L^l	Standard Error	p-Value	Observations
1	1	0.065	0.005	0.000	13,045
2	1	0.051	0.004	0.000	15,925
2	2	0.068	0.005	0.000	15,925
3	1	0.039	0.004	0.000	14,525
3	2	0.043	0.005	0.000	14,525
3	3	0.058	0.005	0.000	14,525
4	1	0.019	0.004	0.000	7,666
4	2	0.022	0.005	0.000	7,666
4	3	0.039	0.008	0.000	7,666
4	4	0.052	0.009	0.000	7,666

Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table presents my estimates of the elasticity of average wage to value added, γ_L^l, for firms that do not change layers in 2 consecutive years. The estimates are obtained from the regression $\text{dlog}\widetilde{w}_{Li,t}^l = \gamma_L^l \text{dlog}\widetilde{VA}_{i,t} + \epsilon_{i,t}$, where $d\text{log}\widetilde{w}_{Li,t}^l$ is the yearly log difference in detrended normalized average wage in layer l for firm i keeping L total layers for 2 consecutive years, and $\text{d}\log \tilde{VA}_{i,t}$ is the yearly log difference in detrended value added for firm i at year t.

theory, wages in all pre-existing layers tend to decrease once a firm adds a new top layer. On the contrary, when firms do not change layers or drop a top layer, wages in all pre-existing layers tend to increase. Once again it is necessary to point out the difference in adjustment of wages and hours between Slovenian and French firms. The former exhibit larger changes in total hours in response to changes in the number of layers[18], whereas the latter tend to make greater wage adjustments. A case in point are firms that expand layers. For these firms I observe that (i) the average growth rate of detrended total hours is 0.336 for Slovenian firms and only 0.04 for French firms and (ii) the wage growth rate in common layers is -0.059 for Slovenian firms, while the corresponding value for French firms is -0.101.

Next, I investigate a theoretical prediction stating that firms adding layers should increase their hours of work in all pre-existing layers and decrease wages in all pre-existing layers. This is done in Table 1.13, which shows the average changes in log hours of work and wages for firms that make a transition from L to L' total layers (for $L \neq L'$), layer by layer. I focus on firms that experience a layer transition as described by the first two columns, and calculate the average log change in detrended normalized hours and wages in the (common) layer (stated in the third column). Focusing first on working hours, I confirm the theory as all my estimates are statistically significant, and for transitions with an increase (decrease) in the total number of layers the change is positive (negative). In comparison to French firms, I find that most (but not all) of the absolute values of the changes we observe are lower, which is exactly what I observe in Table 1.12 in the case of normalized working

[18]Note that the adjustment of normalized hours is smaller in Slovenia, which may be due to smaller absolute change in the top layer.

Table 1.12: Firm-Level Outcomes Conditioned on Layer Management

	All	Increase in L	No Change in L	Decrease in L
dlog Total Hours	0.045**	0.387**	0.043**	-0.299**
Detrended	-	0.336**	-0.003	-0.344**
dlog Normalized Hours	0.012**	1.078**	0.003	-1.046**
Detrended	-	1.066**	-0.009**	-1.058**
dlog Valued Added	0.020**	0.242**	0.012**	-0.136**
Detrended	-	0.222**	-0.008*	-0.116**
dlog Average Wage	0.021**	0.034***	0.020**	0.020**
Detrended	-	0.013**	-0.001	0.000
Common layers	0.021**	-0.037**	0.020**	0.088**
Detrended	-	-0.059**	0.000	0.067**
% of Firms	100.00	8.34	84.01	7.66
% Value Added Change	100.00	15.78	96.28	-12.06

Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table reports changes in various firm outcomes, grouping firms according to the type of transition they experience between two years: increase in their total number of layers L, decrease in L, no change in L, and altogether. For changes in the average wage in common layers, I compute average wage only taking into account the layers that existed both before and after the referenced transition. To detrend variables, I again use aggregate trends following Caliendo et al. (2015b), as explained above. In the last two rows, % of firms shows the percentage of firms engaging in each type of transition, and % value added change shows the share of total change in value added for the whole data set explained by firms in each type of transition. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively.

hours.

Regarding the adjustment of average wages to layer transitions, I note that the estimated coefficients are not all significant as in the case of working hours. Namely, out of 20 estimates, 12 are statistically significant (at the 1% level). More importantly, among the significant coefficients 11 out of 12 have the sign that is in line with the theory: in firms that add layers, wages tend to decrease in every pre-existing layer, and in firms that drop layers, wages should increase in every pre-existing layer. In comparison to French firms, for which Caliendo et al. (2015b) find all coefficients correctly signed and statistically significant, Slovenian firms again exhibit lower responsiveness of wages to layer transitions.

Continuing with the analysis of layers and wages, I follow Caliendo et al. (2015b) to decompose firm-level the log-change in detrended average wage in the firm:

$$\text{dlog}\bar{w}_{Li,t} = \log \bar{w}_{L'i,t+1} - \log \bar{w}_{Li,t} = \log \left[\left(\frac{\bar{w}^{l \leq L}_{L'i,t+1}}{\bar{w}_{Li,t}} \right) s + \left(\frac{\bar{w}^{L'}_{L'i,t+1}}{\bar{w}_{Li,t}} \right) (1 - s) \right]. \quad (1.5)$$

Here $\bar{w}^{l \leq L}_{L'i,t+1}$ denotes the average detrended wage in all pre-existing layers in the firm after the transition from L to L' total layers, where $L' > L$. $\bar{w}^{L'}_{L'i,t+1}$ is the average wage in the newly added layer, $\bar{w}_{Li,t}$ is the average wage in the firm before the transition for all layers, and s is the share of working hours in pre-existing layers.

Table 1.13: Average Change in Log-Hours and Log-Wages in Layer l, Conditioned on Transition Type

Total Layers Before	Total Layers After	Layer	$\text{dlog}\tilde{n}^{l}_{Li,t}$	S.E.	$\text{dlog}\tilde{w}^{l}_{Li,t}$	S.E.	Observations
1	2	1	0.515***	0.039	-0.080***	0.011	1904
1	3	1	0.833***	0.137	-0.044	0.049	165
1	4	1	2.621***	0.522	0.496	0.384	9
2	1	1	-0.610***	0.037	0.083***	0.013	1632
2	3	1	0.645***	0.038	-0.026***	0.007	1848
2	3	2	0.383***	0.041	-0.208***	0.012	1848
2	4	1	1.442***	0.235	0.050	0.051	77
2	4	2	1.581***	0.183	-0.054	0.065	77
3	1	1	-0.964***	0.120	0.118**	0.049	150
3	2	1	-0.629***	0.035	0.037***	0.009	1742
3	2	2	-0.523***	0.037	0.252***	0.014	1742
3	4	1	0.770***	0.039	0.002	0.006	1074
3	4	2	0.753***	0.042	-0.047***	0.010	1074
3	4	3	0.449***	0.048	-0.213***	0.019	1074
4	1	1	-1.846***	0.432	-0.074	0.270	22
4	2	1	-1.540***	0.209	-0.004	0.048	83
4	2	2	-1.466***	0.186	0.225***	0.081	83
4	3	1	-0.742***	0.038	-0.006	0.008	1033
4	3	2	-0.745***	0.039	0.037***	0.011	1033
4	3	3	-0.417***	0.045	0.275***	0.022	1033

Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table presents the log changes in hours worked and wages in a specific layer, separately by total number of layers before and after transition. In each row are shown the estimates for firms transitioning from L to L' total layers in two consecutive years, where $L \neq L'$. Hours are normalized by hours in the top layer. Both wages and hours are detrended using aggregate trends. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively.

In Table 1.14 I report estimates for each component, separately by layer transitions. The upper left and right cells show average ratios that compare wages after and before transitions in common organizational layers. For example, for firms expanding from 1 layer to 2 layers, this ratio is 0.987 for workers that stayed in layer 1, which implies a modest reduction of average wage in common layers, as predicted by the theory of organizational hierarchies. Similarly, all reorganizations that add one layer also exhibit a decrease in the average wage. However, additions of more than one layer lead to growth in wages even in the common layers. These positive growth rates are consistent with my previous observations (Table 1.13), which showed that workers' pay in the first layer did not decline after the layer expansion. This is inconsistent with the theory and evidence provided by Caliendo et al. (2015b) for French firms, which systematically decrease wages in common layers after expanding the total number of layers. Nevertheless, further investigation of changes in the wages of workers in common layers (see Figure 1.8 below) shows that log-changes are mostly negative, especially for workers in higher percentiles of wage distributions.

The upper right panel shows the ratios between wages of workers in the new layers after the transitions in comparison to wages of workers before the transitions. Consistent with the theory and evidence for French firms (see Caliendo et al., 2015b) I observe that the average wage in the newly added layer is far higher than the average wage before said transition. That is, when firms add layers, average wages in those new layers are significantly higher than average wages in pre-existing layers.

The overall effect of transitions on firm wages can be seen in the bottom-right panel, where I report the log change of the average wage. I mostly observe increases in the average wage for firms adding one or more layers, although the estimates are not statistically different from zero in 3 out of the 6 transition types. This result is in stark contrast to French firms, for which Caliendo et al. (2015b) report negative values in 5 out of the 6 transition types, and may be attributed to the fact that Slovenian firms only modestly reduce wages in pre-existing layers when expanding the total number of layers.

In order to complete the analysis of changes in wages in response to layer transitions, I also consider changes in the entire wage distribution. According to the theory by Garicano & Rossi-Hansberg (2006), reorganizations have an impact on wage inequality within firms. Again, I follow Caliendo et al. (2015b) in computing the log difference in wages before and after transitions for each percentile, as well as in building bootstrapped confidence intervals (5th and 95th percentiles of the replications). The plots in Figure 1.7 show that firms in my data set do exhibit some change in their wage distribution when performing a transition. For instance, when firms transition from 2 layers to 1 layer, the bottom percentiles experience an increase in wages higher than those in the top of the distribution. However, the impact of these transitions contains also the component of the newly added (or dropped) layer in the wage distribution. It may therefore be useful to look at changes in wage distribution by focusing only on the changes in wages in pre-existing layers. Figure 1.8 presents log changes in wages by percentiles, just as Figure 1.7, but conditioning on common layers before and after the transition. Here, the picture becomes clearer: wages tend to increase in pre-existing layers when firms drop a layer, especially in higher percentiles; also, when firms add a layer, they

Table 1.14: Decomposition of Log-Change in Average Wages, by Transition Type

	$\frac{\bar{w}^{l\leq L}_{L'i,t+1}}{\bar{w}_{Li,t}}$		
From/To	2	3	4
1	0.987***	1.125***	3.285*
	[1,866]	[163]	[9]
2		0.952***	1.130***
		[1,812]	[77]
3			0.971***
			[1,054]

	$\frac{\bar{w}^{L'}_{L'i,t+1}}{\bar{w}_{Li,t}}$		
From/To	2	3	4
1	1.098***	1.584***	8.726
	[1,866]	[163]	[9]
2		1.519***	2.014***
		[1,812]	[77]
3			2.772***
			[1,054]

	s		
From/To	2	3	4
1	0.584***	0.488***	0.610***
	[1,866]	[163]	[9]
2		0.821***	0.822***
		[1,812]	[77]
3			0.953***
			[1,054]

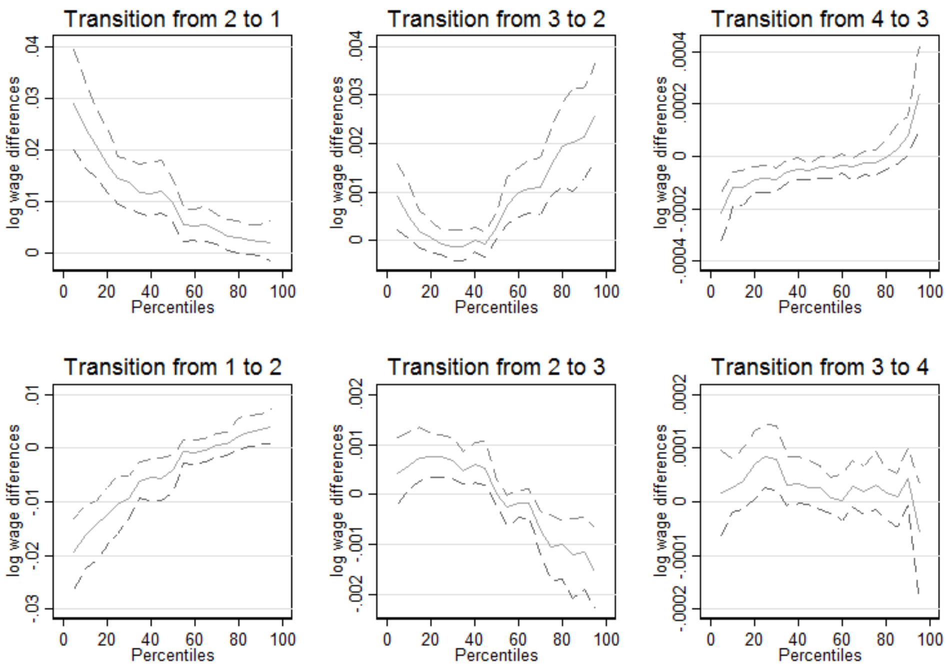
	$\text{dlog}\bar{w}_{Li,t}$		
From/To	2	3	4
1	-0.004	0.075*	0.742
	[1,866]	[163]	[9]
2		0.005	0.076*
		[1,812]	[77]
3			0.016***
			[1,054]

Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table presents estimates of the components of decomposition of the total log-change in average wage, by transition type, into average wage change in pre-existing layers, and in the newly added layer, both with respect to average wage before transition. For the top-left panel, I compute $\bar{w}^{l\leq L}_{L'i,t+1}$, which is the average wage in common layers (i.e. pre-existing layers before the transition occurs) after the corresponding transition from L to L' total layers (with $L' > L$), as well as $\bar{w}_{Li,t}$, which is the average wage before transition among all layers; after detrending both measures using again aggregate trends of wages, I compute the average ratio and its standard error. For the top-right panel I follow the same procedure, but this time I compute $\bar{w}^{L'}_{L'i,t+1}$, which is the average wage in the newly added layer after transition, in order to obtain its ratio with the average wage among all layers before transition (detrending both measures), and compute the average ratio. For the bottom-left panel, I calculate total hours of work in common layers (i.e. pre-existing layers before transition) and total hours of work among all layers, for those firms engaging in layer transitions; after detrending both measures, I compute the ratio of the former over the latter and calculate the average. Hence, s is an estimate of the share of hours of work in pre-existing layers. Finally, the bottom-right panel shows the estimates for total log-change in detrended average wage; to do so, I compute average wage both before and after transition, and after detrending both variables, I compute their log-difference, and calculate its average. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively.

tend to decrease wages, especially in higher percentiles. These results are again in line with the theory by Caliendo & Rossi-Hansberg (2012) and the observed patterns in French firms (Caliendo et al., 2015b).

Figure 1.7: Change in Wage Distribution by Transition Type



Source: Own calculations based on data from SER, SFA and AJPES.

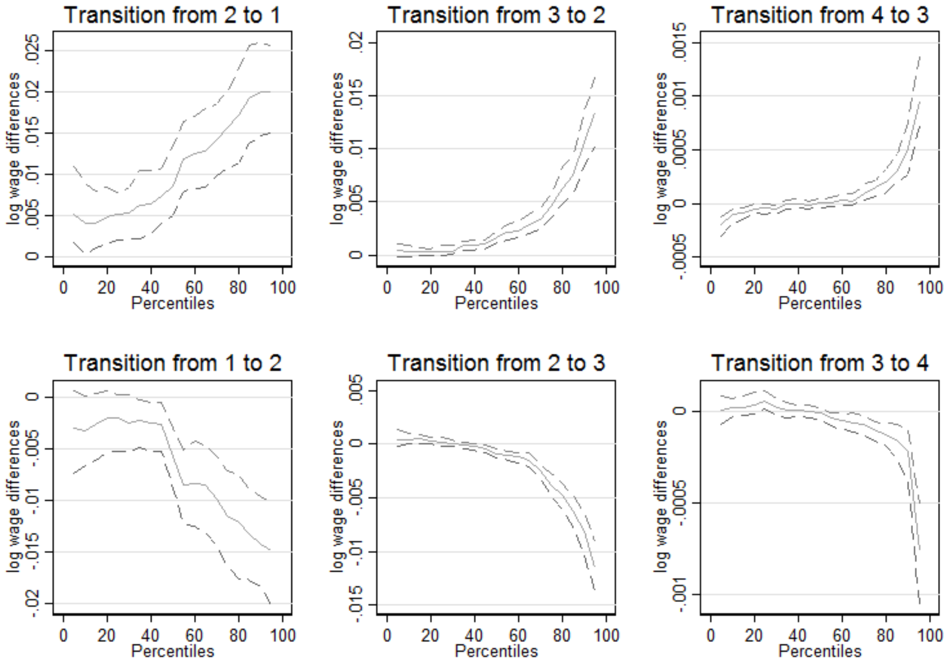
Note: This figure presents differences in log-wages after and before each transition type, by wage percentile in my sample. Following Caliendo et al. (2015b) I remove firm and year fixed effects from log-hourly wage in the data set. Then, I weigh this employee-level "clean" log-wage by the share of yearly working hours of each employee in each firm. After this, I compute the percentile wage distribution for each firm-year, i.e. I obtain 19 values of clean weighted log-wage for each firm-year, corresponding to the pth percentile, with $p = 5, 10, ..., 95$. I then focus on those firms engaging in each 1-layer transition type between 2 years (i.e. from L to L' total layers, with $L, L' = 1, 2, 3, 4$ and $|L - L'| = 1$), and compute the difference in my wage measure at each percentile. Next, using this percentile distribution of log-wage changes I have for each firm-year, I bootstrap its values and confidence intervals (5th and 95th estimated percentiles), with 500 replications and clustering by firm. Hence, I end up with an estimated percentile distribution of log-changes in wages for the whole sample, each estimated percentile with its own confidence interval, for those firms transitioning from L to L' total layers in each panel, with $L, L' = 1, 2, 3, 4$ and $|L - L'| = 1$.

Finally, I use the methodology by Caliendo et al. (2015b) one more time in order to show how hierarchies in firms change in terms of normalized hours of work and wages when they experience transitions. Figures 1.9, 1.10 and 1.11 show how, when adding a layer of management, firms tend to decrease average wages and increase the number of hours of work in pre-existing layers, while the newly added layer has, of course, the highest average wage and the lowest total number of hours of work in it. At the same time, when firms decide to drop a layer of management, they tend to increase average wages and decrease the number of hours of work in pre-existing layers.

1.6.5 Other Variables as *Proxies* of Knowledge

This last exercise seeks to employ variables other than hourly wage that can also measure the level of knowledge within layers, which is what firms manage whenever there are expansions or contractions

Figure 1.8: Change in Wage Distribution in Common Layers by Transition Type



Source: Own calculations based on data from SER, SFA and AJPES.

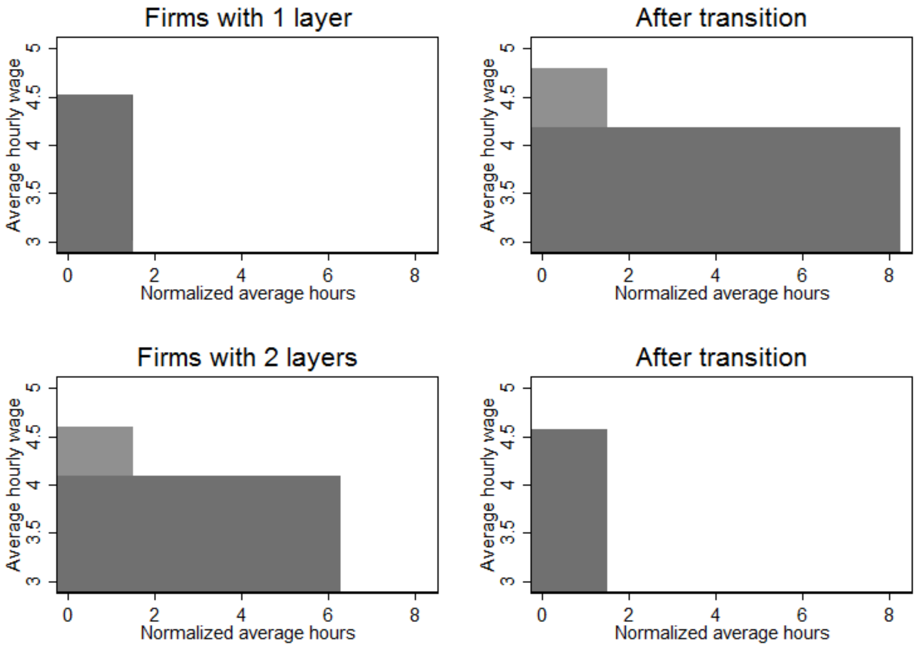
Note: This figure presents differences in log-wages, after minus before each transition type, by wage percentile in my sample, using only common layers (i.e. layers existing before and after the transition). I follow the exact same method I use to build Figure 1.7, but this time using only the pre-existing layers before each transition type in every firm-year to build the wage percentile distribution.

that induce them to change their organizational structure in terms of layers. As the model by Garicano (2000) states, firms use hierarchies in order to optimize their organizational structure by allocating workers and supervisors with different levels of knowledge to different layers. Depending on specific conditions, firms may decide to invest in knowledge acquisition for their workers, thus requiring fewer layers of supervisors dealing with more complex problems, or they may decide to reduce the knowledge of bottom layer workers and instead create a new layer of more knowledgeable problem solvers who will deal with more complex situations whenever they arise.

Thus far I use the variable "hourly wage" as a market-based measure for knowledge. Now, following Caliendo et al. (2015b) I use formal education and experience as more direct measures for the knowledge of employees, and examine how firms manage these as they grow in value added. As I mention earlier, the Slovenian Employment Registry data set contains employee-level information on educational attainment based on the International Standard Classification of Education codes, which I am able to transform into years of formal education.[19] In order to obtain worker experience, I follow Caliendo et al. (2015b) and compute what the authors call "potential experience" for each employee, by taking their age and subtracting their years of formal education from it, and subtracting again 6. Then, I compute average experience and average education by layer in each firm, take logarithms, and after detrending them using aggregate trends, I compute their difference after and before transition. Finally, I regress each of them on a constant for those firms engaging

[19] I recode primary school into 8 years of schooling, attained high school degree to 12 years of schooling, finished 2-and 4-year undergraduate degrees to 14 and 16 years of schooling, respectively, master's degree to 18 years of schooling, and PhD to 20 years of schooling.

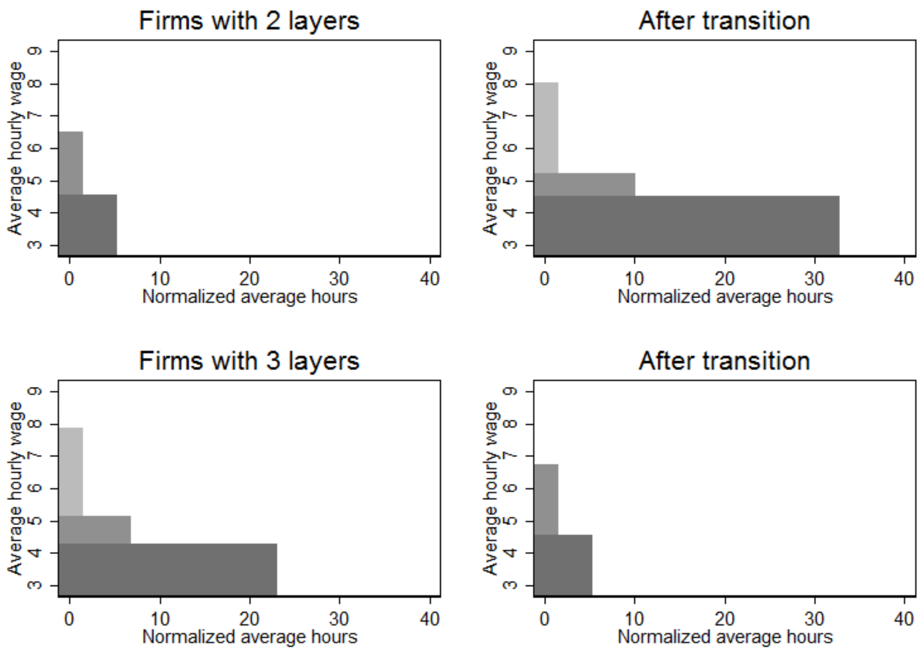
Figure 1.9: Representation of Transition Between One and Two Layers



Source: Own calculations based on data from SER, SFA and AJPES.

Note: This figure provides a graphical representation of hierarchies in the average firm before and after making the transition from 1 to 2, and from 2 to 1 total layers. To build it, I compute total hours of work in each layer, normalized by total hours of work in the top layer in every firm-year, as well as average wage. Finally, I focus in firms that transition from 1 to 2 total layers in consecutive years and compute the averages in normalized hours of work and mean wage among them, both before and after transitioning. I do the same, focusing on firms that transition from 2 to 1 total layers.

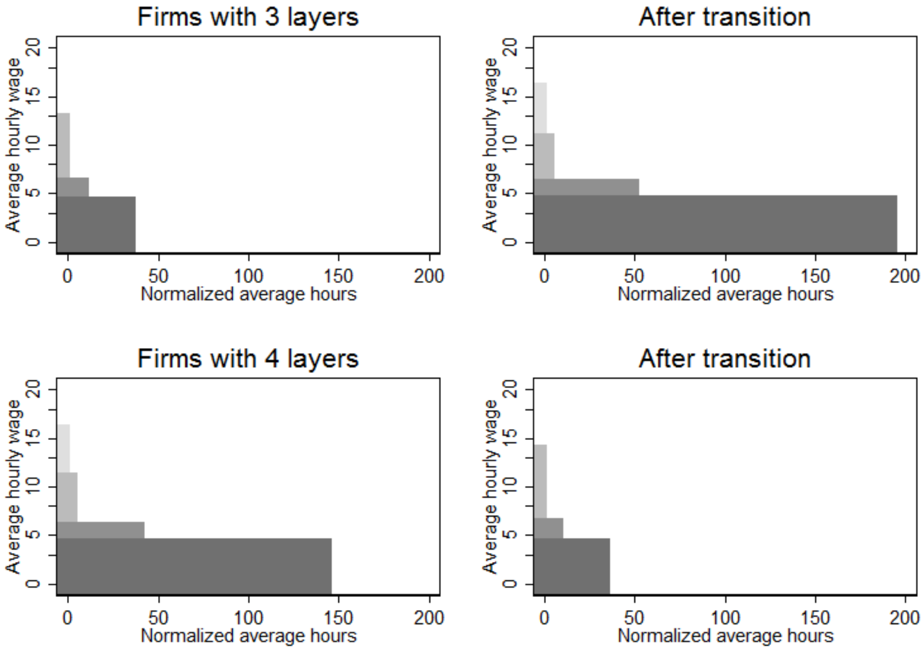
Figure 1.10: Representation of Transitions Between Two and Three Layers



Source: Own calculations based on data from SER, SFA and AJPES.

Note: This figure provides a graphical representation of hierarchies in the average firm before and after making the transition from 2 to 3, and from 3 to 2 total layers. I follow the same method used to build Figure 1.9.

Figure 1.11: Representation of Transition Between Three and Four Layers



Source: Own calculations based on data from SER, SFA and AJPES.
Note: This figure provides a graphical representation of hierarchies in the average firm before and after making the transition from 3 to 4, and from 4 to 3 total layers. I follow the same method used to build Figure 1.9.

in layer transitions, in order to obtain average changes in experience and education, layer by layer, for firms transitioning from L to L' total layers, with $L, L' = \{1, 2, 3, 4\}$ and $L \neq L'$.

According to the model by Garicano (2000), firms that add new layers should exhibit a decrease in knowledge in pre-existing layers, as they hire more knowledgeable superiors in the newly added top layers, whilst firms that reduce their size and drop layers should increase their level of knowledge in pre-existing layers, as they need their bottom-layer workers to be able to solve more complex tasks that their supervisors had to tackle before.

Table 1.15 shows my estimates for average changes in experience and education by transition type. With respect to average years of formal education, out of the 10 transition types that add layers, 6 estimates are statistically significant (only one of them at the 10% level) and have signs consistent with the theory, i.e. a decrease in average education in pre-existing layers. On the other hand, out of the 10 transition types that drop layers, 8 estimates are significant (only two of them at the 5% level) and show the proper sign, i.e. an increase in average education in pre-existing layers. In comparison to French firms in Caliendo et al. (2015b), which exhibit mostly low and insignificant effects of reorganizations on average education, my results seem to lend more support to the theory.

Regarding experience, only 11 out of the 20 transition types altogether have the expected sign and are statistically significant. However, when considering both variables together, I note that only in 2 transition types are changes in average knowledge not significant, and in a third case it does not have the expected sign. In the remaining transition types in which average change in education is not statistically significant, average change in experience results significant and exhibits the correct

Table 1.15: Average Change in Experience and Education for Firms, Conditioned on Transition Type

			Experience			Education		
Total Layers Before	Total Layers After	Layer	$\beta^l_{L,L'}$	p-Value	Observations	$\gamma^l_{L,L'}$	p-Value	Observations
1	2	1	-0.064	0.000	1,637	-0.046	0.000	1,785
1	3	1	-0.007	0.889	150	-0.117	0.000	160
1	4	1	0.263	0.320	8	-0.142	0.068	8
2	1	1	0.099	0.000	1,355	0.047	0.000	1,564
2	3	1	0.010	0.267	1,696	-0.015	0.000	1,815
2	3	2	-0.192	0.000	1,334	-0.015	0.000	1,451
2	4	1	0.085	0.094	72	-0.032	0.005	75
2	4	2	-0.063	0.281	67	0.006	0.670	71
3	1	1	0.060	0.185	111	0.109	0.000	149
3	2	1	0.027	0.003	1,537	0.019	0.000	1,721
3	2	2	0.175	0.000	1,180	0.014	0.000	1,361
3	4	1	0.018	0.000	1,024	0.004	0.046	1,072
3	4	2	-0.034	0.001	967	0.001	0.617	1,015
3	4	3	-0.089	0.000	1,025	-0.005	0.318	1,071
4	1	1	-0.048	0.836	12	0.133	0.017	20
4	2	1	0.057	0.159	72	0.012	0.569	83
4	2	2	0.118	0.096	69	0.022	0.173	79
4	3	1	0.026	0.000	958	0.009	0.000	1,033
4	3	2	0.048	0.000	916	0.005	0.013	991
4	3	3	0.053	0.000	954	0.024	0.000	1,030

Source: Own calculations based on data from SER, SFA and AJPES.

Note: This table presents estimates for average changes in experience and educational attainment by layer, according to transition type. Employee-level educational attainment is one of the variables in the Slovenian Employment Registry data set. Following Caliendo et al. (2015b), I compute potential experience as employee's age minus their years of formal education, minus 6. Then, in each row I focus on firms transitioning from L to L' total layers in two consecutive years, with $L \neq L'$, and I compute log average experience and log average education for said firms at layer l (which exists in both years), where $l = 1, ..., min\{L, L'\}$. I again use aggregate trends in order to detrend both variables at layer l. Finally, I regress the detrended log change in experience and the detrended log change in education, each one by separate, on a constant, which yields my estimates for average change in experience ($\beta^l_{L,L'}$) and average change in education ($\gamma^l_{L,L'}$).

sign.

Hence, my results suggest that in the vast majority of layer transitions, Slovenian firms alter average knowledge in pre-existing layers just as the theory predicts. In most cases, these come in the form of changes in average formal education, which in some cases are complemented with changes in average worker experience. In the couple of cases in which average formal education is not altered when undergoing a transition, it is average experience that firms decide to modify.

According to my results in Table 1.15, Slovenian firms that decide to add a layer of management hire more knowledgeable (in terms of education or experience) workers and/or promote the more educated/experienced ones into the new top layer, thus decreasing the average level of knowledge in bottom (pre-existing) layers, where they hire employees with a level of knowledge similar to the average. Firms undergoing a contraction such that they decide to drop a layer of management do the exact opposite, by transferring their more knowledgeable employees from the recently dropped top layer into lower layers, which will now have to tackle more complex problems. These dynamics are also consistent with the findings by Caliendo et al. (2015b), which allows me to conclude that wage variation due to layer transitions, as shown in Table 1.13, is backed up by changes in knowledge across layers. If anything, my results may suggest that, when undergoing layer transitions, wages in Slovenian firms tend to be a bit more rigid than the level of knowledge of their employees across layers.

1.7 Explaining the Differences between France and Slovenia in Organizational Depth

In the preceding sections several important differences between French and Slovenian organizational hierarchies are found. The aim of this section is to provide some account of the observed differences guided by the theoretical framework of Caliendo & Rossi-Hansberg (2012). The main difference lies in the depth of organizations. Namely, the average number of organizational layers in Slovenian firms over all years is 2.28, significantly lower than 2.56, which is found by Caliendo et al. (2015b) using the French sample. However, a comparison of layer distributions in Table 1.16 shows that the Slovenian sample contains more firms with one layer (26.7 percent vs. 17.8 percent in France) and also fewer firms with top-two layers (41.5 percent in Slovenia vs. 44.6 percent France), which I try to provide some account for.

After investigating several factors that may account for the observed difference in the average number of layers, I believe that the most important driver could be the difference in sample construction. Although based on the shares of firm-year observations in the total number of enterprises[20], which are 29.4 % and 28.8 % for France and Slovenia, respectively, the two samples differ in terms of conditions for inclusion. The data set for France includes all enterprises (both firms and sole proprietors) that are subject to a minimum revenue requirement of 750,000 EUR (which may include

[20] I obtain the total number of enterprises for each year from the OECD (2020) structural analysis database.

Table 1.16: Key Variables in French and Slovenian Manufacturing Samples

	Firm-years		Unweighted means		
Layers	Number	Share	Value added	Hours	Value added per hour
			Slovenia		
1	19,120	26.7	41	3,552	11.63
2	22,872	31.9	183	17,131	10.66
3	19,853	27.7	856	80,899	10.58
4	9,865	13.8	5,125	390,363	13.13
All	71,710	100.0	1,011	82,509	12.26
			France		
1	80,326	17.8	201	7,656	26.25
2	124,448	27.6	401	15,706	25.53
3	160,030	35.4	2,834	80,488	35.21
4	86,671	19.2	8,916	211,098	42.24
All	451,475	100.0	2,862	74,746	38.30

Source: Table 1.4 and Caliendo et al. (2015b).

Note: This table presents the number of observations (firm-years) and the average values for the referenced variables by total number of layers. Mean values are value added are reported in real terms.

data for firms with lower revenue), whereas no such limit on revenues is imposed in Slovenia (which includes only firms).

I account for the impact of truncation on the average number of layers using two approaches. The first approach relies on calculating the average number of layers in my Slovenian sample after imposing a comparable lower bound in line with the French requirement, whereas the second one simply imposes the share of one-layered firms in the French sample on the Slovenian sample. For the first approach I use OECD structural statistics (OECD, 2020) on revenues of all firms to calculate the average size for all enterprises. Based on these, I calculate the ratio between the average size of enterprises in the two countries, which is equal to 3.18. Assuming that the ratio in the average revenue translates into the ratio of reporting cutoffs, the reporting cutoff in Slovenia corresponding to 750,000 EUR in France would be around 235,540 EUR.[21] Using my sample of firm-year observations and excluding those under this lower bound in terms of revenues yields an average number of layers of 2.81, which even exceeds the average number of layers in the French sample. While this number appears implausibly high, it nevertheless implies that the reporting cutoff likely plays an important role in explaining the differences in the depth of organizational hierarchies. Namely, applying a more reasonable reporting cutoff set at 90,000 EUR would already give the same average number of layers in Slovenia as that observed in the French sample (2.56).

An alternative way to evaluate the impact of truncation is to assume that only the share of French firms with one layer is affected by the revenue cutoff. I do so by imposing the same share of 1-layered

[21] For this assumption to hold, the two distributions would need to have the same higher moments, which is unlikely to hold given the typically observed lognormal shape.

firms in French manufacturing on Slovenian manufacturing (26.7 percent; and proportionately reducing the shares of firm-year observations with more than one layer). This adjustment yields an implied average number of layers in French manufacturing equal to 2.39, which accounts for roughly 60 percent of the difference in the average number of layers between the two samples. Hence, I can conclude that a large portion of the difference average number of layers between the two samples could be attributed to the French reporting cutoff.

Next, I turn to the issue of why Slovenia has significantly fewer 3- and 4-layered firms, even when conditioning on firms having at least two layers. The theory of knowledge-based hierarchies by Caliendo & Rossi-Hansberg (2012) offers two major determinants for which I can provide some evidence for. Their theory posits that the incentive to increase the number of layers depends on preference and technology shifters (e.g. quality of products and/or productivity) and the wages of workers in different layers. I first focus on preference and productivity shifters. For this purpose I rely on comparison of average values of labor productivity (value added per hour) and hours by layers, given in Table 1.16. From the table it is evident that the average number of Slovenian and French firms with 2 and 3 layers is quite similar (e.g. the average hours for 2-layered firms is 17,131 in Slovenia and 15,706 in France), while 4-layered Slovenian firms seem significantly larger.[22] Similarity in size, in terms of total hours, suggests that firms in Slovenia and France are organized more or less similarly within layers. The difference in the share of 3- and 4-layered firms (and also the average number of layers) can then be attributed to differences in productivity distributions.

It is indeed evident that the average labor productivity of French firms in the top two layers in comparison to 2-layered firms is significantly higher than that observed for Slovenian firms. In particular, 3-layered (4-layered) firms in France have on average 37.9 (65.4) percent higher productivity than 2-layered firms, whereas their Slovenian peers with 3-layers (4-layers) have -0.8 percent (23.2) disadvantage (advantage) over 2-layered firms.[23] Thus, a higher share of highly productive firms in France seems to contribute to the higher average number of layers.

As already suggested above, the lower proportion of 3- and 4-layered firms in Slovenia could also be attributed to differences in wage structure between the two countries. Although Caliendo & Rossi-Hansberg (2012) link the wage premia for more knowledgeable workers to the costs of education, this may not be an adequate description of labor markets in the short-run. Namely, the skill premia may be determined by current market conditions, i.e. relative demand and supply of workers with different skills. For transition countries, short-run deviations from the long-run equilibria may be particularly stark due to underinvestment in tertiary education during the socialist period. While all Central and Eastern European transition countries — including Slovenia — increased investments in tertiary education, reflected in an increasing number of graduates, the process of convergence of wages towards the long-run equilibria was gradual and featured a lengthy period of high private

[22] The average size of firms with four layers likely reflects the socialist heritage of distorted firm size distribution. See Polanec (2006) for evidence on the evolution of Slovenian firm size distribution during the process of transition.

[23] I also calculate the coefficient of variation for the samples of firms based on categorized data. This measure is 0.11 for the Slovenian sample, which is significantly lower than 0.23 calculated for the French sample.

rates of return to education, particularly for college graduates (see Bartolj et al., 2013).

In an international comparison of returns to education, Psacharopoulos & Patrinos (2018) show that the private rates of return to secondary education in Slovenia (10.3 percent in 2015) were comparable to the corresponding returns in France (9.4 percent in 2013), but significantly higher in Slovenia for tertiary education (16.8 percent as opposed to 9.5 percent in France). As shown in Bartolj et al. (2013), even higher returns are observed in Slovenia in earlier periods, which partly overlap with the period of analysis of the data (1997-2011). To corroborate this evidence, note that during the 2002-2007 period France had on average 27.5 (44.1) percent of its labor force with completed tertiary (secondary) education, whereas Slovenia had during the 1999-2011 period on average 20.6 (62.2) percent its employees with completed tertiary (secondary) education. In the manufacturing sector these differences were even more pronounced; the share of college-educated employees in my data set is 14.8 percent, and around 25 percent in the French sample.

The differences in skill wage premia appear to be also reflected in layer wage premia. Namely, as already noted in Slovenia the wage premium in the third (fourth) layer in comparison to the second (third) one is around 90 (89) percent, whereas in France the corresponding premium is 80 (70) percent. Higher relative wages for college educated workers in the top-two layers may reduce incentives to expand, and explain part of the differences in the distribution of the number of layers between France and Slovenia. To provide some quantitative evaluation of the impact of the divergent shares of college educated persons in France and Slovenia, I run a simple regression of the average number of layers on the share of college educated workers in the manufacturing sector at the level of regions over a period of 15 years (a total of 180 observations). The estimated coefficient is 1.322 (cluster-robust s.e. is 0.306), which implies that an increase in the share of college educated workers by 10 percentage points increases the average number of layers by 0.13 (46 percent of the total difference in the average number of layers of 0.28).

Finally, I consider also that the role industrial structure could play in accounting for observed differences in the average number of layers in Slovenia and France. In general, industries in different countries may differ in terms of productivity distributions, demand patterns, the extent of foreign and domestic competition, technological complexity (spending on research and development), cost of knowledge (if it is industry specific), and entry barriers (e.g. regulatory framework). To give some indication on the role industrial structure could play, I calculate the average number of layers in the Slovenian manufacturing sector using the French manufacturing sector structure. Specifically, I first calculate the NACE 2-digit (Rev. 1) industry-specific average numbers of layers using Slovenian data, and apply the French shares of firms as weights. As I do not have access to the French manufacturing data, I apply the shares based on the number of all enterprises in French manufacturing firms and enterprises with at least 10 employees that is available from the OECD (2020) structural analysis database. The average number of layers in Slovenia would be virtually unchanged when the structural shares of all firms would be used (2.28), whereas the corresponding shares for a more relevant restricted sample is slightly higher (2.32). These numbers suggest that industrial structure accounts only for a rather small part of the differences in the number of layers between the two countries.

In sum, based on this analysis I conclude that the differences in the average number of layers between the two countries are primarily due to presence of the revenue-reporting cutoff in France, but they also seem to be affected by the higher share of more productive firms and more abundant college-educated labor force in said country.

1.8 Conclusions

This paper provides the first empirical investigation of knowledge-based organizational hierarchies for one of the Eastern European countries that underwent a process of economic transition. For this purpose I use a large employer-employee data set from the Slovenian manufacturing sector. I provide a set of summary statistics and empirical tests of various theoretical hypothesis (Garicano, 2000; Caliendo & Rossi-Hansberg, 2012) regarding the dynamics of layer management by firms. Moreover, wherever possible, I compare my results to those reported in the seminal paper by Caliendo et al. (2015b) for French firms.

I find overwhelming support for the key theoretical predictions of the models with knowledge-based hierarchies. Namely, the firms in my sample also organize workers in layers, where larger firms in terms of value added tend to organize in more layers. This cross-sectional relationship seems to arise from demand or supply side shocks, as firms facing changes in value added are more likely to adjust their total number of layers. Slovenian firms frequently feature consecutively-ordered layers, which implies that firms tend to hire less hours of work and pay higher wages in higher layers. When firms decide to change the number of layers (due to changes in value added), they tend to change both hours and wages, but differently across layers. While workers in the newly added layers tend to receive higher wages, pre-existing layers tend to lose when firms expand the number of layers. In contrast, workers in pre-existing layers tend to gain when firms contract in terms of layers. These patterns are confirmed using not only wages but also direct measures of knowledge (education and experience).

In spite of qualitative similarities between my sample of firms and those reported by Caliendo et al. (2015b) for French firms, I find several differences. The number of organizational layers in Slovenia seems to be smaller, and the wage premia of workers in higher layers are significantly higher. Given the higher wage premia, Slovenian firms also seem to adjust layers less frequently and adjust them when value added exhibits greater variation. Slovenian firms tend instead to adjust more strongly in terms of working hours.

Perhaps the more rigid organizational structure of the average firm in Slovenia prevents them from taking advantage of subsequent gains in productivity when adding new layers before an increase in size, as the more flexible French firms appear to be doing more regularly. There is still much work to be done in order to better understand the reasons for these differences in the regularity with which firms undertake layer transitions, but in the meantime the results of this chapter may suggest that Slovenian policy makers could adopt new legislations to facilitate the process of firms in the manufacturing industry of adjusting their labor force and their wages in order to make it easier to add/drop organizational layers. This improved flexibility could in turn allow Slovenian firms to take advantage of productivity gains by changing their knowledge-based hierarchical structure more often, as French firms do.

2 Labor Cost Shocks and Organizational Hierarchies[24]

2.1 Overview

The theory of organizational hierarchies has recently been growing in terms of empirical research aiming at contrasting its predictions with real world data on employees and firms, all the more as the impact of economic shocks on the way firms organize their workers is yet to be studied. This chapter pretends to contribute in filling that gap within empirical research. Using a comprehensive data set on Slovenian manufacturing firms, and taking advantage of the stark changes in minimum wages and payroll tax rates that authorities introduced during the 1997-2011 period, I estimate the effects of exogenous shocks in both variables on the likelihood of different transition alternatives that firms face at each period of time. More specifically, I estimate multinomial logistic models - using pooled ordinary least squares, fixed, and random effects strategies - in which the probability of exiting the market, dropping, keeping, or adding new layers of management in firms is determined by their growth in value added, the fact of being exporters, and minimum wage and payroll tax shocks. I find the exogenous shocks in both variables to be relevant in explaining the likelihood of firms deciding for either alternative for the next year. While the effect of an increase in labor costs due to new minimum wage legislation always bears the expected sign - i.e. such increase augments their probability of exiting the market or dropping layers -, the effect of an increase in labor costs due to changes in payroll tax legislation is more ambiguous.

2.2 Introduction

According to the theory of organizational hierarchies, developed mainly by Garicano (2000), Garicano & Rossi-Hansberg (2006, 2012) and Caliendo & Rossi-Hansberg (2012), firms organize their employees in teams in order to optimize their costs of production. The organization decides on the number of layers and assigns their workers to each of these layers according to their level of skill, such that the more knowledgeable ones will supervise those in bottom layers. Employees in the bottom layers deal with everyday problems in production, but whenever a more complex problem arises, those in the top layers will tackle it. Hence, the bottom layers feature more hours of work in total and lower wages, while the top layers exhibit less hours of work and higher wages.

The hierarchical structure of firms, however, is not static; firms are facing various types of shocks, which shape their decisions about growing or shrinking in size. These decisions, in turn, may or may not involve a change in their number of layers. Firms in some cases can decide to grow by replicating their operations, without changing their hierarchical structure. In other cases, they can

[24]This chapter is co-authored with Sašo Polanec and Tjaša Bartolj. The authors would like to thank the Slovenian Statistical Office for allowing us to access, use and analyze the data in a secure room. I am grateful for the valuable comments by the members of the doctoral committee, prof. dr. Anže Burger, prof. dr. Jozef Konings, and prof. dr. Rok Spruk.

opt for transitions that add or drop layers of management. This will depend on the type of shock, and its magnitude.

The aim of this paper is to provide novel evidence on the effects of policy shocks that change labor costs on organizational hierarchies. As emphasized by Garicano & Rossi-Hansberg (2015), much more empirical work is required regarding the effects of certain policy shocks, such as labor market reforms and tax policy – the two types of policy changes I consider. Specifically, I exploit the minimum wage hikes and gradual abolition of payroll tax in Slovenia during the period 2005—2010 to study the effects on organizational hierarchies of Slovenian manufacturing firms. The minimum wage hikes increased the costs of workers at the lower end of the wage distribution, primarily increasing the labor cost of workers in the bottom organizational layers. In contrast, the abolition of highly progressive payroll tax reduced the relative costs of highly skilled workers, mainly affecting the costs of labor of workers in top organizational layers. While affecting the costs of different organizational layers, both of these policies reduced the relative costs of workers in top layers.

The theory of knowledge-based hierarchies predicts that when firms face sufficiently large changes in demand, as explained above, they might decide to add more layers of management in order to increase their output in a more efficient manner. However, the optimality of firms' hierarchical structure to generate output is not restricted to vary only with changes in the demand they face, but changes on the supply side might also affect the efficiency of producing with a certain number of management layers. Thus, economic policies affecting labor costs may have an effect on firm hierarchical organization, and in this paper I intend to provide empirical evidence in that sense.

As shown in the next sections, I utilize next year's legislation at every period as a means to compute the expected change in labor costs due to exogenous changes in minimum wage and payroll tax, thus allowing me to estimate the unbiased effects of those economic policies on the probability of each transition type that firms face every period, i.e. exiting the market, dropping management layers(s), keeping the same hierarchical structure, or adding management layer(s).

The structure of the chapter is as follows. In section 3 I summarize the most relevant literature dealing with minimum wages, payroll tax and knowledge-based hierarchies. In section 4 I provide some institutional background regarding changes in minimum wage and payroll tax policy in Slovenia. In section 5 I present summary statistics of my data set, and in section 6 I present my estimation results. In section 7 I conclude.

2.3 Theoretical Background on Minimum Wages, Payroll Taxes, and Organizational Hierarchies

The theory offers ambiguous explanations of the effects of minimum wages on employment. Assuming perfect competition, the neoclassical model predicts that firms substitute less-skilled workers with skilled workers or capital due to the increase in marginal labor costs. The size of the negative impact on employment of less-skilled workers however depends on several factors, such as the elasticity of substitution between different types of workers and capital, price elasticity of demand, the share of less skilled workers, the elasticity of labor demand etc. (see for example Brown et al., 1982; Brown, 1999; Card & Krueger, 1995a; Boeri & Van Ours, 2013; Neumark et al., 2008).

However, more realistic models do not provide such straightforward predictions regarding the impact of minimum wage introduction or increase. In models that assume monopsonistic competition, minimum wage introduction can lead either to employment increase due to the monopsony effect (if the minimum wage is set above the monopsonist and below competitive wage, monopsonist must pay higher wages, which leads to higher employment due to the upward sloping labor supply curve) or decrease as reduced profits force some firms to exit (see Bhaskar & To, 2003).

Job search models, which assume agents on the labor market do not have complete information on, e.g. opportunities, preferences and costs, predict a decrease in employment if the minimum wage is set above the marginal productivity of workers or firm (see Koning et al., 1995; Van den Berg & Ridder, 1998; Bontemps et al., 2000; Van Den Berg, 2003; Garloff, 2010; Neumark et al., 2008) or above the negotiated wage (see Flinn, 2006, 2011) as firms' profits drop causing firm exits or a decrease in job openings. According to the job search effort theory (e.g. Cahuc & Zylberberg, 2004), with a premise that workers differ by the effort put into the job search, the employment effect of minimum wage depends on the level of wages prior to the introduction or increase of minimum wage. The net employment effect is positive if the increase in employment due to the more intensive workers' job search offsets the decrease in labor demand and vice versa.

The efficiency wage theory (e.g. Rebitzer & Taylor, 1995) similarly allows for a positive effect of minimum wage on employment: the above-equilibrium minimum wage level increases workers' opportunity costs of job loss, which is followed by an increase in employees' work effort. The firms can therefore lower the costs of supervision and redirect the money to the employment of additional workers. Lastly, the human capital theory predicts an increase in the investments in human capital due to the minimum wage introduction/increase, which can negatively affect the employment of less-skilled workers (see Becker, 1964; Cahuc & Michel, 1996; Acemoglu & Pischke, 1999, 2003; Lechthaler & Snower, 2008). The minimum wage shocks can lead not only to changes in employment but also to changes in the number of knowledge-based hierarchical levels in firms.

According to the theory of organizational hierarchies (Garicano, 2000; Garicano & Rossi-Hansberg, 2006, 2012; Caliendo & Rossi-Hansberg, 2012) the firms are organized in hierarchies where the bottom layers solve routine problems, whereas managers learn how to solve the infrequent ones and do not generate production possibilities. Workers are paid according to their knowledge, so the mean firm-level wages at pre-existing layers fall when layers are added and vice versa (see Spanos, 2016). The firms add a new layer if the lower marginal costs of less knowledgeable employees in pre-existing layers outweigh the higher fixed costs of the added-layer's wage bill. Since minimum wages are potentially binding only for the low hierarchical levels, the shock increases their marginal costs. Consequently, firms might be forced to drop a layer or exit as they can no longer afford the wage bill costs of the top layer. If, however, the marginal costs of lower levels counterbalance the wage bill of the top layer even after the minimum wage shock, the number of layers in firms might remain unchanged. In contrast, the abolition of progressive payroll tax reduces the added-layer's wage bill. If this reduction is high enough, it might be attractive for some firms to add another layer; others, however, might decide to preserve the same hierarchical structure and use the tax reduction to increase profits. Nonetheless, I must mention an important caveat with respect to the hypothesized changes in hierarchical organization due to minimum wages and tax shocks, which relates to the role of "sole proprietorships" as an alternative type of employment contract that firms might choose to use when facing shocks given the tax benefits it offers. Employees then hired by firms in the form of sole proprietorships will not appear as the rest of directly hired employees in the data set, hence blurring part of the effect I try to identify on firms' hierarchical structure of exogenous changes in the economic environment.

In line with the theory, the empirical literature offers little consensus on the effects of minimum wage shocks on employment. Studies report negative (e.g. Brown et al., 1982; Burkhauser et al., 2000; Williams & Mills, 2001; Hoffman & Trace, 2009; Laporšek, 2013), no (e.g. Card & Krueger, 1995a; Bernstein & Schmitt, 2000; Ragacs, 2008; Lee & Suardi, 2011) and positive employment effects (e.g. Katz & Krueger, 1992; Card & Krueger, 1994, 1995b, 2000; Fang & Gunderson, 2009; Addison et al., 2009). About this, Clemens (2021) explains that most models focus only on assessing possible effects in terms of wages and employment, excluding other types of adjustments that changes in minimum wage could induce on firms. Hence, he shows with his extended model that minimum wage increases can affect firns' decision margins such as output prices, nonwage compensation, effort requirements, safety measures and, in general, the quality of the working environment. Similarly, Manning (2021) discusses why it is difficult to empirically establish a robust effect of minimum wage changes on employment. According to the author, this elusive employment effect could be explained by a low pass-through from minimum wage to labor costs perceived by employers, given the existance of some factors that the latter can use to offset a wage increase (e.g. meal breaks, health benefits, training, etc); also, a low labor demand elasticity could account for a rather small effect of a rising minimum wage on the number of this kind of employees that firms use.

On the side of payroll taxes, studies tend to find positive effects of payroll tax cuts on employment, albeit their effect on wages, investment and profits is less clear (see Kramarz & Philippon, 2001; Kugler & Kugler, 2009; Saez et al., 2012; Malm et al., 2016; Egebark & Kaunitz, 2018; Saez et al., 2019). Only two works, to my knowledge, have analysed the effects of payroll taxes in the context of hierarchical layers. Lawson (2019) studies the efficiency of a personal income tax in hierarchical firms with wage bargaining, and López & Torres (2020) calibrate a model to simulate the effects of introducing a size-dependent payroll tax in a context of knowledge-based hierarchical firms, finding that it reduces output and plant size, and increases self-employment. However, none of the aforementioned works studies the real-world effects of changes in minimum wages and payroll taxes on the hierarchical structure of firms from an empirical point of view, and that is where the contribution of this chapter lies. I find that both types of shock significantly affect firms' decisions regarding their hierarchical structure, as I show in the next sections.

2.4 Institutional Background: Minimum Wage and Payroll Tax Policy in Slovenia

2.4.1 Minimum Wage

Slovenia introduced statutory gross minimum wage (henceforth minimum wage) in 1995. During the period until 2006, the wage was a result of tripartite bargaining between the representative trade unions, association of employers and the government. After 2006, the wage is enacted as a law by the parliament upon the government's proposal[25]. The minimum wage includes employees' social contributions, but excludes employers' social contributions and payroll tax[26]. The minimum wage sets amount per month for a full-time employee, working between 40 and 42 hours per week. The minimum wage law does not include compensation for work-related expenses for daily commuting and business trips, meals, overtime, holiday and performance bonuses. The actual gross wage that workers receive may be lower than the gross minimum wage for part-time workers and workers on paid sick leave, but also higher if workers work overtime.

The minimum wage in Slovenia changed regularly, at least once a year, especially during the period of higher inflation rates prior to the start of the process of adoption of Euro. In nominal terms the minimum wage increased from 233 EUR in 1997 to 748 EUR in 2011. While the nominal values were increasing throughout the period, the ratio between the minimum and the average wage was between 42 and 49 percent. The highest ratio was achieved after March 2010, when the minimum wage increased by as much as 22.9 percent[27]. As I use data on gross wages at annual frequency, I calculate the annual minimum wage for the entire calendar year based on monthly minimum wages, as shown below in Table 2.1. Based on these values I am able to determine the proportion in the total wage bill of employees who were paid minimum wage. From Table 2.4 (column 3) it is evident that this share ranges between 13.3 percent in 2008 and 27.8 percent of the wage bill in 1998, and my constructed measure of minimum wage shock was between 2 and almost 9 percent.

2.4.2 Payroll Tax

The payroll tax was a highly progressive income tax that Slovenia introduced in July 1, 1996[28]. The tax was levied on top of the gross wage, thereby effectively increasing the employers total cost of labor. As shown in Table 2.2 below, it featured 4-6 tax brackets, ranging between 1% and 15% of gross wage, where the amount of tax to be paid was determined as a product between the tax

[25] Official Gazette of Republic Slovenia, No. 114, 2006.

[26] The minimum wage also includes personal income tax.

[27] The increase in minimum wage took place during the period immediately after the Great Recession 2008/09. The government allowed firms in financial distress (and were able to demonstrate it) to increase minimum wage by 9.6% instead of 22.9%. The proportion of such firms was relatively small.

[28] The payroll tax was introduced on July 1, 1996 (see Official Gazzete of the Republic of Slovenia No. 34, 1996) to offset reduction of social security revenues due to reduction of employers' social security contributions.

Table 2.1: Annualized Nominal Minimum Wage in Slovenia in EUR, 2007-2011

Year	Annualized Minimum Wage	Share of Average Yearly Gross Wage (%)	Share of Median Yearly Gross Wage (%)
1997	2,875.05	31.24	36.96
1998	3,157.83	33.21	39.51
1999	3,473.15	35.88	42.60
2000	3,820.24	38.24	45.86
2001	4,341.71	42.19	51.07
2002	4,846.22	46.25	56.12
2003	5,302.36	49.17	59.79
2004	5,682.96	52.82	64.23
2005	5,968.92	53.96	65.24
2006	6,180.10	54.63	65.69
2007	6,328.76	54.52	65.48
2008	6,805.00	57.08	68.76
2009	7,103.24	59.85	72.22
2010	8,399.64	66.51	79.87
2011	8,963.25	67.82	82.23

Source: Own calculations using data from various editions of the Official Gazzete of the Republic of Slovenia, as a weighted average of annualized monthly minimum wages.

rate and the gross wage. Thus, the payroll tax was not only highly progressive, but also featured discrete jumps at the upper bounds of preceding tax bracket. After its introduction, the tax rates and tax brackets frequently changed. In order to reduce the labor-income tax progressivity, in 2005 gradual abolition of the tax was enacted.

2.5 Data, Construction, of Variables and Summary Statistics

In the present work I use yearly data of Slovenian manufacturing firms covering the period 1997-2011. The complete data set is obtained by matching three distinct data sets, using unique firm and person identifiers. The Slovenian Employment Registry data features information about employment contracts held between employers and employees. From this data set I extract information on initiation and termination dates of contracts, occupation type by 4-digit ISCO 88 and ISCO 08 code, hours worked and educational attainment. Secondly, the personal income tax data from the Slovenian Financial Authority contains information on gross wages, which are used to compute hourly gross wage for each employee. These wages are also used to construct my measures of policy shocks affecting labor costs. Finally, the Agency of the Republic of Slovenia for Public Legal Records and Related Services data comprises information on firm size-related variables, such as

Table 2.2: Payroll Tax Rates in Slovenia, 1997–2011

	Brackets (up to), in EUR					
	4,507	4,757	5,258	5,759	37,556	above 37,556
1997	0	0.01	0.02	0.03	0.04	0.1
	5,508	6,510	20,030		37,556	above 37,556
1998-2001	0	0.02	0.04		0.08	0.15
	8,262		20,030		37,556	above 37,556
2002-2005	0		0.038		0.078	0.148
2006	0		0.03		0.063	0.118
2007	0		0.023		0.047	0.089
2008	0		0.011		0.023	0.044
2009-2011	0		0		0	0

Source: Official Gazzettes of the Republic of Slovenia.
Notes: The bounds of tax brackets refer to current annual gross wage in EUR.

value added, annual sales and total hours employed.

To build the first set of relevant variables I follow Caliendo et al. (2015b), first using each employee's ISCO 88 or ISCO 08 code to map them into one of four possible occupational layers: occupational layer 1 features blue-collar qualified and nonqualified workers; occupational layer 2 contains professionals and technicians a supervisory level; occupational layer 3 includes senior staff in the firm; and occupational layer 4 comprises firm owners, directors and chief executives.

It is worth noting that the subsequent mapping from occupational layers to hierarchical layers is conditional on the total number of occupations within a firm, which is also done in line with Caliendo et al. (2015b). For instance, a firm whose employees at a certain period have occupational codes 2 and 3, has a total of 2 hierarchical layers; employees with occupational code 2 belong to hierarchical layer 1, and those with occupational code 3 belong to hierarchical layer 2. Thus, each firm can have a maximum of 4 hierarchical layers in a given year, but always a minimum of 1 hierarchical layer, depending on the number of occupational codes of its employees.

As previously mentioned, the present work intends to exploit policy changes that took place in Slovenia and affected labor costs of different groups of workers. In particular, I exploit changes in minimum wage and payroll tax. Based on these institutional changes and using data on gross wages from Slovenian Financial Authority, I construct firm-specific wage shocks. Firm-specific minimum wage shocks are built as follows. First, I construct annualized minimum wage from monthly values in current Euros for the 1997-2011 period. Using these values, I identify all full-time employees whose yearly gross wage in year t, in current Euros, is less or equal to the corresponding annualized legal minimum wage in year $t+1$: these are the employees whose wage increase becomes compulsory in the next period, according to the new minimum wage; this, of course, may induce firms to change the labor-mix they employ, since one key component of production costs – labor costs at the bottom of the hierarchy – has experienced significant variation. Taking the aforementioned employees, I compute their expected wage growth rate according to next year's minimum wage legislation:

$$exp\_wage\_g_{i,j,t} = \frac{w_{t+1}^{min}}{w_{i,j,t}} - 1 \tag{2.1}$$

where $exp\_wage\_g_{i,j,t}$ is the expected wage growth rate for minimum wage-employee i in firm j in year t; w_{t+1}^{min} is the annualized minimum wage, in current Euros, in year $t+1$; and $w_{i,j,t}$ is the current annual gross wage of employee i in firm j in year t, in current Euros[29]. Thus, the previous variable measures a specific employee-level shock within each firm stemming from the wage increase it will have to comply with, should it keep said specific employee. In order to obtain a firm-level specific shock, I weigh each minimum wage employee's individual shock by their gross wage relative to the firm's payroll in year t – both in constant 2004 Euros – and compute the sum from employee 1 to $\mathrm{n_{j,t}}$ as follows:

$$firm\_minwage\_shock_{j,t} = \sum_{i=1}^{n_{j,t}}[(\frac{w_{i,j,t}}{w_{j,t}}) * exp\_wage\_g_{i,j,t}] \tag{2.2}$$

where $firm\_minwage\_shock_{j,t}$ is the firm-level minimum wage shock for firm j in year t; $w_{i,j,t}$ is the gross wage (in 2004 Euros) of employee i in firm j in year t ; and $w_{j,t} = \sum_{i=1}^{n_{j,t}} w_{i,j,t}$ is the wage bill (in 2004 Euros) of firm j in year t, calculated as a sum of gross wages of all employees. Thus, this weighted shock is a measure of how firms are potentially affected by next year's minimum wage legislation, which in turn is bound to affect their decisions regarding their organizational structure. The higher the shock, the higher the expected hike in labor costs for each firm, due to the new minimum wage legislation[30].

On the other hand, in order to build firm-level payroll tax shocks I first compute the corresponding payroll tax to be paid by firms for each one of their employees, in accordance to their class, in period t according to period t legislation[31]. Then, I also compute, in period t, the potential payroll tax to be paid for each employee according to period $t+1$ legislation, should every firm keep the

[29]Note that my approach relies on construction of mininum wage shocks based on current wages. Between current and next period firms may find it optimal to change wages for other reasons. For workers that may have received higher wage even without the minimum wage hike, the calculated measure of wage growth may be too high. Alternatively, for workers that might be subject to wage reduction that is prevented by the hike in minimum wage, the expected wage growth would underestimate the part of wage adjustment due to minimum wage change. An advantage of my approach is that the measure of wage growth may be considered as exogenous.

[30]This measure of firm-level minimum wage shock does not capture indirect effects due to minimum wage spillovers to workers with higher wages in order to preserve pay differences between workers of different skills (see Autor et al., 2013, 2016).

[31]Information on payroll tax rates in Slovenia can be found at the Slovenian Ministry of Finance (https://www.gov.si/en/state-authorities/ministries/ministry-of-finance/)

same organizational structure, i.e. keep the same employees. I then compute totals of both values by firm from employee 1 to $n_{j,t}$ in year t, sum with the firm's wage bill in year t, and subtract 1 from this ratio, as follows:

$$firm\_tax\_shock_{j,t} = [\frac{w_{j,t} + \sum_{i=1}^{n} tax\_rate_{i,t+1} * w_{i,j,t}}{w_{j,t} + \sum_{i=1}^{n} tax\_rate_{i,t} * w_{i,j,t}}] - 1 \tag{2.3}$$

where $firm\_tax\_shock_{j,t}$ is the firm-level payroll tax shock for firm j in year t; $tax\_rate_{i,t}$ is the legal payroll tax rate applicable in year t (according to each employee i's gross yearly wage); $w_{i,j,t}$ is again defined as above; and $w_{j,t}$ is firm j's wage bill in year t, as defined above too. Hence, my firm-level tax shock measures the labor cost change due to next year's anticipated payroll tax changes evaluated at current wage and employment structure. The higher the shock, the higher the expected rise in labor costs due to the new tax legislation.

In addition, I use each firm's value added (in constant 2004 thousands of Euros) and an exports indicator variable. The former is a measure that Caliendo et al. (2015b) use as a means to control for firms' size, given that a key factor to explain layer transitions is when firms grow (shrink) and need to expand (reduce) their operations. The latter controls for the presence of foreign demand – equals to 1 if the firm has positive foreign sales in that year, and zero otherwise – which might also be a source for the need to increase (reduce) the scale of operations in a firm.

Table 2.3 contains the counts and means of the key variables in my sample by year. Evidently, the number of firm-year observations, which continually increases from the beginning of my period of analysis, starts declining after 2008 due to economic crisis and possibly due to large hikes in minimum wage in this period. Similarly, the average values of real value added also starts to decrease from 2008 onward and, interestingly, so does the average hierarchical size of firms. In spite of economic crisis, however, the average gross hourly wage increases throughout the entire period of analysis.

Table 2.4 presents firm descriptives regarding the minimum wage and payroll tax shocks by year. As mentioned previously, payroll tax rates in Slovenia start to decline particularly after 2005, and was abolished in 2009. Prior to its abolition, it is also noticeable in each year the difference between the average payroll tax rate paid by each firm and the average expected payroll tax rate due in the next year. According to my hypothesis, such drop in labor costs is expected to have an effect on firms' internal organization of labor. On the other hand, there is almost a continuous decrease in the average share of minimum wage labor costs in firms' wage bill starting in 2001 until 2009; in both 2009 and 2010 the average share of minimum wage employees within the wage bill is almost 20 percent, a level similar to those before 2001. My main hypothesis states that such changes in minimum wage affect labor costs and thus have an impact on firms' hierarchical organization[32].

[32]Another interesting idea to exploit is that the effects of these shocks could be mediated by additional firm characteristics, such as their position in the global value chain: there might be differential effects of minimum wage and tax shocks on firms' hierarchical structure conditioning on their ownership type (foreign vs. domestic), or their level of outward direct investment, as well as their degree of market power (in terms of price markups), or their current level of wage compression at their lower layers. The inclusion of these possible

Table 2.3: Descriptive Statistics for the Key Variables by Year, 1997-2011

		Average			
Year	Active Firms	Value Added	Total Hours	Hourly Wage	Number of Layers
1997	4,007	1,055.87	101,685.19	4.09	2.27
1998	4,166	986.79	96,528.75	4.17	2.24
1999	4,206	1,034.20	97,079.23	4.32	2.25
2000	4,404	1,051.59	95,329.09	4.39	2.27
2001	4,518	1,065.70	90,974.76	4.61	2.29
2002	4,674	1,069.89	90,547.91	4.73	2.33
2003	4,738	1,074.73	87,632.61	4.85	2.33
2004	4,823	1,025.77	85,230.53	4.88	2.35
2005	4,986	1,004.63	81,864.75	5.05	2.33
2006	5,138	1,048.58	78,548.24	5.26	2.33
2007	5,289	1,061.39	74,943.03	5.56	2.32
2008	5,443	979.31	73,381.65	5.70	2.30
2009	5,378	890.02	67,196.22	5.58	2.24
2010	5,222	874.87	64,593.76	5.80	2.21
2011	4,738	979.33	65,922.55	6.01	2.20

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table contains the number of firm-year observations and yearly average values, among all active firms, of value-added, total working hours, wage and total organizational layers by firm. Average value added is reported in thousand (2004) Euros. Average hourly wage is reported in 2004 Euros. Total working hours are calculated as the sum of hours by all employees in a firm in a given year.

Table 2.4: Summary Statistics on Measures of Minimum Wage and Payroll Tax Shocks by Year, 1997-2011

	Average				
Year	Payroll Tax Rate by Firm in t (%)	Expected Real Payroll Tax by Firm in $t+1$ (%)	Share of Minimum Wage Employees in Wage Bill (%)	Firm-level Minimum Wage Weighted Shock (%)	Firm-level Payroll Tax Shock (%)
1997	1.78	1.42	20.09	3.86	0.35
1998	1.89	1.89	27.78	5.84	0.00
1999	2.12	2.12	18.61	4.60	0.00
2000	2.59	2.59	17.93	5.97	0.00
2001	2.94	1.74	20.72	5.03	1.15
2002	2.08	2.08	17.64	4.03	0.00
2003	2.51	2.51	18.02	3.22	0.00
2004	2.91	2.91	16.85	2.52	0.00
2005	3.35	2.66	15.56	2.54	0.63
2006	3.06	2.33	15.82	2.99	0.67
2007	2.53	1.22	13.50	2.10	1.24
2008	1.39	0.00	13.31	1.77	1.32
2009	0.00	0.00	18.38	8.73	0.00
2010	0.00	0.00	19.83	3.41	0.00
2011	0.00	0.00	13.77	2.82	0.00

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table contains the average values of shock-related variables. The average payroll tax rate at the firm level is a weighted average of individual-specific tax rates, determined for each employee based on year t gross wage, and using gross wages as weights. Similarly, the average expected payroll tax rate by firm in year $t+1$ is obtained in similar manner, only using next year's legal rates and assuming period t gross wages and employment structure. The average share of minimum wage employees' wage bill is calculated as a ratio between the wage bill of workers earning minimum wage or less in the total firm-level wage bill. The average firm-level minimum wage shock is calculated as the weighted average of expected wage growth rates - as defined in the main text - and summed over all workers using current wages as weights. To build the average firm-level payroll tax shock I compute the payroll tax to be paid by each firm for each one of their employees in period t according to period t legislation, as well as the potential payroll tax to be paid for each employee according to period $t+1$ legislation, assuming they keep the same wage and employment structure. The ratio between the expected labor costs including payroll tax in period $t+1$ and total labor cost including current payroll tax in t, minus 1, yields the firm-level payroll tax shock. Finally, I compute the average among all firms in each year.

Table 2.5: Minimum Wage Shock Ranges by Layer Size

Minimum Wage Shock Range	Total Number of Firms	Total Layers 1 (%)	2 (%)	3 (%)	4 (%)	All (%)
$MWshock < 1\%$	49,800	27.27	31.58	27.42	13.73	100
%	74.34	76.51	73.79	73.27	73.59	
$1\% \leq MWshock \leq 5\%$	9,544	12.87	29.53	35.67	21.94	100
%	14.25	6.92	13.22	18.27	22.53	
$5\% \leq MWshock \leq 15\%$	4,513	29.85	36.56	26.59	7.00	100
%	6.74	7.59	7.74	6.44	3.40	
$15\% \leq MWshock$	3,135	50.88	35.66	12.03	1.44	100
%	4.68	8.99	5.25	2.02	0.48	
Total	66,992	26.49	31.82	27.82	13.87	100
%	100	100	100	100	100	
Pearson chi	2,915.20					
P-value	0.00					

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: this table contains the relative frequencies of firms by the number of layers at any given year, according to the minimum wage shock-size they experience.

2.6 Effects of Shocks on Transition Probabilities

2.6.1 Size, Shocks and Transitions

Using the explanatory variables defined in the previous section, I model the probability of a firm undergoing layer transitions. First of all, it is worth examining firms' size in terms of layers and all possible transitions, and classify firms according to the shocks received by them. This simple approach might cast some initial light at the possible relation between minimum wage and taxation shocks on one hand and changes in firms' hierarchical structure.

Table 2.5 shows the total number of firms that at some point experience a minimum wage shock – an expected minimum wage labor cost hike – smaller than 1%, equal to or greater than 1% but smaller than 5%, equal to or greater than 5% but smaller than 15%, or equal to or great than 15%, and their distribution by layer size when receiving said shock. Similarly, Table 2.6 exhibits the relative distribution of firms, by layer size, that at some point receive a tax shock – an expected payroll-tax-induced labor cost increase– smaller than -1% (i.e. an expected decrease in labor costs due to payroll tax larger than 1%), equal to or greater than -1% but smaller than 0%, equal to or greater than 0% but smaller than 1%, or equal to or greater than 1%.

heterogeneities in the model is left for future research iterations given the necessity for some additional data. Special thanks to the doctoral committee members for their comments in this regard.

Table 2.6: Payroll Tax Shock Ranges by Layer Size

Payroll Tax Shock Range	Total Number of Firms	Total Layers 1 (%)	2 (%)	3 (%)	4 (%)	All (%)
$Taxshock < -1\%$	11,532	20.14	29.21	31.80	18.85	100
%	17.21	13.08	15.81	19.68	23.39	
$-1\% \leq Taxshock \leq 0\%$	11,909	14.74	35.33	35.20	14.74	100
%	17.78	9.89	19.74	22.50	18.88	
$0\% \leq Taxshock \leq 1\%$	43,482	31.42	31.56	24.73	12.29	100
%	64.91	76.97	64.38	57.70	57.50	
$1\% \leq Taxshock$	69	14.49	21.74	33.33	30.43	100
%	0.10	0.06	0.07	0.12	0.23	
Total	66,992	26.49	31.82	27.82	13.87	100
%	100	100	100	100	100	
Pearson chi	2,026.52					
P-value	0.00					

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: this table contains the relative frequencies of firms by their layer size at any given year, according to the payroll tax shock-size they experience.

With respect to minimum wage shocks (Table 2.5), it is clear that the vast majority of firms (74.34%) receive a relatively small one (smaller than 1%). Depending on total number of layers, between 73% and 77% of firms experience an expected minimum wage labor cost hike of less than 1%. However, when considering the highest range of minimum wage shocks (equal to or greater than 15%), more than 50% of the firms experiencing those are 1-layered firms. With respect to tax shocks (Table 2.6), the majority of firms (almost 65%) experience a rather small expected increase in labor costs due to payroll tax legislation (greater or equal than 0% but smaller than 1%). When conditioning to firms with each total number of layers, I always find the majority of them (from 57.50% to 76.97%) are affected by a moderate expected increase in labor costs due to payroll tax.

Next, Tables 2.7 and 2.8 exhibit the number of firms undergoing each transition type according to the strength of the experienced shock. From both tables it becomes clear that, in all ranges of shock severity, the majority of firms choose to remain without changing their organizational structure. However, while this number varies from around 73% to 79% of firms depending on shock strength, it is evident that for the most severe shocks said majority is less pronounced, with 59.43% of firms experiencing the strongest minimum wage shocks, and 65.22% of firms experiencing the strongest tax shocks keeping the same layers. In these shock-range, the share of firms undergoing other types of transitions such as "exiting" or "adding layers" is significantly higher than in the rest of shock ranges. As shown above, the firms facing larger shocks were predominantly small, which are exposed to greater variation in other determinants of the number of layers, such as value added shocks. In both tables, the Pearson test statistic indicates that there is indeed a correlation

Table 2.7: Minimum Wage Shock Ranges by Transition Type

Minimum Wage Shock Range	Total Number of Firms	Transition Type: Exit (%)	Drop Layers (%)	Keep Layers (%)	Add Layers (%)	All (%)
$MWshock < 1\%$	49,800	4.70	6.59	77.31	11.40	100
%	74.34	65.66	70.44	75.25	74.64	
$1\% \leq MWshock \leq 5\%$	9,544	3.55	7.59	78.53	10.33	100
%	14.25	9.51	15.53	14.65	12.97	
$5\% \leq MWshock \leq 15\%$	4,513	6.94	8.73	73.19	11.15	100
%	6.74	8.78	8.45	6.46	6.61	
$15\% \leq MWshock$	3,135	18.25	8.29	59.43	14.04	100
%	4.68	16.05	5.58	3.64	5.79	
Total	66,992	5.32	6.96	76.37	11.35	100
%	100	100	100	100	100	
Pearson chi	1,306.47					
P-value	0.00					

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: this table contains the relative frequencies of firms undergoing any of the possible transition types at any given year according to the minimum wage shock-size they experience.

between minimum wage and tax shocks, and organizational transitions.

Given that the data suggest that minimum wage and tax shocks affect the likelihood of undergoing a layer transition, I opt for using a multinomial choice model to estimate the effects of these shocks on the likelihood of a firm keeping the same layers, adding layers, dropping layers, or exiting the market. The general econometric model I estimate is the following:

$$Pr(Y^m_{j,t} = 1|\boldsymbol{X_{j,t}}, \boldsymbol{\beta^m}) = F(\beta^m_0 + \beta^m_1 \times \Delta \log VA_{j,t} + \beta^m_2 \times D\_exp_{j,t} + \beta^m_3 \times minwsh_{j,t} + \beta^m_4 \times taxsh_{j,t} + \sum_{k=2}^{K}[\beta^m_k \times IFE_{k,j}] + \sum_{T=1999}^{2010}[\beta^m_T \times TFE_T]) \quad \text{with } m = 1, 2, 3, 4 \tag{2.4}$$

where $Y^m_{j,t}$ is an indicator variable that for firm j in year t chooses option m. The four different transition alternatives each firm decides on between periods t and $t+1$, depending on their relevant characteristics, are: (i) preserving the number of total layers, (ii) dropping one or more layers, (iii) adding one or more layers and (iv) exiting the market. On the right hand side, $\Delta \log VA_{j,t}$ stands for the log-difference in value added for firm j in year t (i.e. the growth rate in value added at year

Table 2.8: Payroll Tax Shock Ranges by Transition Type

Payroll Tax Shock Range	Total Number of Firms	Transition Type: Exit (%)	Drop Layers (%)	Keep Layers (%)	Add Layers (%)	All (%)
$Taxshock < -1\%$	11,532	2.26	7.71	78.18	11.85	100
%	17.21	7.32	19.07	17.62	17.96	
$-1\% \leq Taxshock \leq 0\%$	11,909	2.33	8.01	78.31	11.35	100
%	17.78	7.77	20.46	18.23	17.78	
$0\% \leq Taxshock \leq 1\%$	43,482	6.94	6.47	75.37	11.22	100
%	64.91	84.65	60.36	64.06	64.13	
$1\% \leq Taxshock$	69	13.04	7.25	65.22	14.49	100
%	0.10	0.25	0.11	0.09	0.13	
Total	66,992	5.32	6.96	76.37	11.35	100
%	100	100	100	100	100	
Pearson chi	689.53					
P-value	0.00					

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: this table contains the relative frequencies of firms undergoing any of the possible transition types at any given year according to the payroll tax shock-size they experience.

t compared to year $t-1$); $D\_exp_{j,t}$ is an indicator variable that takes the value of 1 if firm j has positive foreign sales in year t, and zero otherwise; $minwsh_{j,t}$ and $taxsh_{j,t}$ stand for the minimum wage and payroll tax shocks – as defined above – respectively, for firm j affecting it at period t in terms of the number of layers it will decide to have on $t+1$; $IFE_{k,j}$ and TFE_T are dummy variables capturing industry-level (2-digit NACE codes) and time fixed effects, respectively.

In the econometric model (2.4) I thus propose that the probability of firms deciding to change or keep their hierarchical structure in period t, or exiting the market, depends on the variation of their value added experienced with respect to the previous year, on the fact of being exporting firms or not, and on the minimum wage and payroll tax shocks. According to the theory of knowledge-based hierarchies (Garicano, 2000; Garicano & Rossi-Hansberg, 2006, 2012; Caliendo & Rossi-Hansberg, 2012), whenever firms exhibit a sufficiently large expansion in their operations, as measured by their value added growth, they will respond by increasing the number of organizational layers they use. However, if the experienced growth in value added is not large enough, they may as well opt to keep the same hierarchical structure. Nonetheless, such growth in value added should clearly reduce the likelihood of firms exiting the market or dropping layers. With respect to being an exporting firm, previous studies suggest that exporting could be thought of as a way of diversifying risks by selling to different markets with different business cycles, so the effects of demand crises at home can be minimized by relying on foreign sales (Hirsch & Lev, 1971). At the same time, non-exporting firms are found to be less efficient than exporting firms, with the latter being more productive and experienced in the market (Bernard et al., 1995; Baldwin & Yan, 2011). Hence, being an exporter may increase a firm's survival likelihood. On the other hand, the firm-level minimum wage shock, as defined above, measures the expected relative hike in labor costs due to increase in minimum wage. Such increase in labor costs is expected to motivate firms to change their organizational structure so that the probability of keeping the same number of layers should decrease, while the likelihood of exiting the market, due to elevated wage bill costs, should rise.

The effect on the probabilities of dropping/adding layer(s) could be more ambiguous due to the two ways in which firms are affected: if the labor costs of the bottom layer increase, this may induce firms to either drop upper layer(s) in order to cut wage bill costs, thus reducing their hierarchical structure, or it could induce some firms to actually add layer(s), as the rising relative costs of the bottom layer makes it more attractive to use high-skilled instead of low-skilled workers in the mix (i.e. income and substitution effects). The net effect may be conditional on the current organizational size of each firm. Finally, the firm-level tax shock, as already defined, measures the expected percentage increase in payroll costs for firms due to the tax cuts in next year's legislation. Its effect on the likelihood of exiting the market should unequivocally be positive, as a payroll tax hike rises labor costs in a firm. However, its effects on the probabilities of other transition types may be more difficult to predict, as a negative shock (i.e. an expected reduction in labor costs due to payroll tax cuts) could motivate some firms to add newer layers of management, as some others could actually decide to keep the same layers and transfer the tax cuts into increased profits. This reasoning is summarized in Table 2.9.

Table 2.9: Expected Signs of the Effects of Explanatory Variables

Variable	Transition Type			
	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s)
$\Delta \log VA$	(-)	(-)	(+)	(+)
D_exp	(-)	(-)	(+)	(+)
$minwshock$	(+)	ambiguous	(-)	ambiguous
$taxshock$	(+)	ambiguous	ambiguous	ambiguous

Source: Own calculations.

Notes: This table contains the expected signs of the effect of my explanatory variables on the likelihood of occurrence of the respective transition type, according to my discussion.

2.6.2 Estimation Results

I estimate the models for probability of transitions of adding, keeping and dropping layers, and exiting using standard multinomial models. As firms with distinct number of total layers face distinct choice sets, I perform estimations for these groups of firms separately. Namely, while 2- and 3-layered firms face all four mentioned options, 1- and 4-layered firms can only make three choices.The former are unable to drop layers, whereas the latter cannot add layer(s).

Tables 2.10, 2.11, 2.12 and 2.13 present the average marginal effects (AMEs) corresponding to my estimations, separately for 1-, 2-, 3- and 4-layered firms. The estimated AMEs correspond to three econometric multinomial logistic regression models: without fixed and random effects, with fixed effects and random effects. Due to a small number of controls, my specifications likely suffer from omitted variable bias. Hence the preferred estimator is the fixed effects estimator. Anticipating my main results, I find that minimum wage shocks tend to increase the likelihood of exit and dropping layers, and decreases the likelihood of keeping and adding layers. While mostly statistically significant, these findings are not robust across methods, which I attribute to omitted variable bias. The estimates for payroll tax shocks also tend to have expected statistically significant signs with exception of the effects on adding layers.

Starting with presentation of marginal effects for 1-layered firms, note that the fixed effects estimator does not have any statistically significant AME for payroll tax shocks, and the pooled and random effects estimators do not yield any statistically significant AME for either shock type. However, the fixed effects estimations imply that an increase in minimum wage by 10 percentage points leads to an increase in the likelihood of exit and preserving layers by 0.29 and 1.14 percentage points, respectively, and decreases the likelihood of adding layer(s) by 1.43 percentage points. Regarding control variables, I find that growth in value added and being an exporter have significant effects with the expected signs on the probability of exiting the market, both variables decreasing such likelihood. A 1 percentage point increase in value added growth also increases the probability of a firm keeping or adding layers, while being an exporter appears to decrease the probability of exiting the market and increase the likelihood of adding layers. It also seems to have a negative effect on the probability of keeping the same layer of management, though only obtained with the pooled OLS estimation and at the 10% significance level.

Table 2.11 shows that, in the case of 2-layered firms, all the variables have significant effects on firms' decisions about their organizational structure, also with the expected signs. A 10 percentage point increase in minimum wage labor costs increases the probability of a firm exiting the market or dropping layers in approximately 0.7 to 1.8 and 0.5 to 1.2 percentage points, respectively, while decreasing the likelihood of keeping or adding new layers in 0.6 and 1.2 to 3.2 percentage points, respectively. In turn, a 10 percentage point increase in payroll tax labor costs increases the probability of a firm exiting the market in 33.4 percentage points, albeit this effect is significant only at the 10% level in the fixed effects estimation; at the same time, the 10 percentage point increase in tax shock is found to decrease both the likelihood of dropping and adding layers in 9.8 and 7.3 to 8.4 percentage points, respectively. On the other hand, a 1 percentage point increase in value added growth decreases the probability of a firm exiting the market or dropping layers, while increasing the likelihood of it keeping or adding layers. Becoming an exporter again decreases the likelihood of exiting the market or dropping layers, while at the same time increasing the probability of keeping or adding layers.

Table 2.12 presents similar results to those of 2-layered firms. In the case of 3-layered firms, a 10 percentage point increase in minimum wage labor costs increases the probability of a firm exiting the market or dropping layers in about 1.07-6.35 and 3.22-3.52 percentage points, respectively, while at the same time decreasing the probability of it keeping the same organizational structure in about 4.03-4.28 percentage points; however, it has no significant effect on the likelihood of adding 1 layer of management. A 10 percentage point increase in tax shock, in turn, does not appear to have any significant effect on the likelihood of exiting the market. However, it has a stark effect on increasing the probability of dropping layers of management in 16.04-18.33 percentage points. At the same time, that 10 percentage point increase in payroll tax shock is found to decrease the likelihood of adding a fourth layer in 7.49-8.43 percentage points; it also appears to decrease the probability of keeping the same layer structure in 17.7 percentage points, although this effect is only significant at a 10% level and obtained by the pooled OLS estimator.

With respect to the other control variables, a 1 percentage point increase in value added growth is again found to decrease firms' probability of both exiting the market or dropping layers, while increasing the likelihood of keeping the same layers according to all estimation techniques; the only positive effect on the likelihood of adding 1 layer of management is found with the fixed effects estimator, though just at the 10% significance level. In this case, becoming an exporter has no significant effect on the probability of exiting the market, but it does decrease the likelihood of dropping layers and increases that of adding 1 layer of management.

Finally, Table 2.13 presents the results for 4-layered firms, which constitute the larger firms in terms of hierarchies. On one hand, a 10 percentage point increase in minimum wage labor costs has a significant effect on increasing firms' probability of exiting the market or dropping layers in between 1.05-1.11 and 5.55-7.02 percentage points, respectively, and decreasing their probability of keeping

Table 2.10: Multinomial Logistic Regression Results on 1-Layered Firms

Model	Outcome: Exit	Outcome: Drop Layer(s) (not available for 1-layered firms)	Outcome: Keep Layer(s)	Outcome: Add Layer(s)
Pooled Regression (robust)				
$\Delta \log VA$	-0.0518***	-	0.0262***	0.0256***
	(0.004)		(0.005)	(0.003)
D_exp	-0.0249***	-	-0.0145*	0.0394***
	(0.006)		(0.008)	(0.006)
$minwshock$	0.0062	-	-0.0099	0.0038
	(0.004)		(0.008)	(0.005)
$taxshock$	-0.2854	-	0.4880	-0.2026
	(0.355)		(0.422)	(0.292)
Fixed Effects Regression (robust)				
$\Delta \log VA$	-0.0386***	-	0.0015	0.0371***
	(0.008)		(0.010)	(0.010)
D_exp	-0.0182	-	0.0256	-0.0075
	(0.017)		(0.026)	(0.029)
$minwshock$	0.0291**	-	0.1146**	-0.1437**
	(0.014)		(0.053)	(0.065)
$taxshock$	0.1864	-	1.9576	-2.1439
	(0.474)		(1.409)	(1.660)
Random Effects Regression (robust)				
$\Delta \log VA$	-0.0522***	-	0.0262***	0.0259***
	(0.004)		(0.005)	(0.004)
D_exp	-0.0266***	-	-0.0155	0.0421***
	(0.007)		(0.009)	(0.007)
$minwshock$	0.0060	-	-0.0089	0.0029
	(0.004)		(0.008)	(0.005)
$taxshock$	-0.3152	-	0.5279	-0.2127
	(0.375)		(0.466)	(0.353)

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents the estimated robust average marginal effects resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in equation 4, using only firms with prior 1 layer of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table 2.11: Multinomial Logistic Regression Results on 2-Layered Firms

	Outcome			
Model	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s)
Pooled Regression (robust)				
$\Delta \log VA$	-0.0298***	-0.0223***	0.0309***	0.0212***
	(0.003)	(0.004)	(0.005)	(0.003)
D_exp	-0.0114***	-0.0378***	0.0222***	0.0271***
	(0.003)	(0.004)	(0.006)	(0.004)
minwshock	0.0747***	0.1234***	-0.0693*	-0.1288***
	(0.010)	(0.018)	(0.042)	(0.034)
taxshock	0.3537	-0.0705	0.4480	-0.7312**
	(0.505)	(0.545)	(0.705)	(0.334)
Fixed Effects Regression (robust)				
$\Delta \log VA$	-0.0460***	-0.0126***	0.0456***	0.0130
	(0.014)	(0.004)	(0.012)	(0.014)
D_exp	-0.0444*	0.0036	0.0671***	-0.0263
	(0.024)	(0.007)	(0.022)	(0.024)
minwshock	0.1814***	0.0545***	0.0871	-0.3230**
	(0.070)	(0.019)	(0.106)	(0.128)
taxshock	3.3407*	-0.9860**	-0.5126	-1.8422
	(1.897)	(0.472)	(1.787)	(2.089)
Random Effects Regression (robust)				
$\Delta \log VA$	-0.0304***	-0.0242***	0.0349***	0.0197***
	(0.003)	(0.004)	(0.006)	(0.004)
D_exp	-0.0130***	-0.0406***	0.0264***	0.0272***
	(0.004)	(0.005)	(0.008)	(0.005)
minwshock	0.0772***	0.1281***	-0.0600	-0.1453***
	(0.012)	(0.022)	(0.048)	(0.037)
taxshock	0.3880	-0.2558	0.7152	-0.8475**
	(0.501)	(0.519)	(0.716)	(0.394)

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents the estimated robust average marginal effects resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in equation 4, using only firms with prior 2 layers of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table 2.12: Multinomial Logistic Regression Results on 3-Layered Firms

	Outcome			
Model	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s)
Pooled Regression (robust)				
$\Delta \log VA$	-0.0265***	-0.0238***	0.0453***	0.0050
	(0.003)	(0.005)	(0.007)	(0.004)
D_exp	-0.0025	-0.0515***	0.0121*	0.0420***
	(0.003)	(0.005)	(0.007)	(0.004)
$minwshock$	0.1079***	0.3229***	-0.4033***	-0.0275
	(0.015)	(0.039)	(0.068)	(0.048)
$taxshock$	0.6858	1.8340**	-1.7706*	-0.7492**
	(0.549)	(0.853)	(0.988)	(0.378)
Fixed Effects Regression (robust)				
$\Delta \log VA$	-0.0655***	-0.0091**	0.0403**	0.0342*
	(0.023)	(0.004)	(0.017)	(0.021)
D_exp	0.0380	-0.0020	-0.0476	0.0115
	(0.040)	(0.006)	(0.030)	(0.039)
$minwshock$	0.6357**	0.0530	-0.1379	-0.5509
	(0.265)	(0.043)	(0.289)	(0.395)
$taxshock$	2.1547	-0.1236	0.4747	-2.5058
	(2.922)	(0.483)	(2.521)	(3.544)
Random Effects Regression (robust)				
$\Delta \log VA$	-0.0275***	-0.0281***	0.0507***	0.0050
	(0.003)	(0.006)	(0.007)	(0.004)
D_exp	-0.0025	-0.0529***	0.0124	0.0429***
	(0.003)	(0.006)	(0.008)	(0.005)
$minwshock$	0.1135***	0.3526***	-0.4288***	-0.0373
	(0.018)	(0.053)	(0.087)	(0.052)
$taxshock$	0.7400	1.6046*	-1.5016	-0.8430*
	(0.565)	(0.870)	(1.000)	(0.452)

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents the estimated robust average marginal effects resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in equation 4, using only firms with prior 3 layers of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

the same 4 layers in between 7.21-8.08 percentage points. The same 10 percentage points increase in payroll tax shock surprisingly decreases the likelihood of exiting the market. However, that 10 percentage point increase in payroll tax shock dramatically increases the probability of dropping layers of management in 26.93-29.45 percentage points. Perhaps this means that when larger firms experience a payroll tax shock, they opt for becoming flatter firms instead of leaving the market altogether. For value added growth and being an exporter, I basically confirm the results I obtain for flatter firms, in the sense that either an increase in value added growth or becoming an exporter decrease their likelihood of leaving the market or dropping layers, whilst increasing their probability of remaining with the same layer structure.

After these layer-size specific estimations, I can nothing but confirm the robustness of my findings: increases in value added growth in every case tend to induce an increase in the number of hierarchies; being an exporter decreases a firm's probability of leaving the market or reducing in size, while inducing it to keep or expand its organizational structure. The effects of minimum wage shocks on the likelihood of the various transition outcomes are consistent with the expectations according to the theory by Caliendo & Rossi-Hansberg (2012): a 1 percentage point increase in the expected minimum wage labor costs augments the probability of firms shrinking in size and/or exiting the market, while reducing their probability of adding layers. The effects of payroll tax shocks on transition likelihood, on the other hand, appear to be highly dependant on the current hierarchical size of the firm. Still, both minimum wage and payroll tax shocks are found to affect firms' decisions regarding their hierarchical structure.

2.7 Conclusions

In this chapter I use changes in Slovenian minimum wage and payroll tax legislation to investigate the effects of economic policy shocks on firm organization. More specifically, I build minimum wage and payroll tax shocks in order to estimate their impact on firms' decisions with respect to their hierarchical organization.

Using a large panel data set of Slovenian manufacturing firms at employee level comprising the 1997-2011 period, I compute firm-level minimum wage shocks, which capture the expected hike in labor costs due to minimum wage legislation for next year, and firm-level payroll tax shocks, which measure the expected labor cost increase due to payroll tax legislation each firm experiences, and use these measures together with firms' growth in value added and an exports dummy to estimate multinomial logistic models, where each outcome represents the various choices each firm faces at every year, i.e. exiting the market, dropping layer(s), keeping the same layer(s), or adding layer(s).

In terms of descriptive results, I believe worth mentioning that most of the firms (50.88%) that are affected at some point with the highest range of minimum wage shock are 1-layered firms, which perhaps implies the need for Slovenian authorities to modify minimum wage laws applying to these smaller-size firms in order to protect them from economic shocks that may possibly induce them to exit the market. On the other hand, I find that both types of exogenous changes in policy are

Table 2.13: Multinomial Logistic Regression Results on 4-Layered Firms

	Outcome			
Model	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s) (not available for 4-layered firms)
Pooled Regression (robust)				
$\Delta \log VA$	-0.0213***	-0.0229**	0.0442***	-
	(0.004)	(0.009)	(0.010)	
D_exp	-0.0096**	-0.0543***	0.0639***	-
	(0.005)	(0.009)	(0.010)	
$minwshock$	0.1117***	0.6101***	-0.7218***	-
	(0.038)	(0.180)	(0.213)	
$taxshock$	-1.7315***	2.6938**	-0.9623	-
	(0.403)	(1.233)	(1.258)	
Fixed Effects Regression (robust)				
$\Delta \log VA$	-0.0764**	-0.0219	0.0983***	-
	(0.033)	(0.015)	(0.030)	
D_exp	-0.1194*	0.0242	0.0952	-
	(0.072)	(0.028)	(0.063)	
$minwshock$	-0.2260	0.5555*	-0.3295	-
	(0.345)	(0.318)	(0.371)	
$taxshock$	-7.9696**	3.3176	4.6520	-
	(3.839)	(2.165)	(3.698)	
Random Effects Regression (robust)				
$\Delta \log VA$	-0.0217***	-0.0321***	0.0538***	-
	(0.004)	(0.0108)	(0.011)	
D_exp	-0.0104**	-0.0484***	0.0588***	-
	(0.005)	(0.013)	(0.014)	
$minwshock$	0.1059**	0.7029***	-0.8088***	-
	(0.044)	(0.222)	(0.261)	
$taxshock$	-1.7456***	2.9451*	-1.1995	-
	(0.456)	(1.543)	(1.557)	

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents the estimated robust average marginal effects resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in equation 4, using only firms with prior 4 layers of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

relevant in explaining firms' decisions in terms of hierarchical organization over time, with minimum wage shocks exhibiting somewhat higher significance levels than payroll tax shocks. My results are nonetheless mostly in line with the hypothesised effects on firm organization, according to the theory of knowledge-based hierarchies by Garicano (2000), Garicano & Rossi-Hansberg (2006, 2012) and Caliendo & Rossi-Hansberg (2012). As mentioned by Clemens (2021) and Manning (2021), there are several types of adjustments that changes in minimum wage, as well as tax legislation, can cause on firms other than changes in terms of wages and employment. My findings show that one of these adjustments may occur precisely in the form of changes in hierarchical structure. Still, more evidence on the effects of economic and policy shocks on firm hierarchical organization is required in a field yet relatively understudied in terms of empirical research.

3 The impact of international trade shocks on organizational hierarchies[33]

3.1 Overview

This chapter focuses its attention on the effects that changes in firm size have on their hierarchical organization. According to the theory of knowledge-based hierarchies, a sufficiently large increase in firm size - which can be measured by growth in value added - should induce firms to add a new organizational layer as it becomes more efficient in terms of costs to hire new employees at the supervisory level to manage a larger number of less skilled workers in the layer below once the firm has expanded. However, those changes in firm size are likely correlated with other unobservable firm characteristics, which at some point might lead them to decide to increase or decrease production, in turn affecting their hierarchical structure. The fact of changes in firm size being endogenous leads to biased estimates of their effect on firm organization. This chapter aims to correct this kind of estimation by instrumenting changes in value added by foreign exogenous changes in demand.

3.2 Introduction

The basic theory taught in any microeconomics undergraduate course states that labor is one of the main production inputs that firms use to generate output. The optimal decision of every firm then becomes a question of how much labor to combine with the rest of inputs in order to minimize costs. This simplification, however, leaves aside the fact that in reality firms must also decide how much skilled and unskilled labor to hire, and how to internally organize these heterogeneous workers. The theory of knowledge-based hierarchies studies how firms assign their workers into different hierarchical layers according to their level of knowledge and skill, so that lower-layer workers deal with the common problems, while higher-layer employees (i.e. managers) supervise the lower layers in deal with more complex problems that may arise in production less frequently. This theory (see Garicano, 2000; Garicano & Rossi-Hansberg, 2006, 2012; Caliendo & Rossi-Hansberg, 2012; Garicano & Rossi-Hansberg, 2015) predicts that increases or decreases in firms' size will motivate them to either add or drop layers whenever said changes are sufficiently large. Caliendo et al. (2015b) find, using data for French manufacturing firms, that most of the firms that experience stronger changes in value added at certain period engage in layer transitions for the next period, meaning there is a significant association between value added growth and changes in hierarchical organization.

However, value added growth depend itself on other variables that drive firms to decide whether

[33]This chapter is co-authored with Sašo Polanec. The authors would like to thank the Slovenian Statistical Office for allowing us to access, use and analyze the data in a secure room. I am grateful for the valuable comments by the members of the doctoral committee, prof. dr. Anže Burger, prof. dr. Jozef Konings, and prof. dr. Rok Spruk.

to expand or contract in size, which in turn may or may not be accompanied by changes in their hierarchical structure. This means that, when studying the effects of changes in firm size on their decisions regarding organization, a possible endogeneity problem should be addressed. Whilst theoretical models in which firms build organizational hierarchies to optimize costs are widespread, studies dedicated to empirically contrast their main predictions are not ubiquitous, which is why researchers in this specific field stress that more empirical works are needed, especially to analyze the effects of several types of shocks on organizational decision (Garicano & Rossi-Hansberg, 2015).

This chapter aims to contribute to the field in that sense, as I build international trade shocks following the Bartik framework (see Bartik, 1991; Goldsmith-Pinkham et al., 2020), and use them to capture an exogenous source of variations in value added, allowing me to overcome the endogeneity problem and obtain unbiased estimates of the effects of value added growth (i.e. changes in firm size) on the likelihood of firm transitions. I use a two-stage econometric framework, where in the first stage I regress value added growth on the Bartik-type international trade shocks, and I use the predicted dependent variable from that model in the second stage, where I utilize multinomial logistic models to estimate the average marginal effects of exogenous changes in value added on the probability of firms dropping, adding, or keeping the same layers, or exiting the market. My findings are mostly in line with the predictions of the models of knowledge-based hierarchies, as I discuss below.

The chapter is organized as follows. In section 3 I review the relevant theory in the field of knowledge-based hierarchies and international trade shocks. In section 4 I present the Bartik methodology, which I use to build exogenous trade shocks. In section 5 I provide some basic descriptives of my data set. In section 6 I present the results of my estimations. Section 7 concludes.

3.3 The Theory behind Trade Shocks and Organizational Hierarchies

In their review, Garicano & Rossi-Hansberg (2015) mention that the study of organizations has been present for a long time in economics literature, with early works aiming mostly to explain the distribution of pay and firm size. Calvo & Wellisz (1978) is one of the earliest studies to investigate how managers could monitor their subordinates by the use of hierarchies. However, this type of study does not include an equilibrium approach for firms and the economy, and it also omits the existence of labor heterogeneity.

The theory of knowledge-based hierarchies is thus a relatively new one, with the work of Garicano (2000) being a cornerstone in this matter. The basic theory states that a firm can minimize the cost of producing its output by organizing its employees in teams, with the less-knowledgeable workers dedicated solely to the most routine tasks, while the more-knowledgeable ones deal only with those eventual problems that might appear in production, giving directions to the others regarding these harder tasks. Thus, knowledge-based hierarchies arise in the firm, with labor specialization leading to a more efficient use of working time, and the organizational problem lies in determining the proper quantities and distribution of knowledge, as well as the ways of communicating among hierarchies. However, one of the simplifying assumptions made by Garicano (2000) is that all workers have the same learning and communication abilities.

Building on this basic theory, Garicano & Rossi-Hansberg (2006, 2012) augment it by assuming ex-ante heterogeneity of workers, and embedding it in a dynamic framework. This allows them to study the effects of communication and information technologies on economic growth through its impact on firm organization and innovation. Caliendo & Rossi-Hansberg (2012) utilize the same model of knowledge-based hierarchies, this time assuming heterogeneity in the demand that firms face, to theoretically analyse the effect of international trade on firm organization. By calibrating the model to the U.S. data and running simulations, they find that, due to bilateral trade liberalization, exporting firms will increase the number of management layers. Thus, the theory of knowledge-based hierarchies allows researchers to gain a better understanding of how firms organize internally, using layers of management, in order to solve the problems that emerge in the production process.

In terms of empirical works the field of organizational hierarchies is relatively still understudied, as Garicano & Rossi-Hansberg (2015) point out. Meagher (2001) employs a data set conformed by 5 surveys on Australian citizens, with information on their wages, hierarchical positions in their jobs, education, experience and other related variables. The author finds some interesting patterns, such as the fact that "level one" supervisors appear to receive a wage premium due to some unobserved characteristics such as ability, effort or responsibility; moreover, the marginal effect of increasing an employee's hierarchical level on his wage declines with the number of levels above him. However, this result is only marginally significant, a reason why Meagher (2001) underpins the need for more empirical research on this topic.

Regarding the effect of trade liberalization on firm organization, Guadalupe & Wulf (2010) analyse the impact of increased product market competition brought by the Canada-United States Free Trade Agreement of 1989 on the depth of hierarchies and span of control in a set of large US firms within the manufacturing industry from 1986 to 1999. They find that, for a firm with average tariffs before 1989, trade liberalization induced an increase of 6% in CEO span of control and a reduction of 11% in the number of management levels. Nevertheless, their work focuses on hierarchies in the sense of division depth, measured by the number of managers between the Division Manager and the CEO, in contrast with the concept of knowledge-based hierarchies, which Caliendo et al. (2015b) measure by layers, a broader concept based on occupational categories for all the employees in each firm. In addition, the data set used by Guadalupe & Wulf (2010) is not representative of the US economy, as it consists of only 230 large US companies. Caliendo et al. (2015a) base their analysis on the theory of hierarchical organization developed by Caliendo & Rossi-Hansberg (2012). They use employer-employee matched data on Portuguese firms in order to test if firm reorganizations, caused by expansions, have any impact on firm productivity. The authors find that an exogenous demand or productivity shock that makes a firm add one layer of management produces a quantity-based productivity increase of 4%, but a drop in revenue-based productivity of more than 4% as well. The authors explain this as a result of price dropping due to the increase of produced quantity.

Caliendo et al. (2015b) analyze hierarchical organization in French manufacturing firms by using a comprehensive firm and employee-level yearly data set for the period 2002-2007. The authors map employees into layers according to the PCS-ESE 2003 classification[34] in their data set, and then they use variables such as individual wage and working hours, as well as firm characteristics such as value added, average wage and total number of layers, in order describe how French firms are organized in terms of management layers, and how this relates to those other variables. For instance, they find that, after controlling for time and industry fixed effects, firms with more layers are larger in terms of value added and pay higher average wages. The authors also examine the behavior of those variables in firms that make a transition (i.e. add or drop one or more layers) at some point in time, as opposed to firms that keep the same number of layers. They find, for instance, that firms that grow in terms of value added without changing their hierarchical structure tend to increase wages in all layers, while firms that expand by adding one layer of management tend to decrease average wages in preexisting layers.

Now, Caliendo et al. (2015b) find a strong relationship between firms' growth, measured by value added, and their decisions in terms of layer organization. However, Friedrich (2022) suggests that both firm measures of size such as value added – or total sales in his case – and firm hierarchical organization might be jointly determined by other variable(s) associated with firms' internal decisions. Hence, a model in which firm layer organization is explained by their growth in value added (or sales) will suffer from endogeneity, which is why Friedrich (2022) instruments each firm's sales by firm-level measures of world import demand and transport costs. The author employs an instrumental variable approach with a static model, where the number of layers in a firm at year t depends on log-sales in said year, which he instruments by world import demand and transport costs at firm-level. Nonetheless, Friedrich (2022) finds non-significant results with the static model, which is why he moves on to estimate a dynamic model, where the number of layers a firm has in period t depend on log-sales in period t, but also on the number of layers it had in period $t-1$. The author finds that the number of hierarchical layers is highly persistent overtime and that, given that his dependent variable is the discreet number of layers, the interpretation of the marginal effect of sales on organizational choice is rather difficult.

This motivates the present chapter to use a similar approach in terms of instrumenting firm value added by external trade shocks, and estimating their effect on firm hierarchical organization using a multinomial panel data framework, as I explain below.

3.4 Bartik Instruments and Trade Shocks

The Bartik instrument framework is a very effective way to build trade shocks. Goldsmith-Pinkham et al. (2020) discuss the uses and econometric implications of the different approaches related to Bartik-type instruments, concluding that Bartik methodology is numerically equivalent to GMM

[34] The "Professions at Catégories Socioprofessionnelles" is the occupational classification used in the DADS (Déclarations Annuel des Données Sociales) data set.

estimation that uses industry shares as instruments. In this chapter I build international trade shocks in a similar manner to Aghion et al. (2018). The theory of knowledge-based hierarchies (see Garicano, 2000; Garicano & Rossi-Hansberg, 2006, 2012; Caliendo & Rossi-Hansberg, 2012) predicts that firms will increase the number of organizational layers they use when experiencing a sufficiently large expansion in their operations. Value added growth is a way to measure the expansion (or reduction) in the scale of operations.

Nonetheless, the measure of value added growth of a firm is endogenous in the sense that it might itself reflect the firm's own decisions that also lead to changes in organizational structure. The idea is to obtain a firm-level measure of changes in size that is not correlated with other variables (observable or unobservable) affecting their decisions regarding internal organization, using exposure to international trade shocks for each firm as instrument. In this sense, firms' decisions with respect to which products to export, how much and to which markets, are possibly related to their decisions with respect to output growth and hierarchical structure, i.e. the rate of change of firms' exports is an endogenous measure of international trade exposure. Hence, to estimate an unbiased effect of changes in size on firms' hierarchical organization it is necessary to build an exogenous measure of trade exposure, and for this matter I follow Aghion et al. (2018), Mayer et al. (2021) and Friedrich (2022) in building an exogenous firm-level measure of export demand shocks to Slovenian firms as follows.

Say Slovenian firm j exports product p to country c in year t. I first compute the total imported value of product p by country c in year t from all countries in the world, except from Slovenia. Next, I compute the percentage change in that value between $t-1$ and t. The idea is to compute a weighted average of said measure taking into account all countries and products firm j exports to at year $t-1$, using as weights the share of each product/country of destination of every Slovenian firm within their total exported value at year $t-1$. Hence, the international trade shock affecting firm j's growth in size at year t is computed as:

$$trade\_shock_{j,t} = \sum_{p,c}[\frac{x_{j,p,c,t-1}}{X_{j,t-1}} \times (\frac{M_{p,c,t} - M_{p,c,t-1}}{M_{p,c,t-1}})] \tag{3.1}$$

where $x_{j,p,c,t-1}$ is the exported value by firm j in year $t-1$ of product p to country c; $X_{j,t-1}$ is the total value of exports of firm j in $t-1$; and $M_{p,c,t}$ is the total imported value of product p by country c in year t from the rest of the world, excluding Slovenia. Thus, with the previous calculation I obtain an exogenous source of variation for the export demand that each Slovenian firm faces at a certain year, i.e. a firm-level international trade shock. These are the international trade shocks I use as an exogenous source of variation in demand, which I utilize to instrument firm log-changes in value added in order to estimate their impact on changes in hierarchical organization.

Theoretically, the Bartik-type trade shocks should be highly correlated with changes in firm size, measured in my case through growth in value added, as weighted changes in foreign demand of the products that Slovenian firms export to their trade partners (excluding Slovenian exports, of course) should be in tune with changes in external demand that Slovenian firms actually face and react to.

This means that, theoretically, the Bartik instrument should be relevant. At the same time, there is no reason to consider that those changes in foreign demand, which exclude products from Slovenia itself, have anything to do with internal decisions of Slovenian firms that may determine changes in their hierarchical organization. In other words, my Bartik instrument should be exogenous[35].

3.5 Firm and Trade Descriptives

For this analysis I employ a comprehensive data set of Slovenian manufacturing firms. I obtain my data by combining four different data sets, matching them by employee and firm identifiers. First, the Slovenian Employment Registry data contains employee-level information, providing us with their occupation type by 4-digit ISCO 88 and ISCO 08 code, and hours worked. Second, the Slovenian Financial Authority data contains information on gross wages, allowing us to calculate hourly gross wage for each worker. Third, data from the Agency of the Republic of Slovenia for Public Legal Records and Related Services provides information about size-related variables at firm level, such as value added. Finally, BACI (*Base pour l'Analyse du Commerce International*) provides me with bilateral international trade at the product level, allowing me to obtain total exports by product type and country of destination for each Slovenian firm, as well as total imports at product level for each destination country Slovenian firms export their products to, excluding imports from Slovenia, which allows me to compute exogenous Bartik-type foreign demand shocks for each Slovenian firm as explained in the previous section.

In order to compute organizational hierarchies for each firm I follow Caliendo et al. (2015b), starting with the ISCO 88 or ISCO 08 code of each employee to map them into occupational layers. According to the methodology by Caliendo et al. (2015b), occupational layer 1 contains blue-collar qualified and nonqualified workers; occupational layer 2 is comprises professionals and technicians acting as supervisors; occupational layer 3 features all senior staff; finally, occupational layer 4 corresponds to firm owners, directors and chief executives.

In addition, I must mention that mapping occupational layers into hierarchical layers is a process that depends on the total number of occupations to be found in each firm. For example, a firm that has employees with occupational codes 2 and 4, has a total of 2 hierarchical layers; thus, employees with occupational code 2 are considered to belong to hierarchical layer 1, and those with occupational code 4 are considered to pertain to hierarchical layer 2. Hence, every firm in my data set may have a maximum of 4 hierarchical layers at some point, but it must have at least 1 hierarchical layer while it exists.

[35] I must acknowledge, however, an important caveat regarding the use of this type of shock as an exogenous source of variation in firm value added. If some Slovenian firms in my data set are subsidiaries of multinational enterprises, we can assume that part of the changes in imports from other countries reflect changes in the global supply chain, where international demand shifts faced by some of the subsidiary Slovenian firms stem from decisions by their mother companies in other countries, hence causing the Bartik-type shocks for these firms to not be as exogenous as one would expect. This, of course, is something to bear in mind when interpreting the results of my models. Once again, I appreciate the comments by the committee members, prof. dr. Anže Burger, prof. dr. Jozef Konings, and prof. dr. Rok Spruk in this regard.

Table 3.1: Main Descriptives of Exporting Firms by Year, 1997-2011

Year	Active Firms	Average						
		Value Added	Total Hours	Hourly Wage	Number of Layers	Total Exports by Firm	Exports Growth by Firm %	Firm-Level Exogenous Trade Shock %
1999	1,697	2,240	207,386	4.83	2.82	5,701	2.46	7.25
2000	1,782	2,322	207,526	4.87	2.84	6,226	16.75	26.10
2001	1,833	2,335	196,288	5.16	2.85	6,031	11.47	6.92
2002	1,955	2,293	186,840	5.27	2.84	5,653	6.56	18.40
2003	1,948	2,317	181,342	5.44	2.85	5,401	4.02	2.78
2004	1,978	2,029	174,237	5.41	2.88	5,052	9.60	9.56
2005	1,791	2,417	190,707	5.66	2.93	6,222	13.77	32.97
2006	1,779	2,661	189,199	5.92	2.94	6,819	9.42	20.61
2007	1,812	2,679	180,650	6.22	2.93	7,183	11.07	14.14
2008	1,802	2,540	181,664	6.41	2.95	6,919	21.96	3.33
2009	1,745	2,368	167,234	6.35	2.92	5,567	-12.51	-9.48
2010	1,702	2,327	163,317	6.60	2.90	6,398	11.57	23.61
2011	1,635	2,438	156,977	6.74	2.85	6,998	10.63	15.18

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table contains the number of firm-year observations and yearly average values, among all active firms, of value-added, total working hours, wage, total organizational layers by firm, total exports by firm, growth rate in total exports, and exogenous trade shock. Average value added is reported in thousand (2004) Euros. Average hourly wage is reported in 2004 Euros. Total working hours are calculated as the sum of hours by all employees in a firm in a given year. Average total exports are reported in current thousand Euros. Average exports growth by firm is computed by taking the rate of change in total exports for each firm, and computing a weighted average (weighing by each firm's total exports) among all firms in every year. Average firm-level exogenous trade shock is computed by taking the average among all exporting firms of the Bartik-type trade shock each one faces at each year, which is calculated as shown in the previous section.

Table 3.1 presents descriptives of my data set by year[36]. Note that the average number of layers does not vary much among Slovenian exporting firms. While the average yearly growth rate in total exports – which is an endogenous measure of foreign demand for Slovenian firms – shows a great deal of variation, and is affected by firms' own decisions, the average exogenous trade shock does not exhibit such large variations. It should also be noted that exporting firms in my data set exhibit larger value added, total working hours, wages and total number of layers on average than Slovenian manufacturing firms as a whole, including those that do not engage in international trade (see Table 1.3 in Chapter 1). Another fact worth mentioning is that, when conditioning by total number of layers (see Appendix C), firms with more layers exhibit higher value added, more hours of work, higher average wages, higher total exported values, and even face larger exogenous trade shocks on average than firms with fewer layers.

[36] It is important to mention that the set of exporting firms that I use in this chapter is a subset of the manufacturing firms used in the previous chapters. Hence, there might be a problem of selection bias given that exporting firms are (possibly) different from their non-exporting counterparts in many observable and non-observable ways.

Table 3.2: Yearly Exported Values by Layer Size

Yearly Total Exports Range	Total Number of Firms	Total Layers 1 (%)	2 (%)	3 (%)	4 (%)	All (%)
$Totexp < 100$	7,662	17.40	38.61	34.46	9.54	100
%	32.66	72.37	50.84	29.29	10.77	
$100 \leq Totexp \leq 500$	4,903	7.81	32.55	42.16	17.48	100
%	20.90	20.79	27.43	22.93	12.63	
$500 \leq Totexp \leq 5,000$	6,951	1.78	16.04	45.55	36.63	100
%	29.63	6.73	19.16	35.12	37.52	
$5,000 \leq Totexp$	3,943	0.05	3.78	28.94	67.23	100
%	16.81	0.11	2.56	12.66	39.07	
Total	23,459	7.85	24.80	38.42	28.92	100
%	100	100	100	100	100	
Pearson chi2(9)	6,740.03					
P-value	0.00					

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: this table contains the relative frequencies of firms by their layer size at any given year, according to their yearly exported value. Ranges of total exports are in thousands of Euros.

3.6 Trade, Shocks, Layers and Transitions

3.6.1 Total Exports and Trade Shocks

I first explore the relationship between firms' total exports, their (endogenous) growth in exports and the trade shocks they face, and their layer size and the transitions they undergo in my data set from a descriptive point of view.

Table 3.2 shows the total number of firms and their relative frequency, according to their total exported value at any year, and their distribution by size in terms of layers. It comes as no surprise that while the majority of firms reporting yearly exports under 100,000 euros have 2 total layers (38.61%), the vast majority of firms exporting over 5 million euros per year have 4 total layers (67.23%). Likewise, the great majority of 1-layered firms report yearly exports under 100,000 euros (72.37%), while most of the 4-layered firms report yearly exports greater than 5 million euros (39.07%) and between 500,000 and 5 million euros (37.52%).

Table 3.3 presents the distribution of yearly export percentage changes by layer size. It is interesting to note that, focusing on 4-layered exporting firms (28.92%), only the minority of them (8.17%) report yearly changes in exports larger than 100%, suggesting that larger firms are less prone to experience abnormally great endogenous variations in yearly exported value.

Table 3.3: Yearly Percentage Change in Total Exports by Layer Size

Yearly Exports Growth Range	Total Number of Firms	Total Layers 1 (%)	2 (%)	3 (%)	4 (%)	All (%)
Expgrowth < 0%	11,624	8.37	25.31	38.45	27.87	100
%	49.55	52.82	50.57	49.58	47.75	
0% ≤ *Expgrowth* ≤ 25%	4,922	4.77	18.61	38.54	38.07	100
%	20.98	12.76	15.74	21.05	27.62	
25% ≤ *Expgrowth* ≤ 100%	3,988	7.22	25.73	39.04	28.01	100
%	17.00	15.64	17.63	17.27	16.46	
100% ≤ *Expgrowth*	2,925	11.83	31.93	37.30	18.94	100
%	12.47	18.78	16.05	12.10	8.17	
Total	23,459	7.85	24.80	38.42	28.92	100
%	100	100	100	100	100	
Pearson chi2(9)	513.16					
P-value	0.00					

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: this table contains the relative frequencies of firms by their layer size at any given year, according to their yearly change in total exported value.

Table 3.4, which exhibits the distribution of exogenous trade shocks by layer size, shows that the majority of firms in my data set (37.17%) experience at any year a positive exogenous external demand shock, although no larger than 10% in size; conversely, only a small fraction of firms (7.65%) face exogenous trade shocks larger than 30%.

Tables 3.5, 3.6 and 3.7 present the distribution of yearly total exports, growth in total exports, and trade shocks, respectively, by the type of transition experienced by firms at some point. It is noticeable that, regardless of their yearly exported value, the majority of Slovenian exporting firms tend to keep the same structure across consecutive years, ranging from 58.57% (those exporting less than 100,000 euros per year) to 79.61% (those exporting more than 5 million euros per year). However, when focusing on firms that exit the market at some point, I note that most of them are exporting less than 100,000 euros per year (52.08%). On the other hand, note that the largest exit rates are found both among firms reporting negative growth in exported value (20.96%), and those reporting the largest yearly growth rates in exported value (25.47%). Now, regarding exogenous trade shocks, the majority of firms in my data set (37.17%) experience an exogenous increase in foreign demand between 0% and 10% at some point; irrespective of the size and direction of the trade shock, most firms tend to keep the same number of layers across consecutive years (ranging from 65.73% to 72.23% of them).

I estimate the probability of firms opting for either transition type with a multinomial logistic model, using firm percent change in value added as a measure of size growth (see Caliendo et al., 2015b),

Table 3.4: International Trade Shock Ranges by Layer Size

International Trade Shock Range	Total Number of Firms	Total Layers 1 (%)	2 (%)	3 (%)	4 (%)	All (%)
$Exogshock < 0\%$	6,773	7.90	26.22	38.33	27.55	100
%	28.87	29.04	30.53	28.80	27.50	
$0\% \leq Exogshock \leq 10\%$	8,720	8.91	25.81	37.48	27.80	100
%	37.17	42.18	38.69	36.25	35.73	
$10\% \leq Exogshock \leq 30\%$	6,172	5.77	21.79	39.60	32.84	100
%	26.31	19.33	23.12	27.11	29.87	
$30\% \leq Exogshock$	1,794	9.70	24.86	39.35	26.09	100
%	7.65	9.45	7.67	7.83	6.90	
Total	23,459	7.85	24.80	38.42	28.92	100
%	100	100	100	100	100	
Pearson chi2(9)	136.71					
P-value	0.00					

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: this table contains the relative frequencies of firms by their layer size at any given year, according to the external exogenous demand shock they experience.

Table 3.5: Yearly Exported Values by Transition Type

Yearly Total Exports Range	Total Number of Firms	Transition Type Exit (%)	Drop Layers (%)	Keep Layers (%)	Add Layers (%)	All (%)
$Totexp < 100,000$	7,662	31.06	5.19	58.57	5.17	100
%	32.66	52.08	31.19	27.60	29.27	
$100 \leq Totexp \leq 500$	4,903	16.56	6.06	70.83	6.55	100
%	20.90	17.77	23.28	21.36	23.73	
$500 \leq Totexp \leq 5,000$	6,951	13.68	5.86	74.23	6.23	100
%	29.63	20.81	31.90	31.73	32.00	
$5,000 \leq Totexp$	3,943	10.83	4.41	79.61	5.15	100
%	16.81	9.34	13.64	19.31	15.00	
Total	23,459	19.48	5.44	69.31	5.77	100
%	100	100	100	100	100	
Pearson chi2(9)	1,063.47					
P-value	0.00					

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: this table contains the relative frequencies of firms by the type of transition they undergo at any given year, according to their yearly exported value. Ranges of total exports are in thousands of Euros.

Table 3.6: Yearly Percentage Change in Total Exports by Transition Type

Yearly Exports Growth Range	Total Number of Firms	Total Layers: Exit (%)	Drop Layers (%)	Keep Layers (%)	Add Layers (%)	All (%)
$Expgrowth < 0\%$	11,624	20.96	5.47	68.11	5.46	100
%	49.55	53.30	49.84	48.69	46.93	
$0\% \leq Expgrowth \leq 25\%$	4,922	14.16	5.36	75.09	5.38	100
%	20.98	15.25	20.69	22.73	19.59	
$25\% \leq Expgrowth \leq 100\%$	3,988	17.35	5.57	70.21	6.87	100
%	17.00	15.14	17.40	17.22	20.25	
$100\% \leq Expgrowth$	2,925	25.47	5.26	63.15	6.12	100
%	12.47	16.30	12.07	11.36	13.23	
Total	23,459	19.48	5.44	69.31	5.77	100
%	100	100	100	100	100	
Pearson chi2(9)	202.82					
P-value	0.00					

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: this table contains the relative frequencies of firms by their layer size at any given year, according to their yearly change in total exported value.

Table 3.7: International Trade Shock Ranges by Transition Type

International Trade Shock Range	Total Number of Firms	Total Layers				
		Exit (%)	Drop Layers (%)	Keep Layers (%)	Add Layers (%)	All (%)
$Exogshock < 0\%$	6,773	15.81	6.02	72.23	5.94	100
%	28.87	23.44	31.97	30.09	29.71	
$0\% \leq Exogshock \leq 10\%$	8,720	23.56	5.05	65.73	5.67	100
%	37.17	44.95	34.48	35.25	36.51	
$10\% \leq Exogshock \leq 30\%$	6,172	18.15	5.51	70.82	5.52	100
%	26.31	24.51	26.65	26.88	25.20	
$30\% \leq Exogshock$	1,794	18.12	4.91	70.51	6.47	100
%	7.65	7.11	6.90	7.78	8.57	
Total	23,459	19.48	5.44	69.31	5.77	100
%	100	100	100	100	100	
Pearson chi2(9)	165.62					
P-value	0.00					

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: this table contains the relative frequencies of firms by the type of transition they undergo at any given year, according to the external exogenous demand shock they experience.

and given that said measure is possibly correlated with observable and/or unobservable variables that drive firms' decisions regarding their layer organization (see Friedrich, 2022), I instrument it with my Bartik measure of international trade shocks using a two stage approach. In the first stage I estimate the following model:

$$\Delta \log VA_{j,t} \;=\; \beta_0 + \beta_1 \times trade\_shock_{j,t} + \sum_{k=2}^{K}[\beta_k \times IFE_{k,j}] + \sum_{T=1999}^{2010}[\beta_T \times TFE_T] + u_{j,t} \quad (3.2)$$

where $\Delta \log VA_{j,t}$ is the log-difference in value added of firm j in year t, computed as the growth rate in value added at period t relative to period $t-1$, $trade\_shock_{j,t}$ is the external demand exogenous trade shock that firm j experiences at period t as defined above, $IFE_{k,j}$ is a dummy variable capturing industry-level fixed effects, which takes the value of 1 if firm j belongs to 2-digit NACE industry k, and zero otherwise, TFE_T is a dummy variable capturing time fixed effects, and $u_{j,t}$ is the classical disturbance term for firm j at year t. I propose that foreign demand shocks, both contemporary and 1-period lagged, can explain part of the variation in size (i.e. growth in value added) that firms experience at some point in time. This allows me to compute a new predicted exogenous measure of value added growth for each firm, which should now be uncorrelated with the other observable/unobservable variables shaping firms' own decisions with respect to hierarchical organization. I estimate the first stage using three different regression strategies (pooled OLS, fixed, and random effects, all with robust standard errors), and use this predicted measure in the second stage:

$$Pr(Y^m_{j,t} = 1|\boldsymbol{X_{j,t}}, \boldsymbol{\beta^m}) = F(\beta^m_0 + \beta^m_1 \times \Delta \log \widehat{VA}_{j,t} + \sum_{k=2}^{K}[\beta^m_k \times IFE_{k,j}] + \sum_{T=1999}^{2010}[\beta^m_T \times TFE_T])$$
$$\text{with } m = 1,2,3,4 \quad (3.3)$$

where $Y^m_{j,t}$ is a discreet dependent variable for firm j in year t, which takes values 1, 2, 3 or 4, each of them representing one of the 4 possible transition alternatives that every firm decides to choose at any year t; if firm j maintains the same number of layers it had in year t for the period $t+1$, then its chosen alternative is to keep the same organizational structure; if its number of layers in $t+1$ results smaller than in period t, that means its chosen alternative is to drop layer(s); conversely, if it has more layers in $t+1$ than in the previous year t, that means it decides to add layer(s); lastly, if firm j is in my data set in year t but does not appear in year $t+1$, I consider it chooses to leave the market at period t. The explanatory variable $\Delta \log \widehat{VA}_{j,t}$ is the estimated log-difference in value added of firm j in year t from the first stage regression, and $IFE_{k,j}$ and TFE_T are again industry and time fixed effects as defined above. This second stage regression is also estimated using pooled OLS, fixed, and random effects regression, with robust standard errors in each case. In the fixed effects model I exclude the industry-level dummies, as this estimation technique already includes individual firm fixed effects.

3.6.2 Estimation Results Conditioning by Layer Size

Given that the choice set that a firm faces at any moment in time depends on the number of total layers it has, I estimate multinomial logistic models conditioning on firms' initial number of layers using the 3 techniques described above. The following tables present estimates of the average marginal effects stemming from the second stage of the regressions previously mentioned, taking in each case only those firms that have either 1, 2, 3 or 4 layers of management at year t, and undergo one of the four possible transitions in the next consecutive year $t+1$. Estimated coefficients from the first stage and second stage are presented in Appendix C, and for comparison purposes I also provide there estimation results (using pooled OLS, fixed and random effects strategies) of multinomial logistic models in which the transition type is regressed against actual (endogenous) value added growth and the firm-level trade shock as explanatory variables.

Table 3.8 shows that in the case of firms with a single layer of management no major significant effect of growth in exogenous value added on either transition type is found. There seems to be, however, an effect at the 10% significance level that is obtained by pooled OLS and random effects estimation: a 10 percentage point increase in exogenous value added growth appears to increase the likelihood of firms keeping the same layer of management in 11.25 to 12.05 percentage points.

In the case of firms with 2 layers of management, Table 3.9 shows that a 10 percentage point increase in exogenous value added growth decreases the probability of a firm exiting the market in 20.23 percentage points, although this effect is only significant at 10% level and obtained by fixed effects estimation. The same 10 percentage point increase in exogenous value added growth decreases the likelihood of dropping 1 layer in around 35.51 to 38.82 percentage points, and at the same time increases that of keeping the same 2 layers in 32.38-34.78 percentage points. On the other hand, a 10 percentage point increase in exogenous value added growth is found to increase their probability of adding layers of management in 5.27 to 6.07 percentage points, albeit significant only at the 10% level.

With respect to firms with 3 layers of management, Table 3.10 shows that an exogenous increase in value added growth has no statistically significant effect on either transition type. Nonetheless, it is interesting that, at least with pooled OLS and random effects estimation, the signs of the effects are right according to the theory of knowledge-based hierarchies. The lack of significance has probably a lot to do with the fact that I have but one instrument for the variable causing endogeneity.

Finally, in the case of 4-layered firms, Table 3.11 shows that a 10 percentage point increase in exogenous value added growth decreases the likelihood of them exiting the market in about 23.93 to 25.83 percentage points, and at the same time increases their probability of keeping all four layers in similar magnitude from about 23.35 to 25.48 percentage points, both effects being highly significant.

Table 3.8: Average Marginal Effects Conditioning on 1-Layered Firms

Model	Outcome			
	Exit	Drop Layer(s) (not available for 1-layered firms)	Keep Layer(s)	Add Layer(s)
Pooled Regression (robust)				
$\Delta \log \widehat{VA}$	-0.3532	-	1.2059*	-0.8527
	(0.465)		(0.627)	(0.733)
Fixed Effects Regression (robust)				
$\Delta \log \widehat{VA}$	1.8735	-	0.5181	-2.3917
	(2.341)		(0.452)	(2.586)
Random Effects Regression (robust)				
$\Delta \log \widehat{VA}$	-0.2892	-	1.1251*	-0.8359
	(0.461)		(0.655)	(0.850)
Cragg-Donald chi	1.21			
P-value	0.272			
Kleibergen-Paap chi	3.44			
P-value	0.063			

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table presents robust average marginal effects from the second stage of three instrumental multinomial logit models (pooled, fixed effects, and random effects) where value added growth is instrumented by exogenous international trade shock, and industry and time fixed effects are controlled for, using only firms that have 1 layer of management at period t. Three possible outcomes are identified for each firm at period t, depending on the total number of layers it exhibits at period $t+1$; if the firm does not appear in year $t+1$, that means it exits the market in year t. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table 3.9: Average Marginal Effects Conditioning on 2-Layered Firms

Model	Outcome			
	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s)
Pooled Regression (robust)				
$\Delta \log \widehat{VA}$	-0.2142	-3.5513**	3.2380**	0.5275*
	(0.987)	(1.513)	(1.401)	(0.3035)
Fixed Effects Regression (robust)				
$\Delta \log \widehat{VA}$	-2.0237*	-0.0000	0.2589	1.7648
	(1.177)	(0.000)	(0.278)	(1.171)
Random Effects Regression (robust)				
$\Delta \log \widehat{VA}$	-0.2033	-3.8828***	3.4783***	0.6077*
	(1.090)	(1.335)	(1.314)	(0.315)
Cragg-Donald chi	8.38			
P-value	0.004			
Kleibergen-Paap chi	6.16			
P-value	0.013			

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table presents robust average marginal effects from the second stage of three instrumental multinomial logit models (pooled, fixed effects, and random effects) where value added growth is instrumented by exogenous international trade shock, and industry and time fixed effects are controlled for, using only firms that have 2 layers of management at period t. Three possible outcomes are identified for each firm at period t, depending on the total number of layers it exhibits at period $t+1$; if the firm does not appear in year $t+1$, that means it exits the market in year t. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table 3.10: Average Marginal Effects Conditioning on 3-Layered Firms

	Outcome			
Model	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s)
Pooled Regression (robust)				
$\Delta \log \widehat{VA}$	-36.3296	-7.8909	42.1445	2.0760
	(29.170)	(12.224)	(27.102)	(3.497)
Fixed Effects Regression (robust)				
$\Delta \log \widehat{VA}$	1.9789	-0.9591	-0.1345	-0.8853
	(1.547)	(1.224)	(0.788)	(1.018)
Random Effects Regression (robust)				
$\Delta \log \widehat{VA}$	-481.4404	-203.2935	664.4285	20.3054
	(623.192)	(310.526)	(613.830)	(120.926)
Cragg-Donald chi	0.62			
P-value	0.431			
Kleibergen-Paap chi	6.52			
P-value	0.011			

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table presents robust average marginal effects from the second stage of three instrumental multinomial logit models (pooled, fixed effects, and random effects) where value added growth is instrumented by exogenous international trade shock, and industry and time fixed effects are controlled for, using only firms that have 3 layers of management at period t. Three possible outcomes are identified for each firm at period t, depending on the total number of layers it exhibits at period $t+1$; if the firm does not appear in year $t+1$, that means it exits the market in year t. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Summing up my regression results conditioning by layer size, I find that, from a broad point of view, the hypothesised theoretical effects of exogenous increases in value added growth on hierarchical organization are confirmed by my data on Slovenian firms: they tend to decrease their likelihood of exiting the market and/or dropping layers of management, and to increase their probability of keeping the same structure and/or adding hierarchical layers. The results of Cragg-Donald and Kleibergen-Paap identification tests are contradictory in the case of 1 and 3-layered firms, which accordingly show non-significant effects of the instrumented log-change in value added on transition probabilities. Nonetheless, for 2 and 4-layered firms the identification tests allow the null hypothesis to be rejected, which suggest that in those cases the model is properly identified.

I acknowledge a possible problem in my models as I do not have other demand-related exogenous variables in my data to better instrument value added growth (e.g. transport costs), which translates into larger standard errors, therefore causing many of my estimates to be statistically non-significant. When I compare my instrumental model estimates with the estimates from multinomial logistic models with endogeneity (i.e. regressing transition types on actual value added growth and the trade shock as explanatory variables), I find more statistically significant effects of increases in value added growth in the latter (also with the expected signs), albeit smaller in magnitude than in the models with instrumentation, which may provide evidence of an important bias when using actual changes in value added due to endogeneity.

3.7 Conclusions

Using a data set comprising yearly information about Slovenian manufacturing firms between 1998 and 2011, I construct a firm-level Bartik-type exogenous foreign demand measure to estimate the impact of exogenous increases in value added on the probability of firms choosing their layer transition alternative. To my knowledge, this is the first empirical attempt to estimate the effect of said international trade shocks on firms' hierarchical organization using a multinomial model framework.

I find that the effects of exogenous growth in firm size, instrumented by foreign demand shocks, on firms' decisions with respect to hierarchical organization are fairly in line with what the theory of knowledge-based hierarchies suggests. Taking evidence from 1, 2, 3 and 4-layered firms as a whole, and despite low statistical significance due to the lack of more instruments, I find that increases in exogenous value added growth decrease the likelihood of firms exiting the market and increase their probability of maintaining the same organizational structure. The case of 2-layered firms also provides significant evidence that an exogenous increase in value added growth decreases their likelihood of dropping layers and increases their probability of adding new layers.

There is still much to be explored in terms of the empirics of knowledge-based hierarchies and how several types of shocks affect them. The present chapter serves as one of the first approaches to examine the effect of trade shocks on the likelihood of undergoing layer transitions, but I hope more researchers are motivated to study these issues.

Table 3.11: Average Marginal Effects Conditioning on 4-Layered Firms

Model	Outcome			
	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s) (not available for 4-layered firms)
Pooled Regression (robust)				
$\Delta \log \widehat{VA}$	-2.5839***	0.0358	2.5481***	-
	(0.672)	(0.243)	(0.638)	
Fixed Effects Regression (robust)				
$\Delta \log \widehat{VA}$	-2.1966	1.5858	0.6108	-
	(1.562)	(1.453)	(0.379)	
Random Effects Regression (robust)				
$\Delta \log \widehat{VA}$	-2.3934***	0.0575	2.3359***	-
	(0.703)	(0.314)	(0.663)	
Cragg-Donald chi	17.59			
P-value	0.000			
Kleibergen-Paap chi	23.93			
P-value	0.000			

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table presents robust average marginal effects from the second stage of three instrumental multinomial logit models (pooled, fixed effects, and random effects) where value added growth is instrumented by exogenous international trade shock, and industry and time fixed effects are controlled for, using only firms that have 4 layers of management at period t. Three possible outcomes are identified for each firm at period t, depending on the total number of layers it exhibits at period $t+1$; if the firm does not appear in year $t+1$, that means it exits the market in year t. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

CONCLUSION

This dissertation aims to contribute by providing real world evidence of the use and dynamics of knowledge-based hierarchies by firms in a context where empirical evidence on this matter is yet relatively scarce. The seminal theoretical works by Garicano (2000), Garicano & Rossi-Hansberg (2006), Garicano & Rossi-Hansberg (2012) and Caliendo & Rossi-Hansberg (2012) provides a fertile ground for empirical research to thrive, particularly when detailed information at the employer-employee level is available over time. In my dissertation I use employer-employee matched data on Slovenian manufacturing firms from 1997 to 2011 to test various predictions and implications of the theory of knowledge-based hierarchies.

In Chapter 1 I find that firms in Slovenia, just as French firms analyzed by Caliendo et al. (2015b), organize workers in layers, with larger firms tending to organize in more layers. Firms facing large changes in value added are more likely to adjust their total number of layers. Slovenian firms usually organize in consecutively-ordered layers, which implies that firms tend to hire fewer hours of work and pay higher wages in higher layers. When firms decide to change their hierarchical structure (due to changes in value added), they tend to change both hours and wages, but differently across layers. Employees in the newly added layers tend to receive higher wages, but in pre-existing layers wages tend to decrease when firms expand their number of layers. In contrast, workers in pre-existing layers tend to gain when firms contract in terms of layers. These patterns are confirmed by using more direct measures of knowledge, like education and experience.

In Chapter 2 I find that both minimum wage and payroll tax shocks are statistically significant in explaining firms' decisions regarding hierarchical organization over time, with minimum wage shocks exhibiting somewhat higher significance levels than payroll tax shocks. The estimated average marginal effects are mostly in line with the hypothesised effects on firm organization, according to the theory of knowledge-based hierarchies: exogenous increases in labor costs due to changes in minimum wage legislation tend to increase the likelihood of firms exiting the market or shrinking in terms of layers, while decreasing their probability of keeping the same structure or adding layers. Exogenous increases in payroll tax, on the other hand, exhibit less consistent effects in terms of sign and significance.

Finally, in Chapter 3 I use firm-level Bartik-type exogenous foreign demand shocks to instrument value added changes, in order to estimate their effect on the probability of firms choosing their layer transition alternative. I find that the effects of exogenous growth in firm size on firm hierarchical organization are fairly in line with what the theory of knowledge-based hierarchies suggests. Examining the evidence as a whole, I find that increases in exogenous value added growth decrease the likelihood of firms exiting the market and increase their probability of maintaining the same organizational structure. The case of 2-layered firms also provides significant evidence that exogenous increases in value added growth decreases their likelihood of dropping layers and increases their probability of adding new layers.

The methodologies and exercises used in this dissertation intend to make a contribution to the body of knowledge within the field of knowledge-based hierarchies, an area within economic theory where empirical research is only recently starting to gain traction. To my knowledge, some of the content of this dissertation, particularly in the case of minimum wage and payroll tax shocks, provides a first glance at the effects of economic and policy shocks on firms' decisions regarding hierarchical organization. These changes, in turn – as Garicano & Rossi-Hansberg (2015) point out – affect aggregate results for the economy as a whole, in terms of wage inequality, employment, and other variables. The empirics of knowledge-based hierarchies are nowadays a very fertile ground for new studies to be made, and the possibilities for future research remain immensely rich.

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APPENDICES

Table A.1: Hourly Wage Distribution by Layers. Only Firms with Socialist Heritage.

Layer	Average Hourly Wage	p.10	p.25	p.50	p.75	p.90	p.95
1	4.80	3.27	3.81	4.45	5.32	6.42	7.32
2	7.66	4.84	5.86	7.08	8.64	10.75	12.78
3	15.79	7.14	10.17	14.07	19.19	25.97	31.27
4	29.34	11.01	18.31	27.21	37.60	49.31	57.47

This table contains average hourly wage and hourly wage percentile distribution (in 2004 Euros) among all firm-years, using only firms with socialist heritage.

Table A.2: Hourly Wage Distribution by Layers. Only Firms with Unions.

Layer	Average Hourly Wage	p.10	p.25	p.50	p.75	p.90	p.95
1	4.65	3.26	3.78	4.42	5.25	6.19	6.95
2	7.18	4.63	5.66	6.87	8.27	9.97	11.36
3	15.45	7.09	9.84	13.50	18.51	25.03	30.84
4	26.75	9.16	15.64	24.05	34.35	46.67	54.68

This table contains average hourly wage and hourly wage percentile distribution (in 2004 Euros) among all firm-years, using only firms with unions.

Appendix A: Chapter 1

For the analysis shown in Chapter 1 I use all firms in the Slovenian data set. However, in order to check the robustness of my findings I create 5 subsamples: the first subsample contains only full-time employees; the second one is restrained only to those firms with socialist heritage, i.e. firms that were established prior 1990 or were established through organizational changes and can be considered as descendants of such firms; the third subsample trims both bottom and top 0.8% of the firms according to their average hourly wage; similarly, the fourth subsample drops those firms for which discrepancy in number of employees between Slovenian Employment Registry and AJPES is greater than 20% of either one; finally, the fifth subsample contains only firms with unions, i.e. firms with 50 or more employees.

The following tables present some of the results I obtain by using those subsamples. For instance, I find the average number of layers and average wages being somewhat higher when focusing only on firms with socialist heritage or firms with unions. This is most likely due to these firms being larger in size than the average Slovenian firm, hence the need for deeper hierarchical organization. Aside from those kinds of differences in magnitude, the same patterns and dynamics shown throughout Chapter 1 for the full sample of Slovenian firms are found using the aforementioned subsamples.

Table A.3: Dynamics of the Main Variables. Only Firms with Socialist Heritage.

		Average			
Year	Firms	Number of Layers	Hourly Wage	Value Added	Total Hours
1997	558	3.47	5.16	5,502.20	522,627.41
1998	527	3.44	5.23	5,448.81	518,183.22
1999	507	3.44	5.29	5,682.97	523,719.69
2000	508	3.44	5.43	5,839.60	514,576.19
2001	491	3.40	5.71	6,119.94	498,247.97
2002	489	3.39	5.92	6,193.24	486,865.06
2003	465	3.34	5.98	6,573.37	488,794.63
2004	442	3.38	5.94	5,774.51	485,497.03
2005	416	3.38	6.13	6,062.96	486,658.44
2006	401	3.39	6.40	6,571.93	482,644.16
2007	383	3.40	6.63	7,122.68	482,397.53
2008	363	3.46	6.72	6,864.14	486,472.47
2009	331	3.45	6.63	6,808.47	455,920.44
2010	314	3.44	6.74	6,688.27	442,684.22
2011	300	3.35	7.14	6,988.09	429,244.22

This presents firm average values for the referenced variables per year, using only firms with socialist heritage.

Table A.4: Dynamics of the Main Variables. Only Firms with Unions.

		Average			
Year	Firms	Number of Layers	Hourly Wage	Value Added	Total Hours
1997	703	3.53	4.81	5,302.52	514,691.06
1998	699	3.51	4.89	5,112.79	506,112.69
1999	713	3.50	4.98	5,292.29	502,388.06
2000	715	3.52	5.03	5,586.96	510,411.56
2001	727	3.52	5.28	5,706.78	488,334.34
2002	756	3.48	5.43	5,689.15	478,279.91
2003	723	3.49	5.50	6,002.76	482,815.44
2004	732	3.51	5.56	5,725.88	469,598.47
2005	692	3.54	5.66	6,053.59	487,088.22
2006	700	3.56	5.83	6,438.34	473,551.16
2007	699	3.54	6.24	6,582.60	460,419.50
2008	682	3.56	6.27	6,305.72	469,627.31
2009	603	3.64	6.15	6,416.35	462,971.47
2010	593	3.60	6.46	6,178.27	442,846.19
2011	567	3.56	6.64	6,615.49	434,757.06

This presents firm average values for the referenced variables per year, using only firms with unions.

Table A.5: Dynamics of the Main Variables by Number of Layers in the Firm. Only Firms with Socialist Heritage.

Number of Layers	Firms-Years	Median Hourly Wage	Average		
			Hourly Wage	Value Added	Total Hours
1	158	4.00	6.34	152.34	8,681.04
2	526	5.02	5.96	823.76	83,024.09
3	2,292	5.28	5.86	3,097.80	295,678.53
4	3,519	5.64	6.02	9,292.90	701,767.94

This presents firm average values for the referenced variables, as well as the median hourly wage, by groups of firms-years according to total number of layers in such firms, using only firms with socialist heritage.

Table A.6: Dynamics of the Main Variables by Number of Layers in the Firm. Only Firms with Unions.

Number of Layers	Firms-Years	Median Hourly Wage	Average		
			Hourly Wage	Value Added	Total Hours
1	6	2.32	2.37	2,684.73	99,949.61
2	520	4.32	4.59	1,563.17	190,928.27
3	3,734	5.00	5.28	3,150.57	314,098.56
4	6,044	5.55	5.92	7,997.85	607,941.44

This presents firm average values for the referenced variables, as well as the median hourly wage, by groups of firms-years according to total number of layers in such firms, using only firms with unions.

Table A.7: Average Experience and Years of Schooling by Number of Layers in the Firm. All Firms.

Number of Layers	Firms-Years	Average	
		Experience	Education
1	19,140	22.24	11.60
2	22,872	20.92	11.19
3	19,853	21.45	11.07
4	9,865	23.00	10.91

This presents firm average experience and education by number of layers in the firm. Education corresponds to years of schooling from Slovenian Employment Registry. I compute employee experience by substracting 6 and the years of schooling from their age. I then compute averages of both variables in each firm-year, and then averages of those by total number of layers in firms.

Table A.8: Average Experience and Years of Schooling by Number of Layers in the Firm. Only Firms with Socialist Heritage

Number of Layers	Firms-Years	Average Experience	Average Education
1	158	29.24	11.54
2	526	25.45	10.50
3	2,292	24.49	10.52
4	3,519	24.63	10.50

This presents firm average experience and education by number of layers in the firm. Methodology is the same as in the previous table. Only firms with socialist heritage.

Table A.9: Firms with Consecutively Ordered Layers. Only Firms with Socialist Heritage.

	Firms with 1 Layer	Firms with 2 Layers	Firms with 3 Layers	Firms with 4 Layers	All Firms
Unweighted	68.99	85.17	75.96	100	89.56
Weighted by Value Added	43.19	91.21	91.05	100	98.29
Weighted by Hours of Work	91.51	97.69	90.54	100	97.96

This presents the percentages of firms that fulfill the condition of having consecutively ordered layers, grouped by the number of layers in firm, and among all firms, using only firms with socialist heritage.

Table A.10: Firms with Consecutively Ordered Layers. Only Firms with Unions.

	Firms with 1 Layer	Firms with 2 Layers	Firms with 3 Layers	Firms with 4 Layers	All Firms
Unweighted	100	98.65	77.24	100	91.68
Weighted by Value Added	100	99.30	87.35	100	97.55
Weighted by Hours of Work	100	99.66	85.34	100	96.52

This presents the percentages of firms that fulfil the condition of having consecutively ordered layers, grouped by the number of layers in firm, and among all firms, using only firms with unions.

Table A.11: Firms with Hierarchies in Terms of Hours. Weighted by Value Added.

Number of Layers	$N_L^l \geq N_L^{l+1}$ For all l	$N_L^1 \geq N_L^2$	$N_L^2 \geq N_L^3$	$N_L^3 \geq N_L^4$
2	86.64	86.64	...	...
3	90.15	92.83	97.24	...
4	79.77	85.19	99.51	94.22

This presents the percentages of firms that fulfil the condition of having hierarchies in terms of working hours, weighing each firm by their value added.

Table A.12: Firms with Hierarchies in Terms of Hours. Only Firms with Unions.

Number of Layers	$N_L^l \geq N_L^{l+1}$ For all l	$N_L^1 \geq N_L^2$	$N_L^2 \geq N_L^3$	$N_L^3 \geq N_L^4$
2	95.38	95.38	...	...
3	95.90	96.89	99.01	...
4	83.26	94.69	98.84	89.01

This presents the percentages of firms that fulfil the condition of having hierarchies in terms of working hours, using only firms with unions.

Table A.13: Firms with Hierarchies in Terms of Wages. Only Firms with Socialist Heritage.

Number of Layers	$w_L^{l+1} \geq w_L^l$ For all l	$w_L^2 \geq w_L^1$	$w_L^3 \geq w_L^2$	$w_L^4 \geq w_L^3$
2	87.64	87.64	...	...
3	85.12	95.11	89.79	...
4	78.01	99.12	92.90	85.79

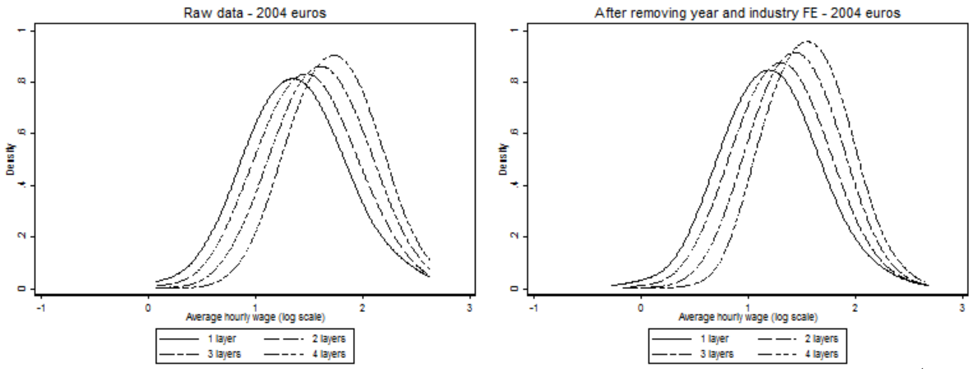
This presents the percentages of firms that fulfil the condition of having hierarchies in wages, using only firms with socialist heritage.

Table A.14: Firms with Hierarchies in Terms of Wages. Only Firms with Unions.

Number of Layers	$w_L^{l+1} \geq w_L^l$ For all l	$w_L^2 \geq w_L^1$	$w_L^3 \geq w_L^2$	$w_L^4 \geq w_L^3$
2	92.50	92.50	...	...
3	88.54	95.58	92.80	...
4	75.00	98.16	93.60	82.68

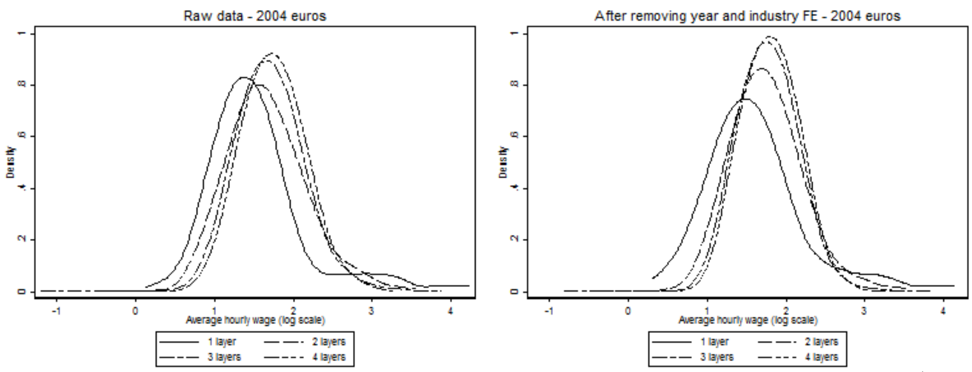
This presents the percentages of firms that fulfil the condition of having hierarchies in wages, using only firms with unions.

Figure A.1: Distribution of Average Wage by Number of Layers.
Wage-Trimmed Sample.



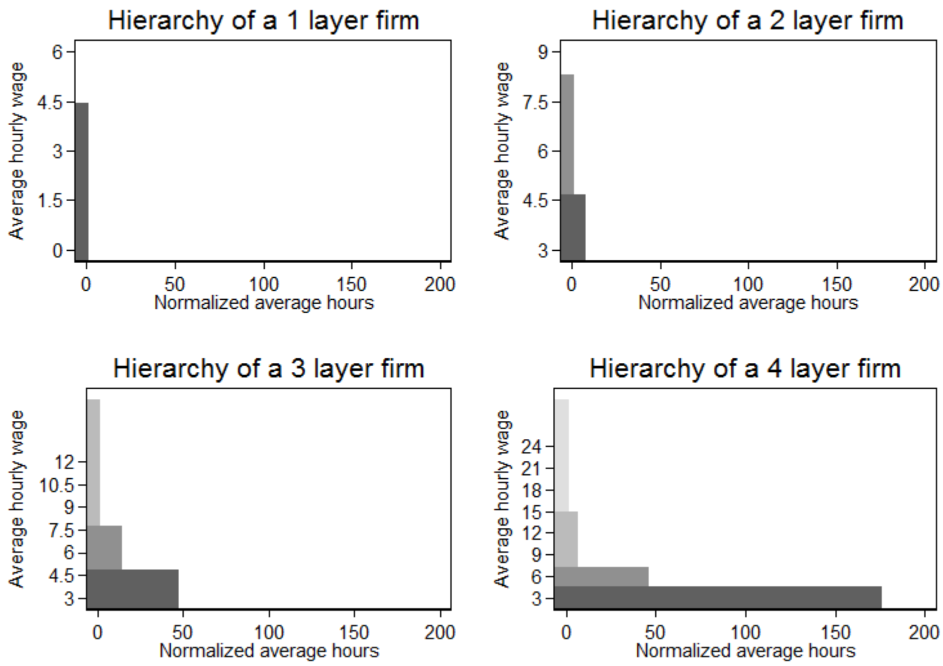
Note: This presents kernel density estimates of the distribution of firm average hourly wage (in logarithm) by number of layers, using the wage-trimmed sample. The left panel uses raw data, whilst the right panel removes fixed industry and year effects. To build it I use the same methodology as in Chapter 1, after computing average hourly wage for each firm-year.

Figure A.2: Distribution of Average Wage by Number of Layers.
Only Firms with Socialist Heritage.



Note: This presents kernel density estimates of the distribution of firm average hourly wage (in logarithm) by number of layers, using only firms with socialist heritage. The left panel uses raw data, whilst the right panel removes fixed industry and year effects. To build it I use the same methodology as in Chapter 1, after computing average hourly wage for each firm-year.

Figure A.3: Normalized Firm Hierarchies in Hours and Wages.
Only Firms with Socialist Heritage.



Note: This presents the hierarchies of the average firm with $L = 1, 2, 3, 4$ layers, using only firms with socialist heritage.

Table A.15: Average Share of Wage Variation Explained by Layer Variation. Only Firms with Unions.

			Weighted by	
	Firms-Years	Unweighted	Hours of Work	Value Added
All Firms	10,304	31.09	27.53	28.64
Firms with More than 1 Layer	10,298	31.11	27.54	28.65
Firms with 1 Layer	6	0.00	0.00	0.00
Firms with 2 Layers	520	12.92	11.88	12.71
Firms with 3 Layers	3,734	28.95	25.16	25.92
Firms with 4 Layers	6,044	34.01	28.72	29.58

This presents the result of regressing the log of hourly wage of workers in each firm-year on a constant and dummy variables for all layers (excluding layer 1), extract the R^2, and compute the mean across all firms, grouping by number of total layers in firms, using only the sub-sample of firms with unions.

Table A.16: Average Share of Wage Variation Explained by Layer Variation. Only Firms with Socialist Heritage.

			Weighted by	
	Firms-Years	Unweighted	Hours of Work	Value Added
All Firms	6,428	33.99	28.04	29.03
Firms with More than 1 Layer	6336	34.49	28.05	29.03
Firms with 1 Layer	92	0.00	0.00	0.00
Firms with 2 Layers	525	29.28	17.12	18.85
Firms with 3 Layers	2,292	33.66	25.67	27.31
Firms with 4 Layers	3,519	35.8	28.89	29.54

This presents the result of regressing the log of hourly wage of workers in each firm-year on a constant and dummy variables for all layers (excluding layer 1), extract the R^2, and compute the mean across all firms, grouping by number of total layers in firms, using only the sub-sample of firms with socialist heritage.

Table A.17: Firm-Level Outcomes Conditioned on Layer Management. Only Full-Time Employees.

	All	Increase in L	No Change in L	Decrease in L
$d$log Total Hours	0.018***	0.049***	0.026***	-0.108***
Detrended	0.013***	0.044***	0.021***	-0.113***
$d$log Normalized Hours	0.013***	0.155***	0.025***	-0.262***
Detrended	0.013***	0.155***	0.024***	-0.263***
$d$log Valued Added	-0.002	0.137***	-0.005**	-0.110***
Detrended	-0.008***	0.131***	-0.011***	-0.116***
$d$log Average Wage	0.023***	0.030***	0.023***	0.021***
Detrended	0.022***	0.029***	0.022***	0.020***
Common layers	0.022***	-0.031***	0.023***	0.071***
Detrended	0.022***	-0.032***	0.022***	0.070***
% of Firms	100.00	7.66	84.91	7.43
% Value Added Change	100.00	13.28	100.42	-13.70

Note: This presents changes in various firm outcomes, grouping firms according to the type of transition they experience between two years, using only the subsample of full-time employees.

Table A.18: Firm-Level Outcomes Conditioned on Layer Management. Only Firms with Socialist Heritage.

	All	Increase in L	No Change in L	Decrease in L
$d$log Total Hours	-0.050***	0.028	-0.037***	-0.268***
Detrended	-0.056***	0.022	-0.043***	-0.274***
$d$log Normalized Hours	-0.041***	1.802***	-0.018***	-1.747***
Detrended	-0.043***	1.800***	-0.020***	-1.749***
$d$log Valued Added	-0.046***	-0.012	-0.044***	-0.096***
Detrended	-0.053***	-0.019	-0.051***	-0.103***
$d$log Average Wage	0.016***	0.056***	0.016***	-0.009
Detrended	0.015***	0.055***	0.015***	-0.010
Common layers	0.018***	0.016	0.016***	0.045***
Detrended	0.017***	0.015	0.015***	0.044***
% of Firms	100.00	5.47	87.43	7.10
% Value Added Change	100.00	295.09	-388.76	193.67

Note: This presents changes in various firm outcomes, grouping firms according to the type of transition they experience between two years, using only the subsample of firms with socialist heritage.

Table A.19: Average Change in Log-Hours in Layer l, Conditioned on Transition Type. Only Full-Time Employees.

Total Layers Before	Total Layers After	Layer	$d\log\tilde{n}^{l}_{Li,t}$	Standard Error	p-Value	Observations
1	2	1	0.075	0.013	0.000	829
1	3	1	0.441	0.128	0.001	42
1	4	1	2.017	2.017	0.500	2
2	1	1	-0.247	0.021	0.000	900
2	3	1	0.135	0.021	0.000	1,291
2	3	2	0.221	0.020	0.000	805
2	4	1	0.477	0.186	0.014	48
2	4	2	0.624	0.140	0.000	49
3	1	1	-0.648	0.139	0.000	60
3	2	1	-0.171	0.023	0.000	1,341
3	2	2	-0.276	0.022	0.000	932
3	4	1	0.176	0.031	0.000	977
3	4	2	0.178	0.034	0.000	897
3	4	3	0.130	0.021	0.000	587
4	1	1	-1.066	0.545	0.091	8
4	2	1	-0.742	0.170	0.000	55
4	2	2	-0.620	0.165	0.000	47
4	3	1	-0.168	0.034	0.000	962
4	3	2	-0.159	0.031	0.000	898
4	3	3	-0.176	0.025	0.000	591

Note: This presents estimates for log changes in detrended normalized hours of work, according to transition type, using only full-time employees.

Table A.20: Average Change in Log-Wages in Layer l, Conditioned on Transition Type. Using Wage-Trimmed Sample.

Total Layers Before	Total Layers After	Layer	$d\log\tilde{w}^{l}_{Li,t}$	Standard Error	p-Value	Observations
1	2	1	-0.070	0.010	0.000	1,854
1	3	1	-0.059	0.035	0.094	157
1	4	1	0.113	0.082	0.227	6
2	1	1	0.120	0.011	0.000	1,571
2	3	1	-0.004	0.007	0.568	1,816
2	3	2	-0.187	0.012	0.000	1,816
2	4	1	0.021	0.032	0.514	73
2	4	2	-0.073	0.057	0.204	73
3	1	1	0.166	0.037	0.000	138
3	2	1	0.051	0.008	0.000	1,712
3	2	2	0.276	0.014	0.000	1,712
3	4	1	0.012	0.006	0.046	1,063
3	4	2	-0.036	0.010	0.000	1,063
3	4	3	-0.190	0.019	0.000	1,063
4	1	1	0.291	0.133	0.044	17
4	2	1	0.043	0.033	0.196	77
4	2	2	0.273	0.072	0.000	77
4	3	1	0.017	0.006	0.005	1,016
4	3	2	0.059	0.009	0.000	1,016
4	3	3	0.302	0.022	0.000	1,016

Note: This presents our estimates for log changes in detrended average wage, according to transition type, using wage-trimmed sample.

Table A.21: Decomposition of Log-Change in Average Wages, by Transition Type. Using Wage-Trimmed Sample.

	$\frac{\bar{w}^{l\leq L}_{L'i,t+1}}{\bar{w}_{Li,t}}$		
From/To	2	3	4
1	1.011***	1.045***	1.138***
	[1,854]	[157]	[6]
2		0.988***	1.029***
		[1,816]	[73]
3			0.998***
			[1,063]

	$\frac{\bar{w}^{L'}_{L'i,t+1}}{\bar{w}_{Li,t}}$		
From/To	2	3	4
1	1.122***	1.280***	1.419***
	[1,854]	[157]	[6]
2		1.599***	1.909***
		[1,816]	[73]
3			2.908***
			[1,063]

	s		
From/To	2	3	4
1	0.585***	0.489***	0.568***
	[1,854]	[157]	[6]
2		0.818***	0.822***
		[1,816]	[73]
3			0.950***
			[1,063]

	$d\log\bar{w}_{Li,t}$		
From/To	2	3	4
1	0.010	0.059*	0.195*
	[1,854]	[157]	[6]
2		0.029***	0.068***
		[1,816]	[73]
3			0.031***
			[1,063]

Note: This presents estimates of decomposing total log-change in average wage, by transition type, into average wage change in pre-existing layers, and in the newly added layer, both with respect to average wage before transition, using only the wage-trimmed subsample.

Appendix B: Chapter 2

The following tables present the estimated coefficients from the regressions that yield the Average Marginal Effects shown in Chapter 2.

Table B.1: Estimated Coefficients from Regressions with 1-Layered Firms

	Panel Model		
Base Outcome: Keep Layers	Multinomial Pooled Logistic Regression	Multinomial Fixed Effects Logistic Regression	Multinomial Random Effects Logistic Regression
Outcome			
Exit			
$\Delta \log VA$	-0.6619***	-0.3609***	-0.6709***
	(0.051)	(0.060)	(0.056)
D_exp	-0.2845***	-0.2223	-0.3052***
	(0.081)	(0.177)	(0.090)
$minwshock$	0.0872	0.0265	0.0851
	(0.061)	(0.055)	(0.056)
$taxshock$	-4.0710	-2.4237	-4.5332
	(4.715)	(4.150)	(4.999)
Drop Layer(s)	Alternative Not Available for 1-Layered Firms		
$\Delta \log VA$	-	-	-
D_exp	-	-	-
$minwshock$	-	-	-
$taxshock$	-	-	-
Add Layer(s)			
$\Delta \log VA$	0.2067***	0.1079**	0.2025***
	(0.037)	(0.048)	(0.041)
D_exp	0.3869***	-0.0767	0.4048***
	(0.062)	(0.134)	(0.078)
$minwshock$	0.0478	-0.6734**	0.0383
	(0.058)	(0.310)	(0.054)
$taxshock$	-2.4999	-10.5732	-2.6282
	(3.057)	(7.901)	(3.632)
Number of observations	13,431	7,545	13,431
Number of groups	-	1,576	3,392
Group variable	-	Firm identifier	Firm identifier
Wald $Chi-2$	843.14	394.30	716.94
Log-(pseudo)likelihood	-8,012.82	-2,243.96	-7,948.49

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents the estimated coefficients resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in Chapter 2, using only firms with prior 1 layer of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table B.2: Estimated Coefficients from Regressions with 2-Layered Firms

	Panel Model		
Base Outcome: Keep Layers	Multinomial Pooled Logistic Regression	Multinomial Fixed Effects Logistic Regression	Multinomial Random Effects Logistic Regression
Outcome			
Exit			
$\Delta \log VA$	-0.7681***	-0.4583***	-0.7937***
	(0.073)	(0.089)	(0.082)
D_exp	-0.3119***	-0.4902**	-0.3560***
	(0.083)	(0.220)	(0.094)
minwshock	1.9250***	1.2071**	1.9826***
	(0.290)	(0.502)	(0.348)
taxshock	8.0655	26.5526*	8.5547
	(12.873)	(15.355)	(12.832)
Drop Layer(s)			
$\Delta \log VA$	-0.3301***	-0.3587***	-0.3570***
	(0.055)	(0.074)	(0.058)
D_exp	-0.5159***	-0.0931	-0.5539***
	(0.063)	(0.135)	(0.076)
minwshock	1.6874***	0.8719***	1.7224***
	(0.266)	(0.276)	(0.321)
taxshock	-1.3523	-17.7884**	-4.1096
	(7.560)	(8.204)	(7.185)
Add Layer(s)			
$\Delta \log VA$	0.2044***	-0.0614	0.1756***
	(0.045)	(0.064)	(0.048)
D_exp	0.2836***	-0.2374**	0.2707***
	(0.055)	(0.115)	(0.065)
minwshock	-1.3886***	-1.2564**	-1.5478***
	(0.427)	(0.640)	(0.463)
taxshock	-8.868**	-5.0769	-10.3663**
	(4.065)	(9.747)	(4.802)
Number of observations	17,839	11,052	17,839
Number of groups	-	2,232	4,267
Group variable	-	Firm identifier	Firm identifier
Wald $Chi-2$	-	559.73	3,185.76
Log-(pseudo)likelihood	-12,531.32	-3,396.96	-12,417.43

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents the estimated coefficients resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in Chapter 2, using only firms with prior 2 layers of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table B.3: Estimated Coefficients from Regressions with 3-Layered Firms

Base Outcome: Keep Layers	Panel Model: Multinomial Pooled Logistic Regression	Panel Model: Multinomial Fixed Effects Logistic Regression	Panel Model: Multinomial Random Effects Logistic Regression
Outcome			
Exit			
$\Delta \log VA$	-1.0209***	-0.5664***	-1.0806***
	(0.100)	(0.121)	(0.107)
D_exp	-0.1166	0.3925	-0.1151
	(0.106)	(0.287)	(0.119)
minwshock	4.4578***	4.7771***	4.7627***
	(0.582)	(1.571)	(0.740)
taxshock	27.3258	13.4440	29.3404
	(20.429)	(22.264)	(21.343)
Drop Layer(s)			
$\Delta \log VA$	-0.2992***	-0.3478***	-0.3450***
	(0.062)	(0.076)	(0.066)
D_exp	-0.5344***	0.1047	-0.5395***
	(0.055)	(0.118)	(0.070)
minwshock	3.7466***	1.7941***	4.0352***
	(0.454)	(0.589)	(0.627)
taxshock	20.7116**	-3.8365	17.8458*
	(9.506)	(9.026)	(9.566)
Add Layer(s)			
$\Delta \log VA$	0.0339	-0.0128	0.0235
	(0.072)	(0.088)	(0.071)
D_exp	0.7112***	0.1653	0.7317***
	(0.081)	(0.173)	(0.094)
minwshock	-0.0117	-1.2306	-0.1197
	(0.883)	(1.852)	(0.983)
taxshock	-10.8873	-8.7351	-12.8012
	(6.868)	(15.543)	(8.226)
Number of observations	16,139	10,073	16,139
Number of groups	-	1,930	3,529
Group variable	-	Firm identifier	Firm identifier
Wald $Chi-2$	4,711	497.11	2,336.08
Log-(pseudo)likelihood	-10,267.03	-2,860.37	-10,152.72

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents the estimated coefficients resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in Chapter 2, using only firms with prior 3 layers of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table B.4: Estimated Coefficients from Regressions with 4-Layered Firms

	Panel Model		
Base Outcome: Keep Layers	Multinomial Pooled Logistic Regression	Multinomial Fixed Effects Logistic Regression	Multinomial Random Effects Logistic Regression
Outcome			
Exit			
$\Delta \log VA$	-0.9593***	-0.6556**	-1.0218***
	(0.161)	(0.266)	(0.176)
D_exp	-0.4904**	-0.9299	-0.5344**
	(0.205)	(0.714)	(0.227)
minwshock	5.6556***	-0.9364	5.7105**
	(1.843)	(2.743)	(2.261)
taxshock	-72.0091***	-59.3201**	-75.0702***
	(17.366)	(25.685)	(20.286)
Drop Layer(s)			
$\Delta \log VA$	-0.2438***	-0.3127***	-0.3216***
	(0.090)	(0.109)	(0.100)
D_exp	-0.5249***	0.0164	-0.4548***
	(0.086)	(0.189)	(0.124)
minwshock	5.9021***	4.4394*	6.5493***
	(1.728)	(2.344)	(2.086)
taxshock	23.1994**	15.8183	24.5651*
	(11.621)	(17.158)	(14.053)
Add Layer(s)	Alternative Not Available for 4-Layered Firms		
$\Delta \log VA$	-	-	-
D_exp	-	-	-
minwshock	-	-	-
taxshock	-	-	-
Number of observations	8,140	3,929	8,140
Number of groups	-	708	1,596
Group variable	-	Firm identifier	Firm identifier
Wald $Chi-2$	3,120.04	5,745.74	1,230.01
Log-(pseudo)likelihood	-3,725.84	-1,053.82	-3,636.68

Source: Own calculations based on data from SER, SFA and AJPES.

Notes: This table presents the estimated coefficients resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in Chapter 2, using only firms with prior 4 layers of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table C.1: Main Descriptives of Exporting Firms, Conditioning to Firms with 1 Layer

		Average				
Year	Active Firms	Value Added	Total Hours	Hourly Wage	Total Exports by Firm	Firm-Level Exogenous Trade Shock %
1999	173	78	5,916	4.09	156	1.45
2000	176	80	6,070	4.05	153	20.07
2001	164	68	4,770	4.32	112	15.01
2002	183	60	4,549	4.48	98	8.25
2003	146	62	5,014	4.67	100	7.17
2004	148	68	4,779	4.70	108	14.72
2005	109	73	4,651	5.16	123	11.37
2006	110	78	4,288	5.94	145	8.95
2007	116	97	4,891	5.97	150	12.78
2008	117	87	5,161	5.97	207	43.09
2009	136	97	7,292	5.76	178	-14.15
2010	132	89	6,406	6.09	191	6.09
2011	132	140	6,133	5.82	273	11.66

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table contains the number of firm-year observations and yearly average values, among firms with only 1 layer of management, of value-added, total working hours, wage, total organizational layers by firm, total exports by firm, growth rate in total exports, and exogenous trade shock. Average value added is reported in thousand (2004) Euros. Average hourly wage is reported in 2004 Euros. Total working hours are calculated as the sum of hours by all employees in a firm in a given year. Average total exports are reported in current thousand Euros. Average firm-level exogenous trade shock is computed as shown in Chapter 3.

Appendix C: Chapter 3

The following tables present main descriptives of exporting firms, as shown in Chapter 3, conditioning to 1, 2, 3, and 4-layered firms. The coefficients from first and second stages of the estimations yielding the average marginal effects shown in Chapter 3 are also presented. Finally, I also present the results from estimating multinomial logistic models by pooled OLS, fixed and random effects (controlling for 2-digit NACE industry and time fixed effects), regressing transition type on actual value added growth and the international trade shock. According to the discussion in Chapter 3, these models probably suffer from endogeneity, given that some observable (or unobservable) variables that are not present in the data set are likely to explain firms' decisions regarding size, which will affect both sales (and value added) and changes in hierarchical structure.

Table C.2: Main Descriptives of Exporting Firms, Conditioning to Firms with 2 Layers

		Average				
Year	Active Firms	Value Added	Total Hours	Hourly Wage	Total Exports by Firm	Firm-Level Exogenous Trade Shock %
1999	437	315	32,075	4.50	678	1.11
2000	445	338	30,518	4.45	681	16.43
2001	454	318	28,722	4.70	637	10.59
2002	478	303	28,454	4.86	522	5.73
2003	524	309	29,012	5.05	521	4.92
2004	493	318	29,041	5.06	490	6.63
2005	434	318	26,888	5.38	532	12.81
2006	434	334	27,553	5.54	596	7.61
2007	442	366	28,494	5.88	704	11.52
2008	413	353	29,736	6.13	675	29.54
2009	413	306	27,355	5.93	453	-9.83
2010	416	339	27,467	6.30	570	13.35
2011	435	420	26,608	6.51	1,420	8.73

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table contains the number of firm-year observations and yearly average values, among firms with 2 layers of management, of value-added, total working hours, wage, total organizational layers by firm, total exports by firm, growth rate in total exports, and exogenous trade shock. Average value added is reported in thousand (2004) Euros. Average hourly wage is reported in 2004 Euros. Total working hours are calculated as the sum of hours by all employees in a firm in a given year. Average total exports are reported in current thousand Euros. Average firm-level exogenous trade shock is computed as shown in Chapter 3.

Table C.3: Main Descriptives of Exporting Firms, Conditioning to Firms with 3 Layers

		Average				
Year	Active Firms	Value Added	Total Hours	Hourly Wage	Total Exports by Firm	Firm-Level Exogenous Trade Shock %
1999	609	1,458	158,353	4.88	3,682	3.93
2000	642	1,388	150,411	4.96	3,705	16.92
2001	702	1,431	146,559	5.27	3,689	11.42
2002	760	1,391	132,228	5.30	3,197	7.10
2003	759	1,322	117,514	5.51	2,589	3.11
2004	791	1,131	110,070	5.43	2,390	9.39
2005	721	1,420	123,902	5.62	3,041	13.27
2006	691	1,355	114,530	5.86	3,192	9.74
2007	712	1,320	101,615	6.23	3,192	11.05
2008	710	1,173	92,501	6.51	3,002	17.77
2009	656	1,057	85,719	6.38	2,367	-12.52
2010	649	1,127	83,921	6.70	2,984	10.50
2011	612	1,306	90,819	6.86	3,420	10.28

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table contains the number of firm-year observations and yearly average values, among firms with 3 layers of management, of value-added, total working hours, wage, total organizational layers by firm, total exports by firm, growth rate in total exports, and exogenous trade shock. Average value added is reported in thousand (2004) Euros. Average hourly wage is reported in 2004 Euros. Total working hours are calculated as the sum of hours by all employees in a firm in a given year. Average total exports are reported in current thousand Euros. Average firm-level exogenous trade shock is computed as shown in Chapter 3.

Table C.4: Main Descriptives of Exporting Firms, Conditioning to Firms with 4 Layers

		Average				
Year	Active Firms	Value Added	Total Hours	Hourly Wage	Total Exports by Firm	Firm-Level Exogenous Trade Shock %
1999	478	5,778	503,050	5.35	14,872	2.19
2000	519	5,939	498,265	5.40	16,158	15.67
2001	513	6,083	473,858	5.69	15,902	11.20
2002	534	6,122	468,813	5.85	15,643	5.95
2003	519	6,432	478,085	5.93	15,931	3.54
2004	546	5,407	444,232	5.89	14,367	11.19
2005	527	5,995	455,495	6.06	16,523	15.72
2006	544	6,700	450,396	6.29	17,742	10.55
2007	542	6,904	446,173	6.54	19,215	10.35
2008	562	6,384	442,702	6.60	17,855	17.28
2009	540	6,109	413,523	6.78	14,725	-14.14
2010	505	6,092	418,276	6.84	17,209	12.91
2011	456	6,550	413,798	7.04	19,067	12.62

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table contains the number of firm-year observations and yearly average values, among firms with 4 layers of management, of value-added, total working hours, wage, total organizational layers by firm, total exports by firm, growth rate in total exports, and exogenous trade shock. Average value added is reported in thousand (2004) Euros. Average hourly wage is reported in 2004 Euros. Total working hours are calculated as the sum of hours by all employees in a firm in a given year. Average total exports are reported in current thousand Euros. Average firm-level exogenous trade shock is computed as shown in Chapter 3.

Table C.5: Estimated Coefficients from First and Second Stage Regressions for 1-Layered Firms

Dependent Variable: $\Delta \log VA$	First Stage: Multinomial Pooled Logistic Regression	Multinomial Fixed Effects Logistic Regression	Multinomial Random Effects Logistic Regression
Exogshock	0.0318**	0.0360	0.0157**
	(0.014)	(0.022)	(0.007)
Number of observations	1,059	1,059	1,059
Number of groups	-	371	371
Group variable	-	Firm identifier	Firm identifier
R-squared	0.0232	0.0118	0.0232
Base Outcome: Keep Layers		Second Stage	
Exit			
$\Delta \log VA$	-3.3820	-4.7257	-3.4319
	(2.134)	(6.986)	(2.137)
Drop Layer(s)	Alternative Not Available for 1-Layered Firms		
$\Delta \log VA$	-	-	-
Add Layer(s)			
$\Delta \log VA$	-9.1178	-18.0842	-9.9490
	(6.913)	(14.997)	(8.965)
Number of observations	1,710	1,218	1,710
Number of groups	-	316	651
Group variable	-	Firm identifier	Firm identifier
Wald $Chi-2$	1,035.63	101.27	1,078.04
Log-(pseudo)likelihood	-1,537.31	-328.31	-1,516.21

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: This table presents the estimated first and second stage regression coefficients resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in Chapter 3, using only firms with prior 1 layer of management. The possible outcomes at the second stage are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table C.6: Estimated Coefficients from First and Second Stage Regressions for 2-Layered Firms

	First Stage		
Dependent Variable: $\Delta \log VA$	Multinomial Pooled Logistic Regression	Multinomial Fixed Effects Logistic Regression	Multinomial Random Effects Logistic Regression
Exogshock	0.0101**	0.0103***	0.0105***
	(0.004)	(0.003)	(0.004)
Number of observations	3,880	3,880	3,880
Number of groups	-	1,019	1,019
Group variable	-	Firm identifier	Firm identifier
R-squared	0.0280	0.0194	0.0272
Base Outcome: Keep Layers		Second Stage	
Exit			
$\Delta \log VA$	-5.9167	-10.7245	-7.2072
	(7.117)	(8.538)	(8.263)
Drop Layer(s)			
$\Delta \log VA$	-107.7194**	-163.1429***	-129.9198***
	(44.982)	(43.334)	(43.738)
Add Layer(s)			
$\Delta \log VA$	1.0599	0.3321	1.1263
	(2.776)	(2.552)	(2.978)
Number of observations	5,383	3,881	5,383
Number of groups	-	844	1,503
Group variable	-	Firm identifier	Firm identifier
Wald $Chi-2$	3,202.06	168.60	2,339.88
Log-(pseudo)likelihood	-4,686.37	-1,189.00	-4,602.18

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: This table presents the estimated first and second stage regression coefficients resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in Chapter 3, using only firms with prior 2 layers of management. The possible outcomes at the second stage are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table C.7: Estimated Coefficients from First and Second Stage Regressions for 3-Layered Firms

Dependent Variable: $\Delta \log VA$	First Stage: Multinomial Pooled Logistic Regression	Multinomial Fixed Effects Logistic Regression	Multinomial Random Effects Logistic Regression
Exogshock	0.0009	-0.0003	0.0000
	(0.003)	(0.004)	(0.004)
Number of observations	6,371	6,371	6,371
Number of groups	-	1,528	1,528
Group variable	-	Firm identifier	Firm identifier
R-squared	0.0210	0.0116	0.0207
Base Outcome: Keep Layers		Second Stage	
Exit			
$\Delta \log VA$	-355.4237	-174.8916	-4,981.576
	(273.234)	(508.073)	(5,884.139)
Drop Layer(s)			
$\Delta \log VA$	-196.3078	428.3252	-4,617.112
	(226.136)	(788.575)	(5,827.620)
Add Layer(s)			
$\Delta \log VA$	-29.8759	110.3235	-716.8202
	(33.331)	(143.721)	(1,681.996)
Number of observations	8,402	6,114	8,402
Number of groups	-	1,229	2,031
Group variable	-	Firm identifier	Firm identifier
Wald $Chi-2$	2,249.63	282.43	4,236.12
Log-(pseudo)likelihood	-6,852.95	-1,840.73	-6,753.88

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: This table presents the estimated first and second stage regression coefficients resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in Chapter 3, using only firms with prior 3 layers of management. The possible outcomes at the second stage are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table C.8: Estimated Coefficients from First and Second Stage Regressions for 4-Layered Firms

Dependent Variable: $\Delta \log VA$	First Stage: Multinomial Pooled Logistic Regression	First Stage: Multinomial Fixed Effects Logistic Regression	First Stage: Multinomial Random Effects Logistic Regression
Exogshock	0.0379**	0.0392**	0.0390**
	(0.017)	(0.019)	(0.018)
Number of observations	5,096	5,096	5,096
Number of groups	-	978	978
Group variable	-	Firm identifier	Firm identifier
R-squared	0.0306	0.0183	0.0301
Base Outcome: Keep Layers	Second Stage		
Exit			
$\Delta \log VA$	-36.5662***	-14.7236**	-32.9920***
	(9.383)	(7.390)	(9.570)
Drop Layer(s)			
$\Delta \log VA$	-2.9029	-3.0616	-3.0073
	(2.740)	(4.442)	(3.377)
Add Layer(s)	Alternative Not Available for 4-Layered Firms		
$\Delta \log VA$	-	-	-
Number of observations	6,329	3,572	6,329
Number of groups	-	656	1,233
Group variable	-	Firm identifier	Firm identifier
Wald $Chi-2$	4,319.15	121.35	1,253.13
Log-(pseudo)likelihood	-3,589.97	-974.86	-3,503.39

Source: Own calculations based on data from SER, SFA, AJPES, and BACI.

Notes: This table presents the estimated first and second stage regression coefficients resulting from running pooled data, fixed effects and random effects multinomial logit models, as shown in Chapter 3, using only firms with prior 4 layers of management. The possible outcomes at the second stage are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table C.9: Average Marginal Effects from Endogenous Model for 1-Layered Firms

Model	Exit	Drop Layer(s) (not available for 1-layered firms)	Keep Layer(s)	Add Layer(s)
	Outcome			
Pooled Regression (robust)				
$\Delta \log VA$	-0.0471*	-	-0.0082	0.0554***
	(0.024)		(0.025)	(0.015)
Exogshock	-0.0127	-	0.0570*	-0.0444
	(0.022)		(0.034)	(0.037)
Fixed Effects Regression (robust)				
$\Delta \log VA$	-0.0100	-	-0.0543	0.0643
	(0.010)		(0.038)	(0.042)
Exogshock	0.0106	-	0.0732	-0.0838
	(0.015)		(0.112)	(0.124)
Random Effects Regression (robust)				
$\Delta \log VA$	-0.0438*	-	-0.0091	0.0530***
	(0.025)		(0.025)	(0.015)
Exogshock	-0.0094	-	0.0523	-0.0429
	(0.021)		(0.034)	(0.039)

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table presents the estimated average marginal effects from running an endogenous model in which transition type is explained by value added growth (endogenous variable) and the trade shock, using only firms with 1 layer of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table C.10: Average Marginal Effects from Endogenous Model for 2-Layered Firms

	Outcome			
Model	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s)
Pooled Regression (robust)				
$\Delta \log VA$	-0.0712***	-0.0094	0.0711***	0.0095
	(0.012)	(0.007)	(0.016)	(0.010)
Exogshock	-0.0002	-0.0274*	0.0237*	0.0040
	(0.006)	(0.014)	(0.012)	(0.003)
Fixed Effects Regression (robust)				
$\Delta \log VA$	-0.0127*	0.0068	0.0601**	-0.0542
	(0.007)	(0.013)	(0.030)	(0.036)
Exogshock	0.0055	-0.0566**	0.0252*	0.0259**
	(0.004)	(0.025)	(0.013)	(0.012)
Random Effects Regression (robust)				
$\Delta \log VA$	-0.0701***	-0.0074	0.0704***	0.0070
	(0.013)	(0.007)	(0.016)	(0.010)
Exogshock	0.0012	-0.0351***	0.0291***	0.0047*
	(0.006)	(0.013)	(0.011)	(0.003)

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table presents the estimated average marginal effects from running an endogenous model in which transition type is explained by value added growth (endogenous variable) and the trade shock, using only firms with 2 layers of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table C.11: Average Marginal Effects from Endogenous Model for 3-Layered Firms

Model	Outcome			
	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s)
Pooled Regression (robust)				
$\Delta \log VA$	-0.0787***	-0.0092	0.0959***	-0.0079
	(0.011)	(0.006)	(0.014)	(0.008)
Exogshock	-0.0145	-0.0080	0.0213	0.0012
	(0.022)	(0.012)	(0.022)	(0.002)
Fixed Effects Regression (robust)				
$\Delta \log VA$	-0.0350*	0.0037	0.0653**	-0.0341
	(0.019)	(0.006)	(0.028)	(0.035)
Exogshock	0.0177	-0.0069	0.0047	-0.0155
	(0.016)	(0.011)	(0.011)	(0.013)
Random Effects Regression (robust)				
$\Delta \log VA$	-0.0829***	-0.0082	0.0983***	-0.0072
	(0.014)	(0.006)	(0.016)	(0.007)
Exogshock	-0.0062	-0.0094	0.0154	0.0003
	(0.015)	(0.014)	(0.017)	(0.002)

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table presents the estimated average marginal effects from running an endogenous model in which transition type is explained by value added growth (endogenous variable) and the trade shock, using only firms with 3 layers of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Table C.12: Average Marginal Effects from Endogenous Model for 4-Layered Firms

Model	Exit	Drop Layer(s)	Keep Layer(s)	Add Layer(s) (not available for 4-layered firms)
	Outcome			
Pooled Regression (robust)				
$\Delta \log VA$	-0.0396***	-0.0247***	0.0644***	-
	(0.011)	(0.009)	(0.015)	
Exogshock	-0.0714***	-0.0016	0.0730***	-
	(0.026)	(0.009)	(0.026)	
Fixed Effects Regression (robust)				
$\Delta \log VA$	0.0014	-0.0396	0.0382	-
	(0.006)	(0.029)	(0.028)	
Exogshock	-0.0157	-0.0080	0.0237	-
	(0.013)	(0.020)	(0.020)	
Random Effects Regression (robust)				
$\Delta \log VA$	-0.0381***	-0.0253**	0.0634***	-
	(0.013)	(0.011)	(0.017)	
Exogshock	-0.0692**	-0.0025	0.0718**	-
	(0.030)	(0.011)	(0.029)	

Source: Own calculations based on data from SER, SFA, AJPES and BACI.

Notes: This table presents the estimated average marginal effects from running an endogenous model in which transition type is explained by value added growth (endogenous variable) and the trade shock, using only firms with 4 layers of management. The possible outcomes are identified for each firm at year t, depending on the number of layers it has at year $t+1$; if the firm is missing in year $t+1$, it is identified as exiting the market. ***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively. Robust standard errors in parentheses.

Appendix D: Summary in Slovenian language/Daljši povzetek disertacije v slovenskem jeziku

Splošni uvod

Podjetja za proizvodnjo potrebujejo delovno silo, ki je eden izmed ključnih proizvodnih dejavnikov. Ta dejavnik pa ni homogen, saj se razlikuje znotraj samega podjetja in tudi med različnimi podjetji. Ker se zaposleni razlikujejo po stopnji in vrsti izobrazbe, spretnostih in delovnih izkušnjah, so odločitve s področja upravljanja človeških virov izjemno pomembne: podjetja morajo sestavo svoje delovne sile določiti na podlagi lastnih značilnosti in sprememb v gospodarskem okolju. Za primer vzemimo majhno podjetje z eno samo organizacijsko ravnjo, ki začne rasti. S širjenjem proizvodnega procesa se naravno pojavijo novi problemi, zato bo najverjetneje najelo več delavcev, ki so tudi bolje usposobljeni.

Z nadaljnjo širitvijo se lahko podjetje odloči, da se reorganizira tako, da vzpostavi dve organizacijski ravni: spodnjo raven proizvodnih delavcev, ki opravljajo najbolj rutinske naloge, in novo raven nadzornikov, ki vključuje samo nekaj izkušenejših in bolj izobraženih zaposlenih, ki se bodo ukvarjali z zapletenejšimi problemi. Če se širitev proizvodnje in prodaje nadaljuje, se lahko podjetje odloči, da bo na obeh ravneh zaposlilo več bolje usposobljenih delavcev, saj se lahko začnejo pojavljati čedalje zahtevnejši problemi. Proces rasti lahko doseže prag, ko se podjetje odloči obstoječima organizacijskima ravnema dodati še eno raven. Tako je sestavljeno iz spodnje ravni delavcev v proizvodnji, ki opravljajo rutinske naloge, ravni nadzornikov, ki se ukvarjajo z zapletenejšimi nalogami, in najvišje ravni uprave, ki sprejema najzahtevnejše odločitve v podjetju. Seveda ni nujno, da se proces širitve konča tukaj, saj se podjetje še naprej prilagaja spremembam v svojem okolju.

Namen opisanega primera je ponazoriti, kako lahko podjetja spremenijo hierarhično strukturo ob širitvi ali krčenju. Ob tem je treba opozoriti tudi na to, da lahko pri tem podjetja po svoji organizacijski strukturi premikajo tudi znanje. Upravljanje količine delovne sile in njene kakovosti se lahko odraža v spremembah števila delovnih ur in višine plač po organizacijski hierarhiji, kar je tudi eno izmed glavnih vprašanj, obravnavanih v tej disertaciji.

V nadaljevanju so predstavljeni nekateri osnovni izrazi, ki se pojavljajo v disertaciji:

- **Hierarhična raven**: pojem hierarhične ravni se nanaša na razmeroma homogeno skupino zaposlenih, ki imajo približno enako raven znanja in odgovornost v podjetju;
- **Prehod**: proces, s katerim podjetje doda ali odstrani hierarhične ravni na prehodu med dvema obdobjema. Na primer, če se podjetje z dvema organizacijskima ravnema odloči dodati še eno organizacijsko raven, bodo zaposleni na dodani ravni nadzorovali tiste na drugi ravni, ti pa tiste na prvi (najnižji) ravni. To vpliva na število delovnih ur in plače na prej obstoječih dveh ravneh;
- **Šoki**: obstaja več načinov oblikovanja šokov v ekonomskih spremenljivkah, vsi pa vključujejo

eksogeni vir variacije posamezne spremenljivke. Na primer, če se vlada odloči spremeniti zakonsko določeno minimalno plačo, sprememba deleža zaposlenih z minimalno plačo ni šok, saj gre za (endogeni) odziv podjetij na novo zakonodajo, zaradi katere lahko spremenijo število tovrstnih zaposlenih v svoji strukturi. Če pa število zaposlenih z minimalno plačo spremenimo leto pred sprejetjem nove zakonodaje in izračunamo pričakovano rast stroškov dela na podlagi nove zakonodaje ob predpostavki, da podjetje obdrži enako strukturo zaposlenih, je to primer eksogenega šoka.

Raziskovalna vprašanja

V zvezi s hierarhično organizacijo podjetij je še vedno mnogo odprtih vprašanj: ali se podjetja širijo tako, da preprosto replicirajo obseg poslovanja ali da zaposlene reorganizirajo v time, kot je opisano v zgornjem primeru, ter kako tovrstne odločitve vplivajo na zaposlene in podjetja? Raziskovalci so s proučevanjem hierarhičnih ravni odkrili več pomembnih značilnosti upravljanja notranje strukture podjetij. Nekateri raziskovalci se osredotočajo na to, kako se podjetja odzivajo na različne vrste šokov (Guadalupe & Wulf, 2010; Caliendo et al., 2015a; Davidson et al., 2017; Caliendo et al, 2017; Bastos et al, 2018; Cruz et al., 2018), na primer šoke, povezane z liberalizacijo trgovine, tujimi prevzemi, programi krepitve konkurenčnosti, IKT in produktivnostjo. Drugi avtorji proučujejo vplive odločitev, povezanih z reorganizacijo, na različne spremenljivke v zvezi s podjetji (Tåg, 2013; Caliendo et al., 2015b; Tåg et al., 2016; Spanos, 2016), kot so dodana vrednost, plače, izvoz in celo verjetnost, da nekdanji zaposleni postanejo podjetniki.

Področje na znanju temelječih hierarhij je torej še razmeroma slabo raziskano, zlasti z empiričnega vidika, glavni namen predstavljene disertacije pa je prav empirična raziskava omenjene problematike. Na podlagi podrobnih podatkov uparjenih slovenskih proizvodnih podjetij in njihovih zaposlenih, ki se nanašajo na obdobje med letoma 1997 in 2011, avtor v njej v nadaljevanju obravnava naslednja raziskovalna vprašanja:

- **Ali je smiselno organizirati zaposlene v hierarhične ravni?**

  Z metodologijo, ki so jo uporabili Caliendo et al. (2015b), je v prvem poglavju na podlagi šifre poklica po klasifikaciji ISCO-88 vsak zaposleni razvrščen v eno izmed štirih hierarhičnih ravni, ki jih ima lahko posamezno podjetje, tako pridobljeni podatki pa so primerni za preverjanje teoretičnih posledic modela hierarhične organizacije, ki sta ga razvila Caliendo & Rossi-Hansberg (2012). Avtor najprej ugotovi, da so višje ravni povezane z višjimi plačami, in sicer pri vseh percentilih znotraj vsake ravni, ter da imajo podjetja z višjo dodano vrednostjo tudi več hierarhičnih ravni in višje plače, število opravljenih delovnih ur njihovih zaposlenih je prav tako večje. Navedeno se ujema z ugotovitvami Caliendo et al. (2015b) za francoska podjetja, podatki pa kažejo, da v primerjavi z njimi slovenska podjetja na višjih ravneh navadno izplačujejo višje dodatke k plači.

- **Kako spremembe v dodani vrednosti vplivajo na hierarhično strukturo podjetij?**

Slovenski podatki, analizirani v prvem poglavju, kažejo, da se tako kot v primeru francoskih podjetij (Caliendo et al., 2015b), verjetnost, da bodo podjetja dodajala hierarhične ravni, povečuje z njihovo dodano vrednostjo, pri čemer pa je verjetnost, da bodo dodala eno raven, večja od verjetnosti, da bodo dodala več kot eno raven. Poleg tega podjetjem, ki se v določenem obdobju prehoda odločijo dodati (odstraniti) več ravni, dodana vrednost na splošno raste hitreje (počasneje) kot pa podjetjem, ki se odločijo zmanjšati (povečati) ali obdržati enako število ravni. Avtor v tretjem poglavju na podlagi pristopa, ki ga je razvil Friedrich (2020), in dvostopenjske ocenjevalne metode uporabi metodo instrumentalnih spremenljivk za dodano vrednost in oceni njene nepristranske vplive na verjetnost, da bodo podjetja spremenila svojo hierarhično strukturo.

- **Kako sprememba hierarhične strukture vpliva na plače in število delovnih ur?**

  Avtor v prvem poglavju proučuje dinamiko podjetij z vidika števila delovnih ur in plač, ko podjetja rastejo in spremenijo število organizacijskih ravni ali pa ne. Ko slovenska podjetja z vidika dodane vrednosti rastejo in obdržijo enako število organizacijskih ravni, njihovi zaposleni na vseh ravneh opravijo več delovnih ur in prejemajo višje plače. Na podlagi ocenjenih elastičnosti in v primerjavi s francoskimi podjetji (Caliendo et al., 2015b) pa avtor opaža, da slovenska podjetja bolj spreminjajo število delovnih ur kot plače. Ko podjetja rastejo in spremenijo hierarhično strukturo, se obnašajo zelo podobno kot francoska podjetja (Caliendo et al., 2015b): tista, ki dodajo (odstranijo) organizacijsko raven, povečajo (zmanjšajo) število delovnih ur, a tudi znižajo (povišajo) povprečne plače na prej obstoječih ravneh. Navedeno se popolnoma sklada s teoretičnimi predvidevanji Caliendo & Rossi-Hansberg (2012), saj morajo podjetja, ki se odločijo dodati (odstraniti) organizacijsko raven, hkrati na vseh prej obstoječih ravneh zmanjšati (povečati) tudi znanje.

  Na podlagi ugotovljenih ocen slovenska podjetja v primerjavi s francoskimi (Caliendo et al., 2015b) pri reorganizaciji bolj spreminjajo število delovnih ur kot plače. V prvem poglavju so za analizo tega, kako podjetja ob spremembi hierarhičnih ravni prerazporedijo znanje, uporabljene izobrazba in izkušnje zaposlenih kot bolj neposredno merilo znanja (podobno kot v Caliendo et al., 2015b). Dobljeni rezultati kažejo, da teorija, ki jo je razvil Garicano (2000), velja tudi za slovenska podjetja: v veliki večini primerov pri prehodu na večje (manjše) število organizacijskih ravni podjetja na vseh prej obstoječih ravneh zmanjšajo (povečajo) ali povprečno izobrazbo ali pa izkušnje zaposlenih, saj se znanje prenese na dodane višje ravni (oziroma z odstranjenih višjih ravni). Natančneje, v slovenskih podjetjih se znanje (prek izobrazbe in izkušenj zaposlenih) po organizacijskih ravneh prenaša bolj, kot to razkrivajo povprečne plače.

- **Kako spremembe v minimalni plači in davek na plače vplivajo na hierarhično strukturo podjetij?**

  Kot navaja Garicano & Rossi-Hansberg (2015), je eno izmed še neraziskanih področij na znanju temelječih hierarhij vpliv eksogenih sprememb ekonomske politike na to, kako podjetja organizirajo svoje zaposlene. Avtor zato v drugem poglavju oblikuje meri eksogenih sprememb stroškov dela zaradi sprememb v zakonodaji, ki določa minimalno plačo, in v politiki davka na plače, na podlagi česar oceni spremembe v hierarhični strukturi podjetij. Njegovi izsledki potrjujejo hipotezo, da tovrstni ekonomski šoki pomembno vplivajo na organizacijo podjetij: povečanje pričakovanih stroškov minimalne plače za eno odstotno točko poveča verjetnost, da se bodo podjetja zmanjšala in/ali zapustila trg, ter zmanjša verjetnost, da bodo dodala nove organizacijske ravni. Po drugi strani so vplivi šokov v davku na plače na verjetnost sprememb v organizacijski strukturi močno odvisni od trenutnega števila organizacijskih ravni v podjetju.

- **Kako spremembe v izvoznem povpraševanju vplivajo na hierarhično strukturo podjetij?**

  Hierarhična struktura podjetij se lahko spremeni tudi zaradi vpliva mednarodne trgovine na njihovo prodajo. Prodajo podjetij večinoma določajo odločitve njihove uprave, zato spremembe v njihovi dodani vrednosti niso samo posledica zunanjih okoliščin, ampak tudi direktorjevih odločitev. Z vidika ustreznosti ekonometričnih ocen to preprečuje nepristransko oceno vplivov sprememb v dodani vrednosti na organizacijo podjetja, kar lahko rešimo samo z uporabo metode instrumentalnih spremenljivk za dodano vrednost in tako izkoriščamo le eksogene vire variacije. Avtor v tretjem poglavju uporabi eksogene vire variacije sprememb v dodani vrednosti, za kar oblikuje šoke v izvoznem povpraševanju po vzoru Bartikovih instrumentov (glej Bartik, 1991; Goldsmith-Pinkham et al., 2020). Na podlagi tega pridobi nepristranske ocene vpliva sprememb v velikosti podjetij na verjetnost, da bodo spremenila svojo hierarhično strukturo.

Zasnova disertacije

Avtor v prvem poglavju primerja ključne hipoteze na znanju temelječih hierarhij, ki so jih oblikovali Garicano (2000) in Caliendo & Rossi-Hansberg (2012). Podjetja, ki se odločajo o reorganizaciji svoje proizvodnje, se ukvarjajo s tem, koliko in kakšne delavce bi morala zaposliti ter kakšne vloge naj bi ti delavci imeli v podjetju. Ob naraščanju povpraševanja se morajo podjetja odločiti, ali bodo replicirala obseg poslovanja ali spremenila organizacijo zaposlenih v time. Pri zmanjševanju povpraševanja pa se morajo odločiti, ali bodo zmanjšala število zaposlenih ali spremenila organizacijo timov. Teorije na znanju temelječih hierarhij ponujajo različne odgovore na ta vprašanja, ki pogosto odstopajo od tradicionalne teorije povpraševanja po homogeni delovni sili.

Garicano (2000) je razvil teorijo, da bi morala podjetja svoje zaposlene organizirati v hierarhične ravni, pri čemer delavci z najmanj znanja opravljajo samo najbolj rutinska dela, tisti z več znanja pa se ukvarjajo z bolj zapletenimi problemi, ki se lahko pojavijo v proizvodnji, in usmerjajo druge pri opravljanju težjih nalog. Caliendo & Rossi-Hansberg (2012) tovrstne odločitve obravnavata v splošnem kontekstu heterogenih podjetij, na podlagi česar oblikujeta nadaljnje teoretične premisleke glede povezave med organizacijo podjetja in njegovimi značilnostmi.

Podjetje, ki se sooča z večjim (manjšim) povpraševanjem ali produktivnostjo, lahko doda (odstrani) organizacijske ravni. Proizvodne stroške lahko zmanjša tako, da uvede več organizacijskih ravni, pri čemer ima na višjih ravneh bolj usposobljene vodje, na nižjih pa delavce z manj znanja. Podjetje bo število svojih organizacijskih ravni navadno spremenilo samo, če bo z njihovim dodajanjem ali odstranjevanjem znižalo proizvodne stroške. Če so spremembe v dodani vrednosti premajhne, se podjetja lahko odzovejo tudi tako, da spremenijo število delovnih ur.

V tem poglavju avtor disertacije proučuje, ali napovedi teoretičnega modela, ki sta ga razvila Caliendo & Rossi-Hansberg (2012), veljajo tudi za slovenska proizvodna podjetja. Analizira razlike med podjetji z različnim številom hierarhičnih ravni ter proučuje posledice dodajanja/odstranjevanja organizacijskih ravni zaradi povečanja/zmanjšanja dodane vrednosti v primerjavi s situacijo, ko podjetja obdržijo enako hierarhično strukturo. V ta namen uporabi podrobne letne podatke uparjenih slovenskih proizvodnih podjetij in njihovih zaposlenih, ki se nanašajo na obdobje med letoma 1997 in 2011.

Na podlagi šifre poklica po klasifikaciji ISCO-88 je vsak zaposleni razvrščen v eno izmed štirih hierarhičnih ravni, ki jih ima lahko posamezno podjetje, tako pridobljeni podatki pa so primerni za preverjanje teoretičnih posledic modela hierarhične organizacije, ki sta ga razvila Caliendo & Rossi-Hansberg (2012). Pri empirični analizi avtor sledi empirični metodologiji, ki so jo Caliendo et al. (2015b) uporabili za analizo uparjenih podatkov francoskih proizvodnih podjetij in njihovih zaposlenih, zaradi česar je mnogo njegovih izsledkov neposredno primerljivih z njihovimi.

Večina avtorjevih izsledkov potrjuje teorijo, ki sta jo razvila Caliendo & Rossi-Hansberg (2012), in se ujemajo z ugotovitvami Caliendo et al. (2015b), ki se nanašajo na francoska proizvodna podjetja. Avtor najprej ugotovi, da slovenska podjetja na višjih ravneh izplačujejo višje plače; podjetja z višjo dodano vrednostjo imajo tudi več organizacijskih ravni in višje plače, pa tudi število opravljenih delovnih ur njihovih zaposlenih je večje. Drugič, z dodano vrednostjo se veča tudi verjetnost, da bodo podjetja dodajala organizacijske ravni, pri čemer je verjetnost, da bodo dodala samo eno raven, večja kot verjetnost, da bodo dodala več kot eno raven. Tretjič, podjetja, ki dodajo več ravni, običajno rastejo hitreje kot podjetja, ki zmanjšajo ali ohranijo enako število ravni. Slovenska podjetja v primerjavi s francoskimi izplačujejo višje dodatke k plači na višjih ravneh in imajo manj organizacijskih ravni.

Avtor proučuje tudi dinamiko podjetij z vidika števila delovnih ur in plač, ko rastejo in spremenijo število organizacijskih ravni ali pa ne. Ko slovenska podjetja z vidika dodane vrednosti rastejo in obdržijo enako število ravni, njihovi zaposleni na vseh ravneh opravijo več delovnih ur in prejemajo višje plače. Na podlagi ocenjenih elastičnosti in v primerjavi s francoskimi podjetji (Caliendo et al., 2015b) pa avtor ugotavlja, da slovenska podjetja bolj spreminjajo število delovnih ur kot plače.

Ko podjetja rastejo in spremenijo svojo hierarhično strukturo, se obnašajo zelo podobno kot francoska podjetja (Caliendo et al., 2015b): tista, ki dodajo (odstranijo) organizacijsko raven, povečajo (zmanjšajo) število delovnih ur, a tudi znižajo (povišajo) povprečne plače na prej obstoječih ravneh. Navedeno se popolnoma sklada s teoretičnimi predvidevanji, predstavljenimi v Caliendo & Rossi-Hansberg (2012), saj morajo podjetja, ki se odločijo dodati ali odstraniti organizacijsko raven, hkrati premakniti znanje navzgor ali navzdol, pri čemer se na vseh prej obstoječih ravneh znanje zmanjša ali poveča. Avtorjeve ocene kažejo, da slovenska podjetja v primerjavi s francoskimi (Caliendo et al., 2015b) pri reorganizaciji bolj spreminjajo število delovnih ur kot pa plače.

V podpoglavju 1.1 je predstavljen pregled prvega poglavja, podpoglavje 1.2 pa vsebuje uvod v poglavje. V podpoglavju 1.3 je predstavljen kratek pregled glavne literature s področja organizacijskih hierarhij, v podpoglavju 1.4 so opisani viri podatkov in spremenljivk, uporabljenih pri empiričnih ocenah, v podpoglavju 1.5 pa so povzeti statistični podatki. Podpoglavje 1.6 vsebuje ključne empirične ugotovitve, v naslednjem podpoglavju avtor na kratko obravnava razlike v organizacijski strukturi slovenskih in francoskih podjetij, v podpoglavju 1.8 pa predstavi sklepne ugotovitve.

Avtor v drugem poglavju na podlagi precejšnjih sprememb v minimalni plači in davku na plače v Sloveniji med letoma 2005 in 2010 oceni vplive eksogenih šokov na verjetnost, da se bodo podjetja odločila za različno obliko prehoda. V skladu s teorijo organizacijskih hierarhij podjetja svoje zaposlene organizirajo v time, da bi s tem optimizirale proizvodne stroške. Določijo število ravni in razvrstijo svoje zaposlene na vsako raven na podlagi njihove usposobljenosti, tako da bolje usposobljeni nadzirajo tiste na nižjih ravneh. Zaposleni na najnižjih ravneh se ukvarjajo z vsakodnevnimi problemi v proizvodnji, ko pa se pojavi zahtevnejši problem, ga rešujejo zaposleni na najvišjih ravneh. Na nižjih ravneh torej zaposleni skupno opravijo več delovnih ur in prejemajo nižje plače, na višjih ravneh pa opravijo manj delovnih ur in prejemajo višje plače.

Hierarhična struktura podjetij ni statična, saj se podjetja spopadajo z različnimi vrstami šokov, ki vplivajo na njihove odločitve glede širitve ali krčenja. Pri tem ni nujno, da se podjetja odločijo za spremembo števila organizacijskih ravni. V nekaterih primerih se lahko odločijo, da se bodo razširila tako, da bodo replicirala obseg poslovanja brez spreminjanja hierarhične strukture. V drugih primerih se lahko odločijo za povečanje ali zmanjšanje števila organizacijskih ravni. To je odvisno od vrste in razsežnosti šoka.

Namen drugega poglavja je predstaviti nove dokaze o vplivih šokov politik, ki povzročijo spremembe v stroških dela, na organizacijske hierarhije. Kot poudarjajo Garicano & Rossi-Hansberg (2015), je v zvezi z vplivi nekaterih šokov politik, kot so reforme trga dela in spremembe v davčni politiki (ki jih avtor obravnava v disertaciji), potrebnih veliko več empiričnih raziskav. Avtor proučuje skoke v minimalni plači med letoma 2005 in 2010 ter njihov vpliv na organizacijsko hierarhijo slovenskih proizvodnih podjetij.

Dvigi minimalne plače so povišali stroške zaposlenih na spodnjem koncu plačne lestvice oziroma na najnižjih organizacijskih ravneh. Po drugi strani je odprava zelo progresivnega davka na plače zmanjšala relativne stroške visoko usposobljenih zaposlenih, kar je vplivalo zlasti na stroške dela zaposlenih na najvišjih organizacijskih ravneh. Obe politiki sta vplivali na stroške dela na različnih organizacijskih ravneh, hkrati pa sta obe zmanjšali relativne stroške zaposlenih na najvišjih ravneh.

Teorija na znanju temelječih hierarhij predvideva, da se ob dovolj velikih spremembah v povpraševanju, kot je pojasnjeno zgoraj, lahko podjetja odločijo, da bodo dodala več organizacijskih ravni, da bi učinkoviteje povečala svoj obseg proizvodnje. Optimalni odzivi podjetij glede izbir organizacijske hierarhije niso odvisni le od sprememb povpraševanja, ampak lahko na učinkovitost proizvodnje vplivajo tudi spremembe v ponudbi. Ekonomske politike, ki vplivajo na stroške dela, lahko zato vplivajo tudi na hierarhično organizacijo podjetij, za kar avtor v tem poglavju predstavi tudi empirične dokaze. Za vsako obdobje na podlagi zakonodaje, ki bo veljala naslednje leto, izračuna pričakovano spremembo v stroških dela zaradi eksogenih sprememb v višini minimalne plače in davka na plače.

S tem lahko nato nepristransko oceni vplive teh ekonomskih politik na verjetnost vsake oblike prehoda (tj. da podjetje zapusti trg, zmanjša število organizacijskih ravni, obdrži enako hierarhično strukturo ali poveča število organizacijskih ravni). Avtor ugotavlja, da obe vrsti eksogenih sprememb v politiki pomembno pojasnjujeta odločitve podjetij glede sprememb v hierarhični organizaciji v proučevanem obdobju, pri čemer so šoki v minimalni plači statistično značilnejši kot šoki v davku na plače. Njegovi izsledki se večinoma ujemajo z vplivi na organizacijo podjetij, ki jih predpostavlja teorija na znanju temelječih hierarhij.

V podpoglavju 2.1 je podan pregled celotnega poglavja, podpoglavje 2.2 pa vsebuje kratek uvod v poglavje. V podpoglavju 2.3 avtor povzame najpomembnejšo literaturo s področja minimalnih plač, davka na plače in organizacijskih hierarhij, ki temeljijo na znanju. V naslednjem podpoglavju predstavi institucionalno ozadje slovenske politike minimalnih plač in davka na plače, v podpoglavju 2.5 povzame statistične podatke, v naslednjem pa rezultate ocen. V podpoglavju 2.7 navede sklepne ugotovitve.

V tretjem poglavju so obravnavani vplivi sprememb v velikosti podjetij na njihovo hierarhično organizacijo. Ker so spremembe velikosti podjetij pogosto posledica drugih neopaznih spremenljivk, bodo ocene njihovega vpliva na organizacijo podjetja pristranske. Avtor se zato v tretjem poglavju osredotoča na pridobitev nepristranskih ocen z uporabo metode instrumentalnih spremenljivk za dodano vrednost, pri čemer so instrumenti oblikovani na podlagi eksogenih spremembe v izvoznem povpraševanju.

Osnovna teorija, ki jo učijo na kakršnem koli dodiplomskem študiju mikroekonomije, je, da je delovna sila eden izmed glavnih proizvodnih dejavnikov, ki jih podjetja uporabljajo za proizvodnjo izdelkov. Pri optimalni odločitvi vsakega podjetja gre pravzaprav za to, koliko delovne sile bi moralo podjetje združiti s preostalimi vložki, da bi čim bolj znižalo stroške. Navedena poenostavitev zapostavlja dejstvo, da se morajo v resnici podjetja odločati tudi o tem, koliko kvalificirane in nekvalificirane delovne sile najeti ter kako te heterogene delavce notranje organizirati.

Teorija na znanju temelječih hierarhij se ukvarja s tem, kako podjetja svoje zaposlene razvrstijo v različne hierarhične ravni na podlagi njihove izobrazbe in usposobljenosti. Zaposleni na nižjih ravneh se tako ukvarjajo s preprostimi problemi, medtem ko zaposleni na višjih ravneh (tj. menedžerji) nadzorujejo zaposlene na nižjih ravneh in se ukvarjajo z zahtevnejšimi problemi, ki se v proizvodnji redkeje pojavijo.

V skladu z opisano teorijo (glej Garicano, 2000; Garicano & Rossi-Hansberg 2006, 2012; Caliendo & Rossi-Hansberg, 2012; Garicano & Rossi-Hansberg, 2015) povečanje ali zmanjšanje obsega podjetij podjetja spodbudi k temu, da dodajo ali odstranijo organizacijske ravni, ko so navedene spremembe dovolj velike. Caliendo et al. (2015b) na podlagi podatkov o francoskih proizvodnih podjetjih navajajo, da večina podjetij, katerih dodana vrednost se v določenem obdobju močneje spremeni, v naslednjem obdobju spremeni število organizacijskih ravni. Navedeno pomeni, da med rastjo dodane vrednosti in spremembami v hierarhični organizaciji obstaja močna povezava.

Sama rast dodane vrednosti je odvisna od drugih spremenljivk, zaradi katerih se podjetja odločijo razširiti ali skrčiti, pri čemer lahko spremenijo tudi svojo hierarhično strukturo. To pomeni, da je treba pri proučevanju vplivov sprememb velikosti podjetij na njihove organizacijske odločitve upoštevati tudi morebitno endogenost. Čeprav je na voljo mnogo teoretičnih modelov, na podlagi katerih lahko podjetja oblikujejo svoje organizacijske hierarhije tako, da optimizirajo stroške, so empirične primerjave njihovih glavnih predvidevanj redke, zato raziskovalci poudarjajo, da je potrebnih več empiričnih raziskav, zlasti za analizo vplivov različnih vrst šokov na organizacijske odločitve (Garicano & Rossi-Hansberg, 2015).

Avtor v tem poglavju prispeva k temu področju tako, da na podlagi Bartikovega pristopa (glej Bartik 1991; Goldsmith-Pinkham et al., 2020) oblikuje šoke v izvoznem povpraševanju, ki jih uporabi z namenom zajetja le eksogenih virov variacije v dodani vrednosti, na podlagi česar reši problem endogenosti in nepristransko oceni vplive rasti v dodani vrednosti (tj. sprememb v velikosti podjetij) na verjetnost, da podjetja spremenijo svojo organizacijsko strukturo. Za to uporabi dvostopenjsko metodo ocenjevanja, pri čemer na prvi stopnji oceni regresijsko enačbo z dodano vrednostjo kot odvisno spremenljivko in s pojasnjevalno spremenljivko na ravni podjetja izračuna obseg sprememb izvoza zaradi variacije uvoznega povpraševanja. Na drugi stopnji potem z logističnimi modeli za več različnih izbir oceni povprečne mejne učinke eksogenih sprememb dodane vrednosti na verjetnost, da bodo podjetja zmanjšala, povečala ali obdržala enako število ravni ali zapustila trg. Njegovi izsledki se večinoma ujemajo z napovedmi modelov na znanju temelječih hierarhij.

Podpoglavji 3.1 in 3.2 vsebujeta pregled celotnega poglavja ter uvod k morebitnemu problemu uporabe sprememb dodane vrednosti kot neposredno merilo sprememb velikosti podjetij v ocenah. V podpoglavju 3.3 je predstavljen pregled ustrezne teorije s področja na znanju temelječih hierarhij in šokov v izvoznem povpraševanju. V podpoglavju 3.4 avtor predstavi Bartikovo metodologijo, ki jo uporabi za oblikovanje eksogenih povpraševalnih šokov. V naslednjem podpoglavju predstavi nekaj osnovne opisne statistike uporabljenega nabora podatkov, v podpoglavju 3.6 pa rezultate ocen. Sklepne ugotovitve navede v podpoglavju 3.7.

Četrto poglavje vključuje zaključno razpravo in sklepne ugotovitve disertacije.

Razprava in sklepi

Empirični dokazi o uporabi in dinamiki na znanju temelječih hierarhij v podjetjih so še razmeroma redki, disertacija pa prispeva konkretne dokaze o tej problematiki. Temeljna teoretična dela avtorjev Garicano (2000), Garicano & Rossi-Hansberg (2006, 2012), in Caliendo & Rossi-Hansberg (2012) zagotavljajo dobro osnovo za empirične raziskave, zlasti če so na voljo podrobni podatki na ravni podjetij in njihovih zaposlenih v daljšem časovnem obdobju. Avtor v disertaciji na podlagi podatkov uparjenih slovenskih proizvodnih podjetij in njihovih zaposlenih, ki se nanašajo na obdobje med letoma 1997 in 2011, preverja različna predvidevanja teorije na znanju temelječih hierarhij.

V prvem poglavju ugotavlja, da tako kot francoska podjetja, ki so jih analizirali Caliendo et al. (2015b), slovenska podjetja svoje zaposlene organizirajo v ravni, pri čemer imajo velja podjetja navadno več ravni. Za podjetja, ki se jim dodana vrednost močno spremeni, je bolj verjetno, da bodo spremenila skupno število organizacijskih ravni. Slovenska podjetja se po navadi organizirajo v zaporedno urejene organizacijske ravni, kar pomeni, da na višjih ravneh njihovi zaposleni skupno opravijo več delovnih ur in prejemajo višje plače. Ko se podjetja odločijo spremeniti hierarhično strukturo (zaradi sprememb v dodani vrednosti), po navadi premenijo tako število delovnih ur kot plače, a različno po različnih ravneh. Zaposleni na dodanih ravneh navadno prejmejo višje plače, tisti na prej obstoječih ravneh pa nižje. Če podjetje zmanjša število organizacijskih ravni, se zaposlenim na prej obstoječih ravneh plače povišajo. Navedeni vzorci so potrjeni na podlagi izobrazbe in izkušenj kot neposrednih meril znanja.

Avtor v drugem poglavju ugotavlja, da so tako šoki v minimalni plači kot šoki v davku na plače statistično značilni pri pojasnjevanju odločitev podjetij v zvezi s hierarhično organizacijo v opazovanem obdobju, pri čemer so šoki v minimalni plači nekoliko statistično značilnejši od šokov v davku na plače. Ocenjeni povprečni mejni učinki se večinoma ujemajo s predpostavljenimi učinki na organizacijo podjetij v okviru na znanju temelječih hierarhij: eksogeno povišanje stroškov dela zaradi zakonskih sprememb v minimalni plači po navadi poveča verjetnost, da podjetja zapustijo trg ali zmanjšajo število organizacijskih ravni, ter zmanjša verjetnost, da obdržijo enako strukturo ali povečajo število organizacijskih ravni. Učinki eksogenega povišanja davka na plače so po drugi strani manj dosledni z vidika predznaka in statistične značilnosti.

Avtor v zadnjem, tretjem poglavju na podlagi eksogenov šokov v izvoznem povpraševanju po vzoru Bartikovih instrumentov oblikuje spremembe v dodani vrednosti, na podlagi česar lahko oceni njihov vpliv na verjetnost, da bodo podjetja izbrala eno izmed možnih sprememb organizacijske strukture. Ugotavlja, da se učinki eksogene rasti velikosti podjetij na njihovo hierarhično organizacijo precej ujemajo s predvidevanji na znanju temelječih hierarhij. Ob pregledu vseh podatkov ugotavlja, da večja eksogena rast dodane vrednosti zmanjšuje verjetnost, da bodo podjetja zapustila trg, in povečuje verjetnost, da bodo obdržala enako organizacijsko strukturo. Primeri podjetij z dvema organizacijskima ravnema poleg tega kažejo, da eksogene spremembe dodane vrednosti zmanjšujejo verjetnost, da bodo podjetja zmanjšala število organizacijskih ravni, in povečujejo verjetnost, da bodo dodala nove ravni.

Metodologije in naloge, uporabljene v disertaciji, razširjajo znanje o hierarhijah, ki temeljijo na znanju – področju ekonomske teorije, na katerem so se empirične raziskave šele pred kratkim začele uveljavljati. Avtor navaja, da kolikor ve, nekateri deli disertacije, zlasti tisti, ki se nanašajo na šoke v minimalni plači in davku na plače, dajejo prvi vpogled v učinke ekonomskih šokov in šokov politik na odločitve podjetij glede hierarhične organizacije. Kot navajata Garicano & Rossi-Hansberg (2015), tovrstne spremembe vplivajo na skupne rezultate gospodarstva v celoti (npr. z vidika plačne neenakosti, zaposlitve in drugih spremenljivk). Empirično ocenjevanje modelov v okviru na znanju temelječih hierarhij zagotavlja plodna tla za nove raziskave, možnosti za nadaljnje raziskovalno delo pa so ogromne.