The Inception of Capitalism through the Lens of Firms

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January 14, 2020

Abstract

Using firm-level data, I analyze one of the largest economic experiments of the twentieth century, the fall of communism. After communism ended, post-communist economies experienced a sharp decline and slow recovery of output. This paper studies the output pattern of these countries using microdata from Hungary from both communist and market economy times (1986-1999). I propose a novel decomposition of output change which allows me to quantify the role of productivity, inputs and allocative efficiency in output change. I find that the majority of the output drop is accounted for by a reduction in labor input. In contrast, the recovery in the 1990s largely reflects gains from within-industry reallocation of inputs toward more productive firms. Next, I explore the mechanisms through which the fall in labor and the gains in allocative efficiency operated. I find that during communism, a large share of firms employed an inefficiently high number of people given the wages firms paid. During the transition, these firms saw their employment decrease 40% more relative to other firms. In particular, these firms shed more low-educated, blue-collar, older, and female workers. The evidence is consistent with the interpretation that the corporate sector in communism provided a social safety net in addition to producing output. With regard to the recovery, I provide evidence consistent with the bank privatization having improved allocative efficiency of capital by removing frictions caused by state banks.

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I thank my advisors, Michael Greenstone, Mikhail Golosov, Stéphane Bonhomme, Amir Sufi and Chad Syverson for their support and encouragement. For helpful discussions, I thank Rodrigo Adão, Gadi Barlevy, Marco Bassetto, Jeffrey Campbell, Eszter Czibor, Stefania D'Amico, Manasi Deshpande, Jonathan Dingel, David Finer, John Heaton, Ali Hortaçsu, Robert Jackman, Sonia Jaffe, Greg Kaplan, Simone Lenzu, Justin Leung, Jim Marrone, Jack Mountjoy, Magne Mogstad, Karthik Nagarajan, Nuno Paixão, Lubos Pastor, Jeremy Pearce, Raghuram Rajan, Jung Sakong, Samuel Schulhofer-Wohl, Alex Sollaci, Alex Torgovitsky, James Traina, Robert Vishny, Karen Ye and Luigi Zingales. I thank seminar participants at the University of Chicago for comments, and the Stigler Center at the University of Chicago for financial support.

1 Introduction

After the fall of communism, output declined by 29% in the average Eastern European country. This average output recovered to its prior trend 16 years later (Figure 1), making this macroeconomic event comparable to the Great Depression in magnitude and length. The large output decline was a surprise to economists: Communism imposed distortions on firms and markets, and removing these distortions was expected to increase output (Blanchard, 1998). Similarly, the 16 years of recovery to trend was unexpectedly long. Despite the importance of the event, the channels behind the output decline and recovery have not been identified or quantified using comprehensive microdata.

In this paper, I use unique microdata from Hungary for the time period 1986-1999 to understand the output fall and recovery. Prior to the fall of communism, Hungary was one of the Soviet-bloc countries, making this microdata ideal to study the surprising output pattern. The microdata include firm-level financial statements from administrative sources, covering a large share of economic activity in the country. Additionally, I create a new database of financial access and banking relationships by hand collecting and digitizing data. I ask two main questions with the data. What factors account for the decline in output and the recovery? And, having identified these main factors, what underlying mechanisms drive the main changes?

First, I develop a novel decomposition of output change into contributions due to six components: average firm productivity, allocative efficiency related to inputs and productivity, aggregate labor, aggregate capital, allocative efficiency related to different inputs (labor and capital), and higher-order terms. The traditional output decompositions, such as Growth Accounting pioneered by Solow (1957), use aggregate data to disentangle the role of aggregate inputs and the residual, aggregate productivity. The firm-level nature of my data allows me to implement my decomposition accounting for allocative efficiency of several types, besides incorporating changes in industry-wide input contribution and productivity. To the best of my knowledge, this paper is the first to incorporate allocative efficiency to the traditional output decomposition, Growth Accounting. The decomposition in this paper is based on the intuition that output can be thought of as the sum of two terms: first, output level if labor, capital, and productivity were randomly assigned across firms; second, the additional output if labor, capital, and productivity are sorted positively or negatively.

I find two main results. First, the decreasing contribution of labor accounts for the majority, 93%, of the decrease in output from 1987 to 1993. Second, improvements in aggregate productivity, in particular via improved allocative efficiency,

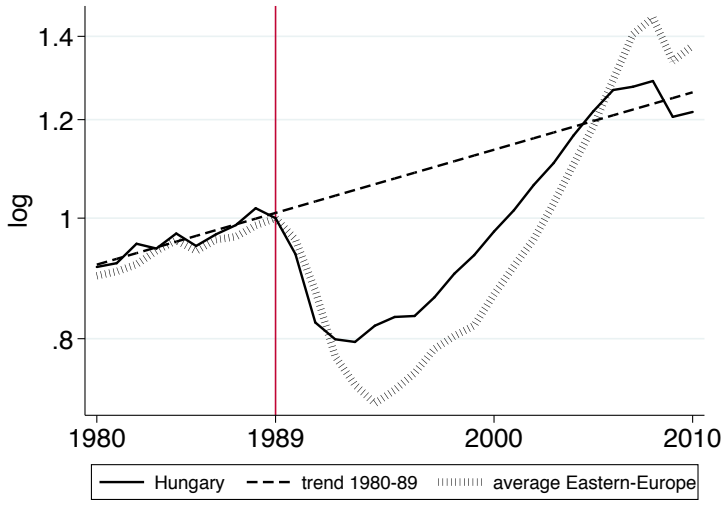
account for 123% of output recovery. In other words, in the post-period,[1] output grows largely because inputs, within the same industry, get allocated to more productive firms. Both labor and capital became more efficiently allocated during the 1990s. In accounting for output gains, the improved allocation of capital accounts for approximately 1.3 times more compared to the improved allocation of labor. In contrast, changes in inputs account for little of the recovery in output.

The decomposition and its results allow me to evaluate previously proposed channels explaining the surprising output pattern of post-communist economies. I find empirical evidence which is inconsistent with the channels previously proposed. Two main papers reflect widely-held views on why output declined (Roland, 2000): (i) according to Blanchard and Kremer (1997), the pre-period's supply chains between firms broke down in the market economy environment, because bargaining inefficiencies arose; (ii) in Roland and Verdier (1999) search frictions, which arise in the market economy environment, coupled with relationship-specific investment result in a fall in investment. The mechanism for output decline proposed by Blanchard and Kremer (1997) implies that productivity is an important factor in the decomposition of output fall. In contrast, the mechanism in Roland and Verdier (1999) implies that a decline in capital is an important factor in the output decomposition. I find that compared to the decline in labor, capital or firm-level productivity (or aggregate productivity) contribute little to the decrease in output. While indirect evidence exists for the proposed channels using Russian and Ukranian data (Konings et al. (2005) and Blanchard and Kremer (1997)), the comprehensive data I use allows me to directly differentiate between the contribution of labor, capital, and productivity in the output decrease and show that a decline in labor accounts for most of the output decrease.

Second, having identified that the majority of the output fall is accounted for by a decline in labor, I leverage the microdata to understand why labor fell in the transition. I find that in the pre-period, a significant share of firms employed suboptimally many people, given the wages they paid. Specifically, for these firms, the marginal revenue product measured at the firm level was consistently lower compared to the firm-specific wages paid ($MRPL_{it} < w_{it}$). I call such firms "overemployer" firms. Such firms did not exhibit differential employment patterns prior to the fall of communism, reative to other firms. However, once the transition commenced, overemployer firms saw their employment drop by 40% more than other firms. In particular, overemployer firms decreased their employment more for categories of workers that in market economies are more marginally attached to the labor market: workers with low education, with blue-collar jobs, women, and older workers.

[1] In the paper, "pre-period" refers to the years prior to the fall of communism, and the "post-period" refers to the time period following the fall of communism.

FIGURE 1: GDP PER CAPITA IN HUNGARY AND OTHER POST-COMMUNIST COUNTRIES, 1989=1



Notes: This graph shows GDP per capita for Hungary and for the average Eastern-European country excluding Hungary. Average Eastern-Europe excludes Hungary and is the unweighted average of GDP/capita in Belarus, Czechia, Estonia, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, and Ukraine, the countries for which GDP data exists for long enough in the past. The data are reported in 2011 US dollars and their value is normalized to 1 in 1989. Data source: Maddison Historical Statistics (2017)

The results are consistent with a world in which firms during communism operated not only as entities that make and sell products, but also as entities that provide a social safety net to workers. This interpretation is supported by internal documents from communist times that were strictly barred from public circulation at the time. These documents referred to many of the firms making losses. Pondering how to resolve the problem, officials warned against closing the loss-making firms, as such a step was feared to have caused local unemployment issues.[2](Central Statistical Office (classified document), 1988) I show further patterns of evidence consistent with the social safety net interpretation of the results. Economic agents "protected by" a certain economic system via an implicit social safety net, when given the chance, are expected to vote to preserve the system.[3] I identify the counties that in 1993, the lowest point of the recession, had higher unemployment rates accounted for by

[2]The Hungarian language has a colloquial expression associated with the idea of employing inefficiently many people: "kapun belüli munkanélküliség" which means "unemployment within the gates." The expression refers to employment which takes place, people provide labor services to the firm, but the firm would have preferred to not hire as many workers.

[3]For evidence on the "pocketbook" theory of voting, see, for example, Pop-Eleches and Pop-Eleches (2012). For a broader overview, see chapter 12 in Congleton et al. (2019).

low-educated or blue-collar workers. In a cross-sectional regression with a host of controls I find that these counties had voted disproportionately for the Communist Party in the first free elections in March 1990.

To understand mechanisms behind the increased allocative efficiency driving the recovery of output, I leverage a quasi-experiment of banking liberalization. With this quasi-experiment, I quantify the role of access to market-based finance (as opposed to state-allocated finance) in the allocative efficiency gains in the 1990s. I interact the staggered nature of the privatization with state-banks' branch network determined decades prior to the quasi-experiment. To the best of my knowledge, this is the largest experiment exploiting the movement of a country's financial system from state ownership to private ownership in the span of a few years. I find that approximately 25% of the cross-county reallocation gains in capital between 1993 and 1999 are associated with the channel of privatizing the financial system in the 1990s.

In the next subsection I discuss my contribution to the literature. In Section 2, I introduce the data and institutional background, in Section 3, I describe the methodology I use. The main results of the decomposition are discussed in Section 4. Section 5 focuses on labor's decline. Section 6 describes the quasi-experiment related to the banking privatization. Section 7 concludes.

This paper contributes to several strands of literature, namely, the literature on misallocation (in particular distortions induced by the state), decomposition methods using firm-level data, transition economics, and the role of finance in economic growth. The paper is also relevant to current policy debates on the role of the state in providing employment opportunities.

Misallocation

Broadly, my paper contributes to the large and growing literature on misallocation. Banerjee and Duflo (2005), Restuccia and Rogerson (2008) and Hsieh and Klenow (2009) were among the firsts to formalize the role of misallocation in output levels. I contribute to this literature by analyzing one of the most significant deregulatory episodes in the 20th century, namely the fall of communism. This "experiment" can be thought of as the time-series version of the Hsieh and Klenow (2009) exercise, whereby the economy is moved by external forces from an institutional environment with many frictions to one with fewer frictions. My findings related to the decrease in output are a prominent example of output distortions associated with the state-imposed restrictions on firms' operations. Through my finding on the large role of improving allocative efficiency in the 1990s, my results relate to Bartelsman et al. (2013) focusing on the importance of allocation gains across the world. I also quantify the extent to which the lack of access to market-based finance impedes growth. Through the analysis of financial frictions as a source of misallocation, my paper

relates to Buera et al. (2011), Buera and Shin (2017), Moll (2014), and Gilchrist et al. (2013). In addition, my paper relates to work analyzing large-scale structural reforms or responses to crises, such as Cheremukhin et al. (2016), Cole and Ohanian (2002) or Oberfield (2013).

Decomposition Methods using Firm-level Data

Methodologically, my paper contributes a new decomposition method to understand the sources of output changes over time, using firm-level data. It builds on two insights: (i) Olley and Pakes (1996) decompose aggregate productivity into the role of unweighted firm-level productivity and allocative efficiency using firm-level data; (ii) Growth accounting, started by Tinbergen (1942), and Solow (1957), decomposes the time series of aggregate output in a country to the role of aggregate inputs, and the residual, aggregate productivity.[4] The decomposition in this paper blends these two approaches in order to leverage the firm-level data in quantifying the driving forces behind changes in output of an industry (and aggregated to a country) over time. The method I suggest is a decomposition of output changes, as opposed to productivity changes. However, in its approach it is similar to decompositions of productivity using firm-level data, for example Olley and Pakes (1996), Melitz and Polanec (2015), Griliches and Regev (1995), or Foster et al. (2001).

Transition Economics

This paper relates to the large transition economics literature that focuses on understanding why post-communist countries experienced a surprising output pattern. In Roland (2000) two views emerge which are most consistent with microfoundations of firm behavior. Both views are based on supply-chain disruptions in the market economy. The model in Blanchard and Kremer (1997) implies that productivity is the main contributor to the fall in output. The model in Roland and Verdier (1999) implies that output falls largely because investment falls. Blanchard and Kremer (1997) and Roland and Verdier (1999) are primarily theoretical papers. Blanchard and Kremer (1997) and Konings and Walsh (1999) show indirect evidence for the channels based on supply-chain disruptions. My empirical results are not consistent with the implications of the theories based on supply chain disruptions, and point, instead, to the large role of declining labor in explaining the decrease in output. Similarly, the "partial reform" approach outlined in Murphy et al. (1992) does not explain the output fall in Hungary, as reforms were not partial, different from the environment in which Murphy et al. (1992) lives. De Loecker and Konings (2006) show that between 1994 and 2000 in the Slovenian manufacturing sector, the largest part of productivity growth is associated with within-firm TFP improvements as opposed to allocative gains across firms within an industry. In contrast, my results show that within-industry reallocation gains dominate every other channel in the

[4] Jorgenson (1988) gives a detailed exposition of growth accounting.

recovery of the 1990s in Hungary.

Role of Finance in Growth

The results on the privatization of the banking system relate to a large literature on the role of finance in economic growth, summarized in Levine (2005). Greenstone et al. (2014), Rajan and Zingales (1998), and Jayaratne and Strahan (1996) all ask, albeit in different contexts, whether financial access is relevant for economic outcomes such as growth. To the best of my knowledge, this paper is the first to study the effects of a complete overhaul of the financial system in the matter of a few years in which the system moves from being fully state-run to almost fully privately run.

Policy

Recent policy discussions in developed market economies, including the US, have suggested an increasing role of the state in providing employment opportunities or social insurance. Examples of proposals that have been put forward, are: (i) guaranteed employment;[5] (ii) basic universal income.[6]. This paper finds evidence which is consistent with the communist system providing social insurance also via guaranteed employment.

2 Data and Institutional Background

2.1 Communism in the 1980s and transition

After World War II, countries in Eastern Europe became part of the Soviet sphere. Along with a repressive political regime came an economic system based on the replacement of private property with state property and based on total planning of economic activity. The Central Planning Bureau in the respective country created five-year plans that were broken down to the firm-level. Each firm had a strict production goal to achieve that was checked on every year (Havas, 1980). During the 1960s a reform package was designed whose goal was to introduce limited market mechanisms in the economy. The reform package, called New Economic Mechanism, was introduced on January 1, 1968 (Balassa, 1970).

The data used in this paper starts in the 1980s, therefore, I describe the economic environment in detail for this period relative to a market economy in the West. The 1980s Hungarian communist economy was state controlled to a large extent relative to market economies. Firms were either owned by the state or they were

[5]For example, the Washington Post (2018) reported that potential 2020 presidential candidate Senator Bernie Sanders will propose a job guarantee program for every American worker that "wants or needs one." Another potential presidential candidate for 2020, Senator Cory Booker, has introduced "Federal Jobs Guarantee Development Act of 2018," a bill to run pilot programs for federal jobs guarantee programs (Sen. Cory A. Booker, 2018)

[6]For example, as in Finland (The Economist, 2018)

cooperatives. Both state-owned firms and cooperatives operated at the confluence of strong bureaucratic control and autonomy. The major difference between the two was that cooperatives had slightly more autonomy than state-owned firms. (Kornai, 1986) Growing a firm to a significant market share was not possible for private individuals, because private ownership was limited to craftsmanship, small shops, and restaurants (Kornai, 1986). Relatively little entry and exit of firms occured. A major pillar of communist economic policy was full employment, unemployment did not exist.(Kornai, 1986) Full employment meant that everybody of working age had to have a job. Managers of firms could make decisions on the subjects, quantities, and methods of production. Although they took into account consumers' demands, they also had to subject themselves to the rules and restrictions the communist economic system imposed on them. For example, the ability to invest, at least for larger investments, was tightly linked to specific funds approved by and obtained from the state. Prices were similarly more regulated compared to a market economy: Although managers had some ability to set prices, the state imposed rules on prices as illustrated by a brief summary of the pricing system according to the price reforms of the early 1980s: (i) prices of manufactured goods had to have the same profit content as the same product's export prices; (ii) where the above was not possible, the method of cost-based pricing had to be invoked. This method relies on the need for the price to be tightly linked to the cost of producing the good; and (iii) prices of primary energy and raw materials were raised to international levels. (Hungarian Ministry of Finance, 1991)

The communist political and economic regime officially ended in October 1989, when the Hungarian Republic was proclaimed in the place of the People's Republic of Hungary. The first free elections took place in March 1990. The transition was peaceful; no major incidents took place between the population and representatives of the old regime. As communism ended, the state withdrew from the tight control of the economy. This withdrawal was implemented by liberalizing several markets early in the 1990s (OECD, 1991): The policy on full employment was abolished and unemployment ensued; starting in January 1989, private individuals were allowed to found and grow their firm to a size they chose resulting in a proliferation of private enterprise (Ecostat, 1998); legislation was passed to found the State Wealth Management Agency, whose goal was to privatize the vast amount of state assets; the foreign trade system got liberalized; any remaining price regulations were dismantled; and the antitrust law was passed, setting the rules of fair market competition in the economy.

By the early 1990s, most reforms had taken place and the economy largely resembled a market economy. The only major reform that had not taken place early in the 1990s was the reform of the banking system. Until the end of the 1980s

the financial system was fully state-owned and operated.[7] Prior to 1987, the Central Bank of Hungary (CBofH) operated a monobanking system. In the monobanking system, the central bank both enacted monetary policy and was the full provider of commercial banking activities to firms.[8] In 1987, the monobanking system was replaced by a two-tiered banking system (Várhegyi, 1995). In 1987, new commercial banks were founded and these inherited the central bank's portfolio of corporate loans. In the early 1990s, the banking system suffered from an undercapitalization problem whose source was twofold: (i) The communist lending practices were not market based, resulting in underperforming loans after the communist system ended; and (ii) the share of non-performing loans increased due to the general downturn of the economy. After recapitalizing the banking system in the early 1990s, the state prepared its banks to be sold off. By the second half of the 1990s, the major banks were privatized typically by well-known, large foreign financial intermediaries.

2.2 Data

This paper uses five data sources. The central data source consists of firm-level financial-statement information. I augment it with firm-level employment information, county and city level employment, data on election outcomes from parliamentary elections, and financial-access information. I describe the different data sources in turn.

2.2.1 Firm-level financial statements

I use firm-level financial statements between 1986 and 2000 in Hungary. The data are administrative data from tax filings of firms. Prior to 1992, the data was hosted by the Ministry of Finance, starting in 1992 by the Hungarian Tax Authority. Prior to 1992, the data covers virtually all firms with at least 20 employees. After this period, the data covers all firms required to submit a balance sheet to the tax authority. Except for sole entrepreneuers without employees, virtually all firms were required to do so. To ensure comparability of the sample over time, throughout my analysis, I focus on firms with at least 20 employees. The variables I use from the financial statements are sales, tangible assets, employment, total employment cost, and material cost. In my analysis, I include industries that are covered by the dataset both in the pre-period and the post-period. This choice leaves me with the majority of industries: the manufacturing sector, construction sector, agricul-

[7] At least some (limited) efforts had been made to introduce some amount of market principles in the corporate sector from the reforms of 1968, zero attempts were made to modernize the banking system until 1987.

[8] A separate bank specialized in lending for foreign trade purposes, but this bank was also under full state control.

ture sector, post and telecommunications, retail sector, water management, data management and processing. The industries excluded from the analysis due to data limitations are certain services (business and personal services) and the activity of the public sector. My main sample contains 123,280 firm-year observations over 26,740 firms. In the pre-period, the coverage of my main sample is approximately 84% of value added of the industries I analyze. In the post period, the sample covers 71% of value added in these industries. As robustness check, I will Include smaller firms in the post-period in order to increase the coverage of value added to the level of the pre-period.

Several firms that existed in the pre-period saw their identification number change in the post-period, which brakes the crucial panel nature of the data. In order to recreate the panel nature of the data, I use printed publications, digitize them, and use names and addresses of firms to manually recreate the broken links.

2.2.2 Firm-level employment information

I obtain information on firms' employees from a dataset of the National Labor Office. The data are available at the firm level for 1986, 1989, and from 1992 yearly. They cover a representative sample of the workers in a given firm, with weights attached to each individual sampled. I use information on workers' age, gender, education for firms that had at least 20 employees.

2.2.3 Local employment and election data

I use the Hungarian Statistical Office's dataset on local economic outcomes (e.g. population, unemployment rate) at the county and municipality level. I collect election data from the National Election Office at the same level of aggregation.

2.2.4 Local financial-access data

I hand collect information on local financial access by reconstructing the branch network of banks for the 1980s and the 1990s. I augment these data by hand collecting information on the ownership status of each bank for every year. I use newspapers, publications of banks, and directories as sources.

2.2.5 Reliability of data

A natural question is whether the financial statements data used in this paper is accurate. In this section I address whether misreporting is a problem, whether the regulated nature of prices or the existence of the informal economy poses a threat to my analysis. I find that the data is reliable, the regulated nature of prices does not pose a problem for the questions I ask, and the unchanged relative size of the

informal economy pre and post the fall of communism makes Hungary an ideal environment to answer my research question.

Misreporting

Communist countries had a particularly large government sector. For example, central government expenditure in Hungary in 1980 amounted to 62.7% of GDP (Kornai, 1986). Countries with comparable levels of economic development had central government expenditure approximately half this size.[9] The lion's share of tax revenues were collected from the corporate sector. For example, in 1988, between 70% and 80% of total tax revenue originated in the corporate sector (IMF (1988) and Bartlett (1997)). In this environment, there was a large emphasis for systems forming the basis of tax-payment to function well. The corporate sector submitted its tax filings with the corresponding balance sheet to the tax authority (which in the pre-period was part of the Ministry of Finance). The Department of Revenue within the Ministry of Finance conducted comprehensive control of accounting practices for every firm, every two years (Dr. Sütő, 1985). They inspected whether firms followed accounting rules, analyzed firms' operations based on their financial statements and potentially made recommendations to the firm based on the analysis. The Department of Revenue published its findings every two years. In fact, the reports read similar to modern days' audit and consulting reports. Examples of such published findings include Dr. Sütő (1977, 1979, 1983, 1985). I cite from Dr. Sütő (1979):

"The examination of compliance with accounting rules and discipline with regard to documentation showed that companies' balance sheets and profit and loss statements present the financial positions of the companies fairly, the economic basis for the financial result is real."[10]

A natural question is whether the Department of Revenue only reported favorable results from their examination. The reports often cited violations and/or pointed out lessons learned from the Department of Revenues' analysis on how firms' operations could be improved. In some years, the reports singled out firms as examples whose practices and results are exemplary and others where practices could be improved.(Dr. Sütő, 1983) In sum, based on the existence of a comprehensive bi-annual examination of companies' books, the possibility to be singled out for violations, it is reasonable to believe that the balance sheets reflect companies' operations fairly.

I conducted two interviews with László Makó, who, during the 1980s, was an official at a consulting firm to Hungarian enterprises (Struktúra Organizational En-

[9]The corresponding number for Spain was 29.4%; for Greece, 36.5%; and for Finland, 37.7% (Kornai (1986) who cites Muraközy (1985)).

[10]The translation is the author's translation from the original.

terprise).[11] The interviews confirmed that there were little gains from misreporting even outside of the considerations of the comprehensive bi-annual examination of companies' books.

In addition, the firm-level data were used for internal purposes both in the pre- and the post-period. Therefore, the accuracy of the data faced no threat from the will to show external observers a brighter than real picture.

Market-clearing prices

To deflate values of firms' sales, I use industry-year-specific price indices from the Statistical Office. The goal of the deflation is to obtain measures as close as possible to quantities as opposed to values. In the pre-period, prices at which goods were transacted might not have been market-clearing prices. I address how this possibility might influence my analysis. My object of interest is quantity produced by a firm. I observe values of firms' sales and indices of transaction prices by industry. Whether the transaction prices were market-clearing prices or not is irrelevant, as long as the price indices reflect accurately how transaction prices evolved in the economy. The statistical office's price indices, both in the pre- and the post-period are calculated based on the prices of representative samples of products produced in a given industry (CSO, history of the producer price statistics, 2018). Therefore, the index does satisfy the criterion that it reflects accurately how transaction prices evolved over time.

Informal economy

The official GDP statistics and the administrative data from tax records might underestimate output if the size of the informal economy grew in the post-period relative to the pre-period (Johnson et al., 1997). Kaliberda and Kaufmann (1996) estimate the size of the informal economy based on electricity consumption country by country for Eastern European economies. For Hungary, the estimated size of the informal economy both prior to and post the fall of communism is very similar: 27% of official GDP in 1989, and 28.5% in 1993[12]. Johnson et al. (1997) report a corrected GDP-index which takes account of the size of the informal economy. For Hungary the corrected index is 84.3 (as opposed to 83.4) for GDP in 1994 with a base of 100 in 1989. Among all the post-communist economies, Hungary has the lowest correction of official statistics. Because the official GDP statistics reflect a very similar share of actual economic activity in the pre- and the post-period, Hungarian data is ideal to study the output pattern of post-communist economies.[13]

[11] The interviews took place in December 2016 and May 2017 in Budapest.

[12] In 1994 the corresponding number is 27.7%.

[13] Kornai (1986) explains the relatively large size of the informal sector in Hungary of the 1980s by suggesting the government tolerated activities of people as long as they were "socially useful or at least not harmful."

2.3 Summary statistics

I provide basic summary statistics from my main dataset, namely the firm-level data. First, I characterize the average firm across different years in Table 1. Second, in Figure 2 I show how value added in the economy evolved over time, comprised by the activity of different types of firms.

It is apparent from Table 1 that the number of firms quickly increased after communism ended. The average firm became smaller in terms of employment and value added, and started to use relatively more capital than labor, compared to the pre-period. The number of firms that were privately owned increased in parallel.

Table 1: Summary Statistics

	1987	1991	1995	1999
number of firms	4,898	7,883	10,888	12,057
share of private firms (%)	0	42	73	82
mean value added	319	132	98	121
mean employment	650	281	134	115
mean employment/capital	1.57	0.98	0.61	0.51

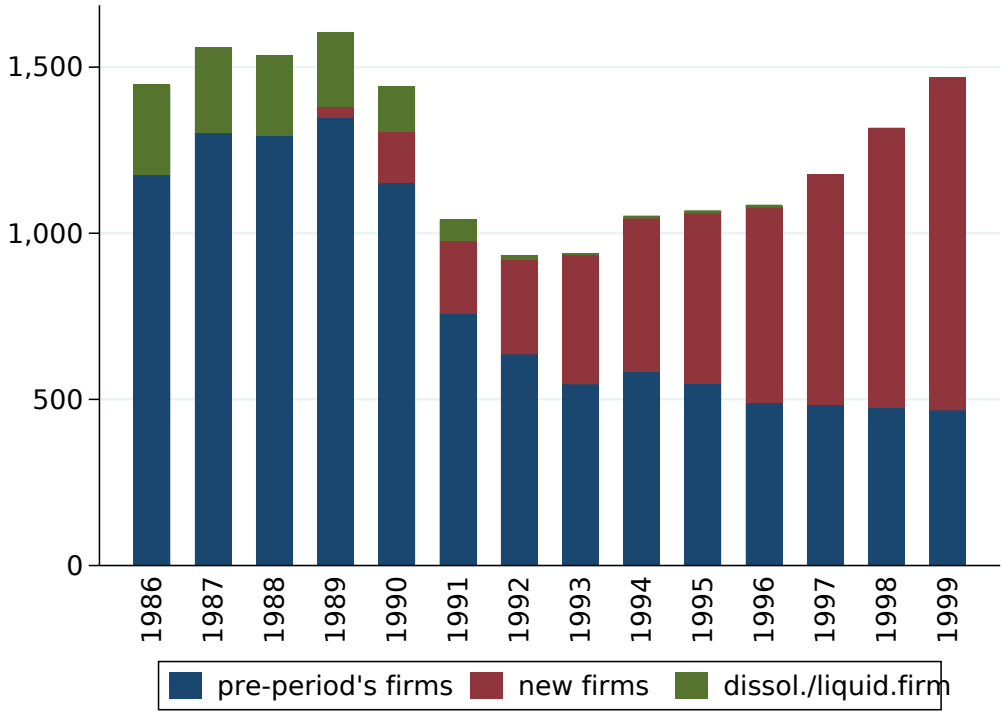
Notes: This table reports summary statistics of the firm financial accounts dataset. The sample is the set of firms that have at least 20 employees in a given year. Mean value added is reported in 1991 million HUF. Employment is in number of people and Capital is the stock of capital in 1991 million HUF.

Figure 2 reflects the nature of changes in production in the economy. In 1990, the State Wealth Management Agency was created whose role was to sell off the assets of the state to private investors. In performing this role, the agency deemed some firms not viable for the market economy and these firms were then dissolved or liquidated. The graph shows the value added by each type of firm, where the categorization of a firm (except for the "new" firms) is determined in the pre-period. The graph offers two major takeaways: (i) In the pre-period a significant share of value added was created by firms that were not viable in the market economy; and (ii) the growth in output in the post-period was largely accounted for by new firms.

3 Methodology

The output pattern that all post-communist countries experienced is characterized by a double-digit fall in output and a slow recovery (Figure A.9). The size of the fall and the length of the recovery is comparable to the output pattern of the US economy during and after the Great Depression. The average Eastern-European

Figure 2: Value Added by Type of Firm



Notes: This figure shows the sum of firms' value added in all industries analyzed. They are reported in 1991 billion Hungarian forints. The different colors refer to a fixed firm-specific characteristic. Dissolved/liquidates firms were deemed unviable for the market economy by the State Wealth Management Agency in 1990. New firms were founded in 1989 or later.

economy experienced a 29% drop in GDP per capita and took 16 years to get back to trend after the fall. In the Great Depression, the comparable numbers are 30% and 14 years as shown in Figure A.10. In Hungary, GDP declined by 20%, and the recovery of GDP per capita to trend took 16 years. To assess what factors were responsible for both the downward and the upward pattern in GDP per capita, I propose a decomposition of output change between two time periods. Extracting the most important factors behind the downfall and the recovery and their relative importance is possible by combining the decomposition with firm-level microdata under certain assumptions. Working with a method to compare the relative importance of the different channels is directly useful to asses my findings in relation to the previous literature emphasizing certain channels driving the fall in output.

3.1 Decomposition

I propose a decomposition whose aim is to quantify the driving forces behind changes in a country's GDP over time. The traditional approach is to use Growth Accounting. Growth Accounting decomposes changes in aggregate GDP into the roles of aggregates: aggregate inputs and aggregate productivity (Solow (1957), Tinbergen (1942)). Therefore, it does not quantify the role of firm heterogeneity in changes of a country's GDP. The novelty of the decomposition this paper proposes lies exactly in incorporating the role of firm heterogeneity. The decomposition I propose identifies, within an industry over time, the role of allocative efficiency of productivity and inputs, of mean productivity, of allocative efficiency of different inputs, and of the role of aggregate inputs in changes of industry-wide value added over time. The way heterogeneity across firms is incorporated in the decomposition of output change is inspired by how Olley and Pakes (1996) decompose industry-wide productivity. I aggregate the industry-specific results of output-change to reflect the sources of change in country-wide GDP.

I propose an exact statistical decomposition of output change for a given industry between two years. I start by assuming that firms produce according to a Cobb-Douglas production technology. In year t, firm i that belongs to industry j has the following production function:

$$Y_{i(j)t} = A_{i(j)t} L_{i(j)t}^{\alpha_j} K_{i(j)t}^{\beta_j} \tag{1}$$

where A denotes the firm's total factor productivity (TFP), L denotes the number of people employed at the firm, and K denotes the services of the firm's capital stock. Y stands for value added created by the firm. The labor and capital elasticities are assumed to vary across industries, but not over time. This assumption is equivalent to postulating that a given industry produces according to the same physical technology over time.[14] The object to be decomposed is the change in output in a given industry j, between years t and $t+1$:

$$\Delta Y_{jt} = Y_{jt+1} - Y_{jt} = \sum_i Y_{i(j)t+1} - \sum_i Y_{i(j)t}. \tag{2}$$

3.1.1 One-input case

For simplicity of exposition, I first show the decomposition assuming firms' production technology only uses one input, that is, labor according to the production function $Y_{it} = A_{it} L_{it}$.[15] In this case, the expected value of output across firms can

[14] In section 3.3.3 and Figure 3 I will return to why this assumption is reasonable.

[15] I take it as implied that firm i is in industry j. To save on notation, I omit the subscript (j).

be characterized by

$$E(Y_{it}) = E(A_{it}L_{it}) = \underbrace{E(A_{it})E(L_{it})}_{\text{random allocation}} + \underbrace{\text{cov}(A_{it}, L_{it}).}_{\text{sorting of productivity and input}} \tag{3}$$

The sources of output in an industry are easily identified by writing down expected output according to equation (3). The first term of the sum can be thought of as the expected output if labor is allocated across firms randomly with respect to the productivity of the firm; that is the covariance between productivity and labor is 0.[16] The second term in the sum captures the output that arises because firms that are more productive within the industry command more (less) labor. In the case of positive (negative) sorting between productivity and labor, overall output is larger (smaller).

The empirical counterpart of equation (3) is

$$\sum_i Y_{it} = \sum_i A_{it}L_{it} = \underbrace{\bar{A}_t(N_t\bar{L}_t)}_{\text{random allocation}} + \underbrace{\sum_i (A_{it} - \bar{A}_t)(L_{it} - \bar{L}_t).}_{\text{sorting of productivity and input}} \tag{4}$$

where expectations were replaced by means and the equation was aggregated across the N_t firms in the industry. To decompose $\Delta \sum_i Y_{it}$ I start by decomposing the first term in equation (4)

$$\Delta \left(\bar{A}_t(N_t\bar{L}_t)\right)$$

into the contribution of changing each of its two factors: mean firm-level productivity and aggregate labor in the industry. To this end, I use a simple mathematical identity[17] and write

$$\begin{aligned}\Delta \left(\bar{A}_t(N_t\bar{L}_t)\right) =& \Delta\bar{A}_t(N_t\bar{L}_t) + \Delta(N_t\bar{L}_t)\bar{A}_t \\ &+ \Delta(\bar{A}_t)\Delta(N_t\bar{L}_t).\end{aligned} \tag{5}$$

Combining the above, $\Delta \sum_i Y_{it}$ decomposes into the following terms in an exact

[16] A less general but simpler case is when all firms are equal in terms of productivity and labor. In this case, the covariance between productivity and labor is 0 in this industry, as well. Additionally, $E[A_{it}] = A_t$ and $E[L_{it}] = L_t$.

[17] $\Delta(x \times y) = \Delta x \times y + x \times \Delta y + \Delta x \times \Delta y$. It is possible to think of this step as a Taylor-expansion of the function $f(\bar{A}, (N\bar{L})) = \bar{A}(N\bar{L})$ around the point $(\bar{A}_t, (N_t\bar{L}_t))$. Because this function is a polynomial of degree two, the Taylor expansion of the function terminates after the second-order terms in the expansion, that is all higher-than-second-order terms are 0 in the expansion. Therefore, the second-order Taylor expansion of the function is not an approximation but is exact.

way:

$$\Delta \sum_i Y_{it} = \underbrace{\underbrace{\Delta \bar{A}_t(N_t \bar{L}_t)}_{\text{contribution of } \Delta\text{A}} + \underbrace{\Delta \sum_i (A_{it} - \bar{A}_t)(L_{it} - \bar{L}_t)}_{\text{contribution of } \Delta\text{allocative efficiency}}}_{\text{contribution of } \Delta\text{aggregate productivity}} + \underbrace{\Delta(N_t \bar{L}_t)\bar{A}_t}_{\text{contribution of } \Delta\text{L}} + \underbrace{\Delta \bar{A}_t \Delta(N_t \bar{L}_t)}_{\text{contribution of higher-order terms}}. \tag{6}$$

The goal of writing down this decomposition is to isolate and quantify the role of each factor in the output change (in the one-input case, the role of the change in aggregate labor, the change in mean productivity, and the change in allocative efficiency). The role of the higher-order terms is to correct the sum of the other three terms to arrive at the true size of the change in output. This decomposition is only meaningful if the size of the higher-order term is small relative to the other terms. A large higher-order term means that due to comovements of the different factors, separately isolating the contribution of one factor only is impossible. Therefore, the below interpretations are all conditional on the higher-order term in the decomposition being quantitatively small relative to the other three terms.

Contribution of ΔA. The first term captures the extent to which mean productivity changing between two years contributes to the change in output, holding everything else constant. If the productivity of firms between two years changes such that the average firm becomes more productive, aggregate output in the industry will increase because the same inputs are now being transformed to output via firms that, on average, are more productive.

Contribution of Δallocative efficiency. The second term quantifies the role of changing sorting between productivity and inputs across firms. Intuitively, it shows the extent to which more productive firms relative to the mean productivity also command more labor relative to the mean firm's labor.

Olley and Pakes (1996) introduced a widely-used decomposition of an industry's aggregate productivity Ω_t into firms' unweighted, mean productivity and the covariance between firms' productivity and their outputshare. Analogously to this breakdown, I call the sum of the contribution of Δallocative efficiency and of ΔA, the contribution of Δaggregate productivity.

Contribution of ΔL. The third term holds constant average productivity within the industry and quantifies the size of the output change due to aggregate labor changing. If the number of people employed in the industry changes,[18] output will

[18]This can happen either because more firms of the same size exist than before or because the existing firms change their total employment.

change because more inputs are being transformed into output via equal productivity as before.

Contribution of higher-order terms. The last term is a second-order term. Different from the thought experiment in the first three terms' description, in reality, mean productivity or aggregate labor is not kept constant while the other factor is changing; rather they change at the same time. As such, the last term captures the additional contribution to output of both changing at the same time.

3.1.2 Two-inputs case

In reality, firms use both labor and capital to produce value added, as in equation (1). With two inputs, the decomposition identifies the contribution of five terms in the output change between two periods. These are, (i) the contribution of Δaggregate productivity, (ii) the contribution of ΔL, (iii) the contribution of ΔK, (iv) the contribution of Δallocative efficiency related to inputs, and (v) the contribution of higher-order terms. Similarly to the one-input case, the contribution of Δaggregate productivity is comprised of two terms: (a) the contribution of ΔA, where A is the mean, unweighted productivity of firms, and (b) the contribution of Δallocative efficiency related to productivity. The term "contribution of Δallocative efficiency related to productivity" measures the extent to which increasing (decreasing) sorting between productivity and inputs of firms contributes to output increase (decrease). The term "contribution of Δallocative efficiency related to inputs" measures the extent to which changing sorting between firms' labor and capital contributes to output changes between two periods.

The detailed derivation of the decomposition in the two-input case is in Appendix A.1, together with detailed interpretations of all terms in the decomposition. The intuition of the interpretations are similar to the one-input case. The main difference is that due to the more complex, two-input production function, the change of a factor operates through two channels to contribute to changes in output. For example, if the mean productivity of firms increases between two periods, output grows via two channels: (i) using the same number of people and measure of capital services, larger productivity will result in more output; and (ii) larger baseline levels of allocative efficiency between labor and capital will result in the same productivity change having a larger effect on output. This is due to there being a complementarity between a firm's productivity and its input bundle comprised of labor and capital.

3.1.3 Generalization of the output decomposition

One note about the power of the decomposition is in order. With microdata and with this decomposition, it is possible to dissect most different contributors to output growth that models of firm dynamics and productivity focus on. For example, a large literature focuses on dispersion of productivity and the extent to which this dispersion changes output relative to a scenario with no dispersion (Hsieh and Klenow, 2009). Another large literature focuses on the role of net entry in changes in aggregate productivity (e.g. Foster et al. (2001), Griliches and Regev (1995), Melitz and Polanec (2015)). Similarly, a large literature focuses on the role of allocative efficiency in aggregate productivity growth (Olley and Pakes (1996)). In understanding long-run growth, a large literature focuses on the role of primary inputs (labor and capital) versus the role of aggregate productivity. The decomposition of output in this paper allows the running of a horse race between most of the different factors the firm dynamics and productivity literature focuses on and determining which ones are the quantitatively relevant factors in driving changes in GDP. These factors are (i) the role of aggregate labor (as in Solow (1957)); (ii) the role of aggregate capital (as in Solow (1957)); (iii) the role of aggregate productivity (as in Solow (1957)); (iv) the role of allocative efficiency (as in Olley and Pakes (1996)) for productivity, but this paper for output); (v) the role of net entry (as Foster et al. (2001), Griliches and Regev (1995) or Melitz and Polanec (2015) for productivity, but this paper for output); (vi) the role of dispersion of productivity (as in Hsieh and Klenow (2009)); (vii) the role of dispersion in inputs.

Appendix A.2 derives the full decomposition that separates all the above-mentioned potential explanatory channels to output change.

3.2 Implementation of the decomposition

All terms derived in the exact statistical decomposition have a counterpart in the data. I recreate the counterparts of all the components in my main decomposition in the data and report them in section 4. Recreating the counterparts requires, for every year-industry pair, the number of firms, firm-level employment L_{it}, capital services K_{it}, TFP denoted by A_{it}, and industry-level output elasticities α_j and β_j. I observe the number of firms, labor, and tangible assets. I need to estimate productivity and the output elasticities, and create a measure of capital services from the stock variable tangible assets. The next section describes how I carry out these steps.

3.3 Measurement of output elasticities and firm-level productivity

This section describes the measurement of components of firms' assumed production function (equation (1) reproduced):

$$Y_{i(j)t} = A_{i(j)t} L_{i(j)t}^{\alpha_j} K_{i(j)t}^{\beta_j}$$

In the data, I measure value added Y_{it}, flow of capital's services K_{it}, labor L_{it}, labor cost $w_t L_{it}$, and capital rental cost $R_t = (r_t + \delta)K_{it}$. Using two separate estimation procedures relying on different assumptions, I recover the industry-specific output elasticities[19] and the firm-specific productivities A_{it}.

3.3.1 Variables used

First, I observe firms' sales and material costs. By subtracting the latter from the former, I obtain firms' value added. To filter out the variation in value added due to changing prices, I deflate the value added measure by the year-industry specific producer price index. Value added before deflation is $P_{it}Y_{it}$, whereas deflated value added is denoted by $\frac{P_{it}}{P_{jt}}Y_{it}$. Because I observe industry-year specific prices, but not firm-specific prices, any deflated value added measure I use will contain firm-specific price premia or price deficits relative to the price index of the industry as a whole. As such, the data will allow me to identify revenue productivity (TFPR) but not quantity productivity (TFPQ). For simplicity of notation, I will denote deflated value added at the firm level by Y_{it}.

Second, I observe the tangible assets (TA_t) accounting variable at the firm-level, reported at the end of the year. To create a measure that captures the services of the firm's capital stock, I follow the perpetual inventory method (Becker et al., 2006). This method requires the use of depreciation values. Because rules on depreciation rates during communist times resulted in slightly lower reported depreciation than during market economy times (Price Waterhouse, 1990), I disregard the reported depreciation values and use instead a uniform 10% depreciation rate across the whole time period.[20] The steps of the perpetual inventory method are reported in Appendix A.3.

Third, I measure the labor input at the firm-level as the number of people working at the firm.

Fourth, I measure labor cost of the firm as the total labor expenses and capital cost at the firm by adding the depreciation rate to the real interest rate measured

[19] Because I assume the production function is constant returns to scale, $\beta_j = 1 - \alpha_j$.

[20] The results are not sensitive to using the reported depreciation values.

in Germany.[21]

3.3.2 Elasticities and productivity

The physical way in which output is created from a given level of inputs in firms of an industry embodies the technology of the industry. This section describes the estimation procedures used to obtain the parameters that describe an industry's technology. The technology is represented by the output elasticities α_j and β_j in equation (1). Given α_j and β_j, the firm-year level productivities are recovered as residuals.

All of the estimation methods for recovering elasticities and productivities assume some type of optimizing behavior by the firm. In the setting of this paper, in the pre-period, firms were likely characterized by some sort of optimizing behavior.[22] However, given the significant grip of the state on the economy, as well as the constraints the economy as a whole and thus firms faced, we can reasonably assume the optimizing behavior by the firm was overpowered by additional constraints it might have faced in production and input choices. By contrast, once the economy transitioned to being a market economy, the institutional setting was much more similar to standard market economies. As discussed in section 2.1, after the fall of communism, the government helped quickly build out the legal and institutional framework in which market economies work. As such, we might reasonably believe that in a matter of a few years, the economy's workings resembled standard market economies well, for example in the way in which firms make decisions. For this reason, I perform the estimation of elasticities and productivities on data from market economy times and not from the pre-period. The assumption of time-invariant, industry-specific technologies implies that estimating elasticities in the post-period is informative about the technology in the pre-period as well.

To recover the industry-level elasticities and the firm-level productivities in a value added production function as introduced in equation (1), I use two standard methods in the literature: the cost-share-based method (Syverson (2004)) and a proxy-based method (Ackerberg et al., 2015). The two methods have different

[21] I take the real returns on 10-year German government bonds as a proxy for lending rates. Because the transition put a large weight on monetary policy as a tool for stabilization, the real interest rate in the early 1990s in Hungary is relatively unstable. By the second part of the 1990s, the real interest rate became much more stable, and in fact in those years using the German or the Hungarian real interest rates result in a 0.97 correlation coefficient of estimated elasticities. The difference in levels of the elasticities computed with the two interest rates results in little, only 1% difference, on average. In order to show that technology used by firms in the 1990s did not go through large changes, I opt to use the German interest rates. Taking the Hungarian real interest rate as is as the cost of capital, the volatility of the rate would imply that technology used changes abruptly year by year. This is clearly not true, as technology used by a given industry does-not respond strongly to year by year fluctuations in the real interest rate.

[22] Such optimizing behavior is especially true after more autonomy was effectively conceded to firms starting in the 1980s.

assumptions about market structure, decision rules of firms, and constraints on these decisions. I use both methods to show my results do not rely on the set of assumptions invoked by either of the two methods used.

The cost-share-based method assumes firms minimize their costs given their production technology. If this production technology is assumed to be constant returns to scale, the market structure implied is that of perfect competition. The method takes advantage of the fact that the first-order condition of optimal input choice in this setup has a counterpart in the data that is straightforward to construct. The caveat is that the method assumes the first-order condition is satisfied in each period, which might not be the case in reality if significant adjustment costs are present.

The proxy-based method, by contrast, relies on two sets of assumptions. First, the ability to proxy for the one-dimensional productivity[23] in the firm's production function using a polynomial in the firm's inputs, labor, capital, and materials. This assumption relies on the strict monotonicity between materials used by the firm and its productivity, conditional on other inputs. The second set of assumptions includes timing assumptions of firms' input choices relative to when they observe their productivity shock. This method relaxes the period-by-period optimality invoked by the cost-share based method but makes other assumptions that may or may not hold in reality, depending on what other institutional details influence the environment in which firms make their production and input choices.

While Hungary was a market economy in the 1990s, frictions might have remained that precluded firms from exactly satisfying any one set of assumptions of productivity-estimation methods to the letter of the word. If both productivity-estimation methods give similar qualitative results, I feel confident the results are not due to assumptions of any one of the two methods.

3.3.3 Cost-share based method

I assume firms are cost-minimizing and so they solve the problem

$$\min_{L_{it},K_{it}} w_t L_{it} + R_t K_{it}.$$

[23]This one-dimensional productivity is unobserved to the econometrician but revealed to the firm in the beginning of the period when its production takes place.

Given the previously introduced production function $Y_{it} = A_{it}L_{it}^{\alpha_j}K_{it}^{\beta_j}$, the first-order conditions of this problem can be rearranged into

$$\alpha_j = \frac{w_t L_{it}(\alpha_j + \beta_j)}{w_t L_{it} + R_t K_{it}}$$
$$\beta_j = \frac{R_t K_{it}(\alpha_j + \beta_j)}{w_t L_{it} + R_t K_{it}}$$

Assuming constant returns to scale, the formulas for the elasticities simplify to

$$\alpha_j = \frac{w_t L_{it}}{w_t L_{it} + R_t K_{it}}$$
$$\beta_j = 1 - \alpha_j = \frac{R_t K_{it}}{w_t L_{it} + R_t K_{it}},$$

The assumption of constant returns to scale also implies firms have 0 markup; in other words, they operate in a perfectly competitive environment. This assumption likely becomes a better assumption with the passing of time during the 1990s. Therefore, my analysis uses industry-specific elasticities which are averaged across the different years of the 1990s. Extensive robustness checks in A.4 show that the qualitative results are unchanged across elasticities estimated in any given year. Consistent with this is Figure 3 showing that labor's costshare varies little in the 1990s, for most industries.

The fact that the elasticities displayed in Figure 3 change little over time is consistent with relatively unchanged technologies during the 1990s. "Technology" here means the physical way in which a given amount of labor input and capital input gets translated into value added in an industry. If technology was drastically different in the pre-period, technologies were unlikely to change from one year to the next, for example, from 1989 to 1990. Instead, if technologies were drastically different in the pre-period, we should see a continuously changing technology from 1989 until it settles into the new technology used in the long-run. If we assume the early 1990s' cost shares are reasonable approximations to the true elasticities, we can infer that the lack of large changes in the cost shares over the 1990s is consistent with the assumption of very similar industry-level technologies in the pre- and the post-period.

Having recovered the industry-level elasticities, the logarithm of the firm-year-level productivities are calculated as a residual of value added, as per the logarithm of equation (1).

3.3.4 Proxy-based method

To check whether elasticities recovered using different assumptions significantly impact the results, I estimate elasticities using a proxy-based method as well. I use the

Table 2: Output elasticities of labor

industrycode	name	costshare	proxy
11	mining	0.64	na
12	electricity	0.30	na
13	metallurgy	0.60	0.76
14	machinemaking	0.56	0.76
15	construction materials	0.55	0.76
16	chemical	0.40	0.56
17	light	0.67	0.62
18	other ind	0.78	na
19	food	0.57	0.50
21	construction	0.80	0.72
22	construction mgmt.	0.77	0.62
31	agriculture	0.59	0.75
32	forestry	0.67	0.61
41	transport	0.54	na
42	post& telecomm.	0.46	0.57
51	retail	0.68	0.62
52	foreign trade	0.60	0.77
61	water mgmt.	0.36	na
71	data process. & IT	0.79	0.78

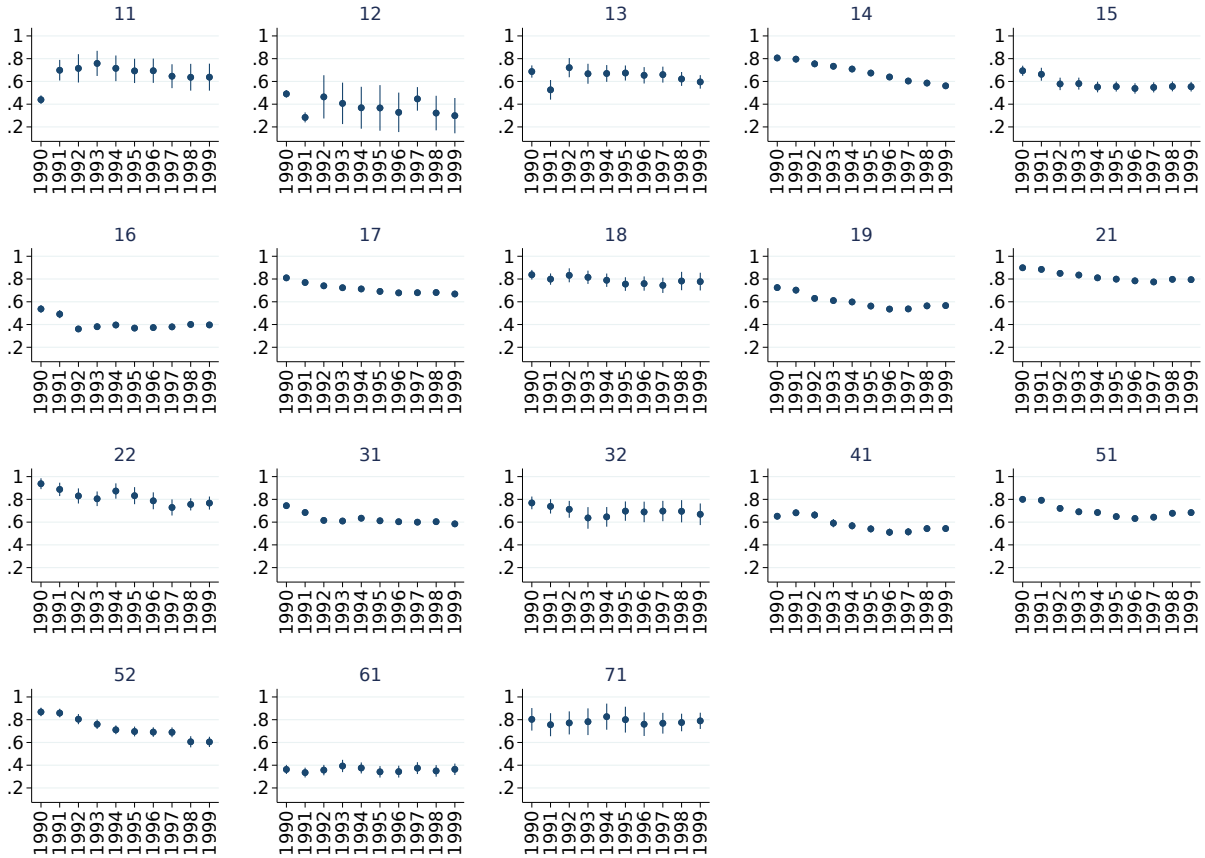
Notes: This table reports the estimates for the industry-specific elasticities of labor. Column "costshare" reports elasticities recovered using the cost-share-based method, for one representative year, 1996. Column "proxy" reports those recovered using a proxy-based method.

identification results in Ackerberg et al. (2015) and thus do not identify the variable input's coefficient in the first stage. To set up this estimation method, I first take the logarithm of the production function. All lower-case letters mean logarithms of the variable represented by the corresponding uppercase letter:

$$y_{it} = \underbrace{\alpha_0 + \omega_{it} + \epsilon_{it}}_{a_{it}} + \alpha_j l_{it} + \beta_j k_{jt}. \tag{7}$$

The only difference compared to the production function in the preceding section is that the components of the productivity term a_{it} are separated: α_0 is the common component of productivity for all firms in the industry; ω_{it} is the component the firm observes when it makes its decision in period t, but it is not observed before or not observed by the econometrician. The assumption is that the firm is aware of the process that drives the productivity period by period but does not know the exact value of the productivity until period t. Instead, the firm learns it before making its choices in period t; ϵ_{it} is the part of productivity that is not observable to the

FIGURE 3: MEAN COST SHARE OF LABOR ACROSS FIRMS



Notes: These graphs show the weighted mean of firms' labor cost share across years and industries. The cost shares are weighted by firms' value added.

firm until after it has made its decisions in period t.

I assume productivity follows an AR(1) process, and allow productivity levels to be correlated with whether the firm existed in the pre-period or is a new firm, and its export share:

$$\omega_{it} = \rho\omega_{it-1} + \gamma \text{exportshare}_{it} + \delta \text{old firm}_{it} + \xi_{it}. \tag{8}$$

In the first step of this method, one uses a polynomial in materials, labor, and capital in order to proxy for the ω_{it}. To be able to do this, an additional assumption is required: namely, that the true underlying function that relates materials, labor and capital to ω_{it} is invertible, conditional on labor and capital.

This method relies on timing assumptions. The identifying assumption is that the firm chooses certain inputs prior to the period of production. Because of the assumption that it does not observe its productivity shock before the period of

production, the input choices made in preceding periods will be uncorrelated with the unobserved component of the productivity process. In the application of this paper, I assume that capital is chosen at t-1 and labor is chosen at t (both are standard assumptions).

Using all the assumptions above, I write down five moment conditions and recover estimates of the parameters of interest α_j and β_j:

$$E\left[\xi_{i(j)t} \otimes \begin{bmatrix} 1 \\ k_{i(j)t} \\ k_{i(j)t-1} \\ l_{i(j)t-1} \\ \hat{\phi}_{i(j)t} \end{bmatrix}\right] = 0,$$

where $\hat{\phi}_{i(j)t}$ is a (predicted) polynomial in $k_{i(j)t}, l_{i(j)t}, m_{i(j)t}$ to control flexibly for the unknown inverse function of productivity. In the estimation procedure, I also impose constant returns to scale for two reasons. The first is that the decomposition assumes constant returns to scale. While modifying it to accomodate increasing or decreasing returns to scale is possible, I prefer to keep this aspect of the decomposition simple. The second is to avoid obtaining elasticities that are unreasonable, for example, exceed 2. The output elasticities of labor obtained using the proxy-based method are reported in Table 2, column (4). These elasticities are missing for five industries. Proxy-based methods typically work well with a high number of firms, and the industries with missing elasticities tend to be on the lower end of the distribution in terms of the number of firms in the industry: mining, electricity, other industry, transportation, and water management. In Table 4 I report the results of the decomposition replacing the missing elasticities with those obtained with the cost-share based method. In the Appendix, I report the decomposition dropping the industries with the missing elasticities, and the results are qualitatively unchanged.

4 Main Results: Decomposition

Having estimated industry-specific elasticities and productivities, I perform the decomposition of output change industry by industry between two years. Subsequently I aggregate the results across industries. The aggregate results can then be thought of as a weighted mean of the industry-specific results, where the weights are proportional to the size of the output fall/recovery that a given industry experiences. As such, the decomposition results are representative of the changes the economy experienced. To understand the drivers of the decrease in output, I perform the decomposition between 1987 and 1993. I choose these two years because 1987 was the last year in which no reforms related to the corporate sector were introduced or

were close to introduced. The lowest point of the recession was 1993 as this year had the lowest GDP. In terms of recovery, I perform the decomposition between 1993 and 1999, which is the last year of my sample.

Table 3: Decomposition Results, Cost-share-based Productivity Measures

	fall (1987-93)	recovery (1993-99)
contribution of Δaggregate productivity	−11	108
contribution of ΔL	−93	−10
contribution of ΔK	−25	11
contribution of Δ realloc inputs	16	−16
contribution of higher-order	13	7
sum	−100	100

Notes: This table shows the result of the decomposition of output change based on all industries. The fall in output between 1987 and 1993 is represented as -100, the recovery between 1993 and 1999 is represented as 100. The numbers are reported as percent of total fall and percent of total recovery. The productivity measures in the decomposition are estimated using the cost-share-based method. Each number in the table is rounded to the closest integer.

Fall in output. The factor whose contribution accounts for the largest share of the decrease in output, 93%, is labor. Capital's falling contribution is also important, but labor's contribution is almost four times larger. The role of decreasing aggregate productivity is slightly lower than half in magnitude compared to the role of falling contribution of capital. Decomposing the contribution of aggregate productivity to the role of mean productivity and allocative efficiency of inputs as it relates to productivity reveals a rise in mean unweighed productivity (41% with cost-share-based and 44% with proxy-based method) and a corresponding fall in allocative efficiency (−52% with cost-share-based method and −55% with the proxy-based method). The mean productivity and the allocative efficiency related to productivity, are two terms which are tightly linked. They capture the fact that firms that newly enter the economy are more productive than old firms. However, because they entered post 1988 and had little time to grow, they are small. Because allocative efficiency exactly measures the extent to which productive firms command a large share of inputs, unsurprisingly, allocative efficiency contributes to the fall in GDP between 1987 and 1993. On aggregate, productivity matters little in the change in output between 1987 and the lowest point of the recession, 1993.

Identifying the main driving force behind the decline in output is interesting per se. Additionally, it allows to address the literature that aims to understand why GDP unexpectedly fell in post-communist economies. Two main papers stand out among the many written on the output fall: both relate the decrease in output to changing buyer-supplier relationships. I address both papers in turn.

Table 4: Decomposition Results, Proxy-based Productivity Measures

	fall (1987-93)	recovery (1993-99)
contribution of Δaggregate productivity	−10	110
contribution of ΔL	−93	−9
contribution of ΔK	−26	12
contribution of Δ realloc inputs	11	−21
contribution of non-linearities	17	9
sum	−100	100

Notes: This table shows the result of my decompositon of output change. The fall in output between 1987 and 1993 is represented as -100, the recovery between 1993 and 1999 is represented as 100. The numbers are reported as percent of total fall and percent of total recovery. The productivity measures in the decomposition are estimated using a proxy-based method as described in the text. Industries for which no elasticity estimate is available are dropped. Each number in the table is rounded to the closest integer. The results are based on all industries. The elasticities for industries with no elasticity estimates using the proxy-based method have been replaced by elasticities using the cost-share-based method. Appendix Table A.9 reports the decomposition results dropping the industries with no proxy-method-based elasticity estimates. The results are qualitatively unchanged.

Blanchard and Kremer (1997) argue that in the post-period, bargaining inefficiencies arose between firms that supply parts and firms that buy parts for production. The reason for the bargaining inefficiencies is that in the post-period, the state is no longer involved in such relationships, and the problem of asymmetric information about true costs of the supplier arises. The existence of asymmetric information (together with assumptions on costs of the buyer and on the perfect complimentarity between inputs in the production process) makes it so that certain transactions will not take place between suppliers and buyers. Without appropriate inputs, firms are not able to produce as much as they would like to, and thus output decreases. While the model in Blanchard and Kremer (1997) does not have a firm with explicit labor and capital inputs in its production function, it is implied that the fall in output happens via the average firm's productivity falling.

Roland and Verdier (1999) make the assumption that firms in the post-period had to search for new partners to sell to. They also assume firms need to invest in client-specific capital in order to be able to sell to the client. Because the search process is time-intensive, and firms do not invest in the client-specific capital until they do find the new long-term partners, output drops via decreases in investment.

My results are not consistent with the stories outlined in Blanchard and Kremer (1997) or in Roland and Verdier (1999) being the major drivers behind the fall in GDP. Neither of the two stories attribute a large role to the changing contribution of labor, while the decomposition results indicate that labor clearly accounts for

most of the decrease.

In section 5, using detailed microdata on firms' employment, I aim to understand why labor plays such a large role in the drop in output.

Recovery in output. The recovery is accounted for by improvements in aggregate productivity, in particular, reallocation gains. I reproduce the definition of the contribution of changing aggregate productivity to output change, from section 3.1.2:

$$\begin{aligned}\text{contribution of } \Delta\text{aggr. product.} =& \text{contrib. } \Delta\text{mean firm-level productivity} \\ &+ \text{contrib. } \Delta\text{allocative efficiency} \\ =& \text{contrib. } \Delta\text{mean firm-level productivity} \\ &+ \text{contrib. } \Delta\text{allocative efficiency of L} \\ &+ \text{contrib. } \Delta\text{allocative efficiency of K} \\ &+ \text{contrib. } \Delta\text{triple allocative efficiency.}\end{aligned} \tag{9}$$

Table 5 dissects the "contribution of Δaggregate productivity" to the "contribution of Δallocative efficiency" and the "contribution of Δmean firm-level productivity" and shows that the most important factor accounting for the output gains in the 1990s is increases in allocative efficiency. Further decomposing the allocative efficiency term shows that 41% of output recovery is due to more capital being allocated to higher productivity firms, and 31% is due to more labor being allocated to higher productivity firms. 51% of the recovery is due to a triple effect whereby more productive firms command both higher labor's contribution and higher capital's contribution to output. The mean, unweighted productivity declining is responsible for -15% of the recovery. The corresponding numbers using the proxy-based productivity estimates are similar: 41%, 34%, 57%, and -22%.

The results on reallocation are consistent with a successful reform process: As labor, capital, and output markets became liberalized in the 1990s, market forces filled the void left behind as the state's control of the economy dissappeared at the end of the 1980s. The evidence is consistent with Hayek (1945): No central planning system can achieve the efficient allocation, because no one entity can aggregate all the information based on which individual market participants decide on their actions in the economy. Once individual agents are allowed to make decisions and the state withdraws from this role, allocative efficiency greatly improves.

In section 6, I address the question of why allocative efficiency improved to a large extent, more closely.

The main results of the decomposition are unchanged across robustness checks of using the proxy-based productivity estimation method, as shown in Tables 4 and

Table 5: The Anatomy of Aggregate Productivity Change in the Recovery

	cost-share	proxy
contribution of Δ allocative efficiency of L	31	34
contribution of Δ allocative efficiency of K	41	41
contribution of Δ triple allocative efficiency	51	57
sum: contribution of Δ allocative efficiency	123	132
contribution of Δ mean firm-level productivity	-15	-22
sum: contribution of Δ aggregate productivity	108	110

Notes: This table decomposes the contribution of Δaggregate produtivity to its four componets, as shown in equation (9).

5, excluding those industries for which the proxy-based method does not recover meaningful elasticities, including firms that have fewer than 20 employees in the post-period or dropping the 1% tails of productivity estimates for each industry-year. The results from the robustness checks are shown in Appendix A.4.

5 Channel One: Declining Labor

This section focuses on the result of the decomposition exercise for the decline in output by asking the question why labor's contribution to output fell. I categorize firms in the pre-period based on whether they employ labor inputs optimally. I find that there is a significant share of firms that in the pre-period consistently employ an inefficiently high number of people given the wages paid at the firm. Once communism ends (and consequently the constraints on firm-employment disappear) firms that in the pre-period employed an inefficiently high number of people, see their employment decline 40% more relative to other firms. I find that these firms decrease their employment in particular for groups that in market economies are typically more marginally attached to the labor market: people with low education, blue collar workers, women and older workers. These findings are consistent with a world in which firms during communism serve two roles: they produce, but they also provide a social safety net. They employ people that in a market economy would be typically without jobs. An additional pattern of evidence which is consistent with the outlined story explaining the data relates to people's preferences as revealed by their voting behavior in the first free elections in March 1990. I find that across the country, areas which, during the lowest point of the recession (1993), had higher unemployment rate accounted for by people with low education/people with blue collar skills are the areas where people vote disproportionately more for the Com-

munist Party in the first free elections in 1990. In fact, approximately 10% of the Communist Party's voteshare is accounted for by the channel of low-educated/blue collar skilled unemployed.

5.1 Firms with inefficiently high number of employees

The first order condition for optimal employment at the firm level is

$$MRPL_{i(j)t} = w_{i(j)t}, \tag{10}$$

where i is firm, j is industry and t is year. The marginal revenue product of labor is defined as $MRPL_{i(j)t} = \alpha_j \frac{Y_{i(j)t}}{L_{i(j)t}}$ given the production function in equation (1); $w_{i(j)t}$ is the average wage paid at the firm. Similarly to before, I omit the industry (j) notation with the understanding that firm i belongs to industry j.

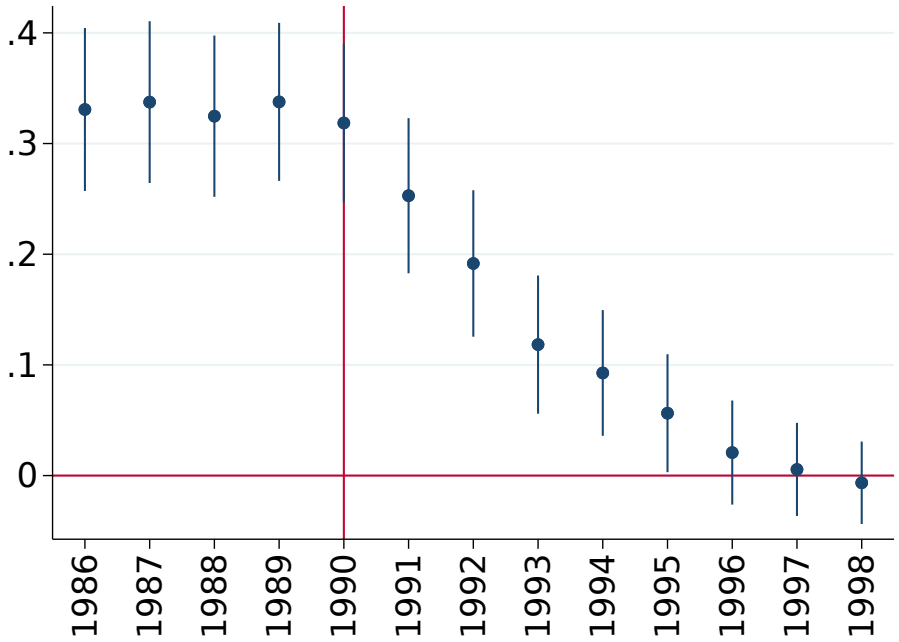
I find that for a disproportionate share of firms in the pre-period $MRPL_{it} < w_{it}$ holds, instead. It is possible that in a given year $MRPL_{it} < w_{it}$ simply due to randomness. However, a firm having a negative deviation in all years of the pre-period points to a systematic pattern. I call firms for which $MRPL_{it} < w_{it}\ \forall t <$ 1989 holds, "overemployers". To characterize whether these firms behave differently in terms of their input choices after communism ends, I run the following regression on the sample of firms that existed in the pre-period already

$$\ln(L_{it}) = \alpha_i + \delta_t + \sum_t \beta_t 1\{\text{overemployer}_i\} + \epsilon_{it}, \tag{11}$$

where L_{it} is the number of people employed at firm i in year t, α_i is a firm fixed effect, δ_t is a year fixed effect and $1\{\text{overemployer}_i\}$ is an indicator that takes the value of 1 for the entire existence of the firm if in all years of the pre-period the firm had $MRPL_{it} < w_{it}$. In this specification, the β_t coefficients are of interest and are plotted in Figure 4. They show that the same, overemployer firm sees its employment decline by 40% more post-communism, relative to other firms. Before communism ends, overemployer and non-overemployer firms show a parallel trend. The parallel trend implies that despite employing inefficiently many people, overemployer firms during communism do not adjust their employment relative to non-overemployers, in order to correct the inefficiency. In contrast, they immediately start the adjustment, once communism, and with it, the policy of full employment ends. The clear lack of pretrends, and the monotonic adjustment in the post-period point toward the interpretation that the additional adjustment of labor by the overemployers is due to the disappearance of the distortions in the labor market. As an additional check for the validity of this interpretation, I reproduce the same exercise in the post-period: I categorize firms in the post-period as overemployers and follow their

employment trends relative to non-overemployers. I find strong pre-trends, that is, in the post-period, overemployer firms start adjusting their employment downwards as soon as they experience the negative deviation in $MRPL_{it} - w_{it}$. Taken together, the evidence suggests that due to the communist economic policy of full-employment, inefficient overemployment by firms persisted and saw its end only once the communist system collapsed.

FIGURE 4: OVEREMPLOYER FIRMS' LABOR TRAJECTORY WITHIN FIRM, RELATIVE TO NON-OVEREMPLOYERS, WITHIN FIRM–COSTSHARE BASED METHOD

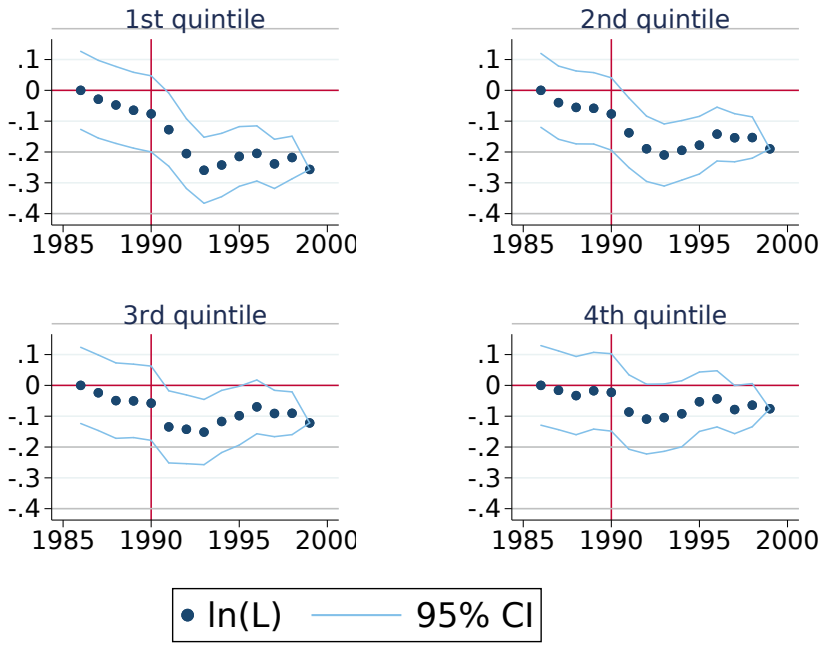


Notes: This graph shows the β_t coefficients from equation (11). The sample of firms for this regression is all firms that existed before 1989. Standard errors are clustered by firm. The productivity measures are recovered using the costshare-based method as explained in the text.

While the 0 threshold for the $MRPL_{it} - w_{it}$ difference is informative and convenient to work with, in reality the difference has an intensive margin, as well. To show that the adjustment of labor post-communism behaves as predicted given the size of the difference at a given firm, I categorize firms into quintiles based on their average $\frac{MRPL_{it}-w_{it}}{w_{it}}$ across the years of the pre-period. In Figure 5 the control group is the fifth quintile, where the larger the quintile, the larger the value of $\frac{MRPL_{it}-w_{it}}{w_{it}}$. While firms in each quintile adjust their labor downwards once the transition starts, the more negative the $\frac{MRPL_{it}-w_{it}}{w_{it}}$ difference, the larger the downward adjustment.

To understand the relative importance of the channels through which employment adjustment happens, I test how firms that survived in the long-run adjusted

FIGURE 5: LABOR ADJUSTMENT BY QUINTILES OF INITIAL DISTORTION



Notes: This graph shows the β_t coefficients from equation (11), where the overemployer status of firms is segmented into five categories, based on the average $\frac{MRPL_{it}-w_{it}}{w_{it}}$ of the firm in the pre-period, across years 1986-1988. The lowest quintile is the most distorted. The omitted category is the fifth quintile. The value of β_t specific to each quintile is normalized to 0 in 1986. Standard errors are clustered by firm. Elasticities are calculated using the costshare-based method.

their employment post-communism. That is, I run the regression (11) on the restricted sample of firms that existed in the pre-period and that survived post-1999. Appendix Figure A.11 shows that the long-term survivor overemployer firms saw their employment decline by 35% more relative to the long-term survivors that were not overemployers. This finding implies that the exit of firms after a couple of years of lower employment was not the only option for the adjustment of overemployer firms to market economy conditions. In fact, many of the once-overemployer firms were able to adjust their employment and operate in the long-run.

5.2 Overemployer firms decrease employment in particular for certain groups

To understand if there is any difference between the changes in employment of overemployer firms relative to non-overemployers, I investigate how the composition of communist firms' employment changes over time. In particular, I run the regression corresponding to the model in equation (11), replacing the left-hand-side

variable by the log number of workers at the firm in a given category. I use categories by education, by age, by gender and by the type of work (blue-collar/white-collar). The results are summarized in Table 6. On average, the same overemployer firm, relative to non-overemployer firms, decreases employment of workers with at most elementary school education 16% more. The extent to which such firms decrease employment of workers with other educational qualifications is not statistically significantly different from non-overemployer firms. Similarly, on average, the same overemployer firm sees its employment of women decrease by 27% more, and for men by 13% more. The same overemployer firm sees its employment of people with blue-collar jobs decrease by 20% more, while with white-collar jobs only by 7% more. The same overemployer firm decreases its employment of older people by 19% more, and of middle-aged people by 20% more, on average.[24] While the difference between old and middle-aged workers is not statistically significant, the same overemployer firm decreases its employment of old people much faster compared to middle-aged people, and compared to non-overemployers. All differences within the type of workers, except those by age, are statistically significant. That is, the difference between the extent to which women and men are detached from the overemployer, between at most elementary school-educated people and people with higher education, between people with blue-collar jobs and white-collar jobs is statistically significant. The corresponding event-study type figures are Figures A.12, A.13, A.14 and A.15.

A natural question is whether in the post-period the "protected" workers obtain jobs elsewhere. Aggregate unemployment statistics suggest that a large share of them do not find jobs elsewhere. The low-educated (at most elementary school) and the blue-collar workers are overrepresented among the unemployed, relative to the employed, in the 1990s. Similarly, women are overrepresented among the unemployed, relative to the employed, compared to before large job losses associated with communism took place. For example, in 1993,[25] low-educated (at most elementary school) people constitute 27% of the employed, while 42% of the unemployed. In contrast, college educated people constitute 8% of the employed and only 0.4% of the unemployed. People with blue-collar qualifications constitute 61% of the employed, but 83% of the unemployed, while people with qualifications for white-collar jobs constitute 39% of the employed and 17% of the unemployed. Women might be mechanically overrepresented among the employed relative to the unemployed because their age of retirement eligibility was 5 years lower than men's, and because maternity leaves were generous in terms of time available to take off. Therefore, the

[24]The age categories are: (i) young 15-30, (ii) middle-aged 31-50, and (iii) old 51+. The choice of the threshold for old is due to the fact that the retirement age for women was 55 years, therefore defining the old threshold to be much later than 51 would result in a mechanical finding.

[25]The pattern cited holds in all years, I choose 1993 as this year is the deepest point of the recession.

right comparison to understand if on aggregate, after the post-communist loss of jobs took its full extent, women have a harder time finding jobs relative to men is to compare the share of unemployed women to men relative to the share of employed women to men in 1993 relative to 1990 (when the large losses in employment had not yet taken place). I find that women in 1993 are overrepresented among the unemployed relative to the employed, compared to 1990.[26]

Table 6: Difference in overemployer firms' decrease of employment by type of labor, relative to non-overemployers

	difference	p-value
elementary school or less	0.1643**	0.01
vocational school	0.0292	0.67
high school	0.0144	0.83
college or more	0.0741	0.41
women	0.2434***	0.00
men	0.1554***	0.01
old	0.1595**	0.03
middle-aged	0.1856***	0.00
young	0.0913	0.21
blue collar	0.1739 ***	0.00
white collar	0.0601	0.29

Notes: This table shows the additional, within-firm decline in log employment of overemployer firms relative to non-overemployers, in the employment category listed in the respective row. The corresponding regression equation is displayed in equation (11), where the left-hand side variable is employment level of labortype displayed in the respective row. The respective event-study type figures are shown in Figures A.12, A.13, A.14 and A.15. Standard errors are clusted by firm. The column "difference" displays the difference between the first and last year's coefficient estimates in equation (11) and the p-value refers to the F-test of the difference being different from 0.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

To summarize, I find that firms classified as overemployers in the pre-period decrease their employment by 40% more, relative to non-overemployers. The overemployer firms stop employing disproportionately more those types of workers that in market economies are typically marginally attached to the labor market: low-educated people, people working in blue collar jobs, women and older people (whom they detach faster). These two results together are consistent with a world in which firms not only function as entities that sell products and services, but also as

[26]To make this comparison more concrete, in 1993 women constitute 38% of the unemployed, 48% of the employed, while the same numbers in 1990 were 32% and 44%. $\frac{38}{48} = 0.79 > \frac{32}{44} = 0.73$.

providers of a social safety net. The Hungarian language has an expression which refers to the social safety net aspect of firms during communism: "kapun belüli munkanélküliség" which means "unemployment within the gates." The expression refers to people having a job and working, however, their labor is not, in reality, demanded by the firm. In the next two sections I show further patterns in the data which are consistent with the social safety net interpretation of my findings.

5.3 The relationship between inefficient employment and bankruptcy

As shown in the previous sections, a significant share of firms were consistently and substantially overemploying in the pre-period. A natural question to ask is what made it possible to sustain firms that were suboptimally employing workers. During communism one of the major economic policy goals was full employment. As a result, the concept of unemployment (and thus unemployment itself) did not exist in the pre-period.

Secret internal documents (KSH (1988)) reveal that the policymakers were aware of the existence of substantial suboptimality in the functioning of firms. Together with the lack of corporate bankruptcy procedures, the suboptimality of firms' functioning resulted in the government financing the losses that firms made. The document, acknowledging that the deficits attributable to loss-making firms is substantial, ponders the possibility of closing down factories that make losses. However, according to the document, policymakers feared that such a step would cause local unemployment problems, which is why such steps were not taken until communism ended.

In this section I first show that the exitrate of lossmaking firms discretely jumps after the fall of communism. Second, I show that the majority of lossmaking firms in the pre-period was also overemploying, as defined in a prior part of this section ($MRPL_{it} - w_{it} < 0, \quad \forall t < 1989$). To identify the lossmaking firms, I use the financial statements data to define a measure of variable profits at the firm-year level

$$\text{var } \Pi_{it} = \text{sales}_{it} - \text{material costs}_{it} - \text{employment costs}_{it} - \text{depreciation}_{it}. \quad (12)$$

I call a firm loss-making if its variable profit is negative.[27] Consistent with the content of the confidential document, in Figure 6 I show that the relationship between being a loss-making firm and exiting the market discretely changes after communism

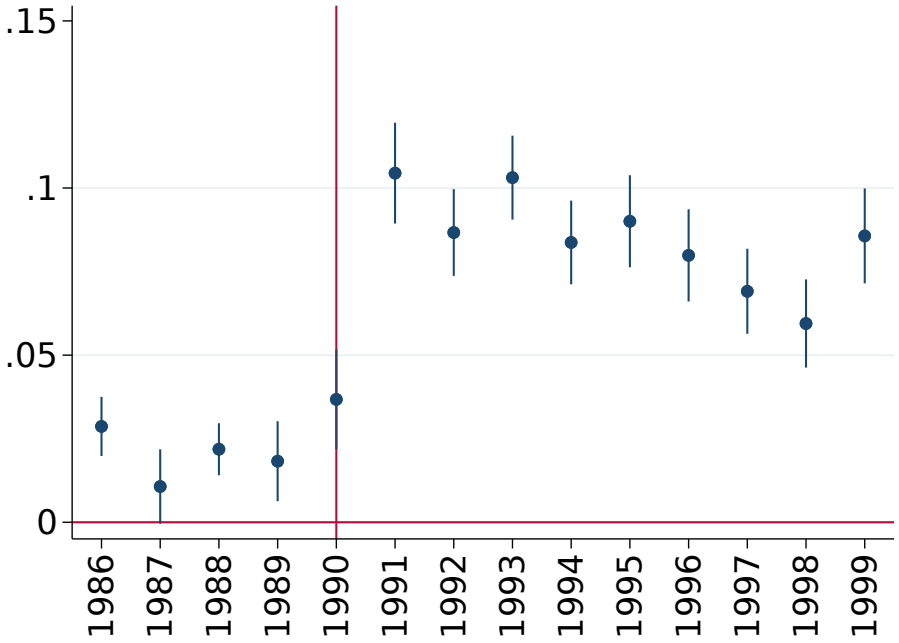
[27]In my main specification, I use 10% depreciation rate, but the result is robust to using lower and higher depreciation rates, as well.

ends. The corresponding regression equation is

$$1\{\text{exit}_{i(j)t+1}\} = \alpha_j + \delta_t + 1\{\text{var } \Pi_{i(j)t} < 0\} + \epsilon_{i(j)t}, \tag{13}$$

where i denotes firm, j denotes i's industry and t denotes year. α_j is industry fixed effect and δ_t is year fixed effect. In the pre-period, loss-making status is associated with a 2 percentage point higher probability of exit in the subsequent period. In the post-period, it is associated with a 9 percentage point higher probability. Consistent with the internal document, I find that in 1987, 75% of firms that were loss-making were also overemployers.

FIGURE 6: EXIT INDICATOR AND LOSS-MAKING STATUS



Notes: This graph shows the β_t coefficients in the regression of an exit indicator on the previous period's lossmaking status. A firm is categorized as a lossmaking firm if sales-laborcost-materialcost-depreciation(10%)<0. Robust standard errors. Industry and year fixed effects are included.

5.4 Who do the "Protected" vote for?

If firms during communism were providers of a social safety net in the form of guaranteed employment to the population, there are implications for voting behavior. The groups benefiting from the safety net are expected to prefer a system in which they are protected, and when presented with the choice, are expected to vote for the

system to continue.[28] While free elections were not held during communism, the first free elections took place in March 1990. To understand if there is any relationship between unemployment by various measures of "protected", and the share of votes the Communist Party received, I exploit cross-municipality variation within the same state,[29] as per the regression equation (14). I ask whether the vote-share of the Communist Party in March 1990 is higher in a municipality where the unemployment rate at the trough of the recession (1993) accounted for by low-educated people is higher.[30] Tables A.16 and A.17 show that the cross-municipality variation in unemployment rate by the low-educated people accounts for approximately 13% of the vote-share that the Communist Party received.[31] A similar calculation by type of job shows that the cross-municipality variation of unemployment by blue-collar workers accounts for 12% of the vote-share received by the Communist Party.[32] The regression results are consistent with three possible interpretations: (i) The "protected" people were aware that they were the beneficiaries of the full employment policy and voted to preserve the system. They forecasted that in a different economic system which does not put "equality" at the center of policy, they would be worse off. (ii) The areas with the highest unemployment levels by the respective groups in 1993 were already the highest unemployment areas in 1990. (iii) Areas with higher unemployment accounted for by a particular group simply had a higher share of people from the particular group. This particular group had an inherent preference for the Communist Party, irrespective of the "protected status".

[28] See footnote 3 for reference on "pocketbook" voting.

[29] There are 19 states in Hungary.

[30] Due to data limitations, I cannot use contemporaneous unemployment data. Instead, I investigate the relationship between voting patterns in 1990 and unemployment in the lowest year of the recession, 1993, which is the first year in which unemployment numbers are available at this fine level.

[31] Municipalities where the share of low-educated unemployed was one standard deviation (4.7) higher in 1993, the vote-share received by the Communist Party was 0.38 percentage points higher in 1990. This variation accounts for approximately 13% of the total vote-share received by the Communist Party.

[32] Municipalities where the share of people that had blue-collar jobs and are unemployed in 1993 was one standard deviation (6.1) higher, the vote-share received by the Communist Party in 1990 was 0.42 percentage points higher. This variation accounts for approximately 12% of the total vote-share received by the Communist Party.

$$\text{Communist Party vote-share}_{m(p)1990} = \tag{14}$$

$$\frac{\#\text{ unemployed with at most elem. sch. educ.}_{m(p)1993}}{\#\text{ eligible to work}_{m(p)1993}}$$

$$+\frac{\#\text{ unemployed with vocational sch. educ.}_{m(p)1993}}{\#\text{ eligible to work}_{m(p)1993}}$$

$$+\frac{\#\text{ unemployed with high sch. educ.}_{m(p)1993}}{\#\text{ eligible to work}_{m(p)1993}}$$

$$+\frac{\#\text{ unemployed with at least college educ.}_{m(p)1993}}{\#\text{ eligible to work}_{m(p)1993}}$$

$$+\delta_s + \ln(\text{taxbase/capita})_{m(p)1993} + \gamma_p + \epsilon_{m(p)1993},$$

where m stands for municipality, p stands for its type (village, large village, town, town with state rights, state capital), δ_s is state fixed effect and γ_t is type fixed effect.

The explanation that supports the social safety net interpretation of my results is explanation (i) or (ii). I address why explanation (i) is the most likely explanation.

To exclude interpretation (iii), I isolate cross-municipality variation in the share of unemployed accounted for by the "protected groups", conditional on the share of employed accounted for by the "protected groups". I augment regression (14) by the share of people by education/type of work (blue-collar or white-collar) in total employment in each municipality (Table A.18). Unfortunately this data is available only for approximately half of the observations. However, the coefficients of interest increase in both specifications with the additional controls. This result is not consistent with interpretation (iii).

To address interpretation (ii), I estimate that in March, 1990 unemployment levels were only approximately 7.5% of the total unemployment level as measured in 1993.[33] It is possible, though, that the areas with high unemployment accounted for by a given group in 1993 were the areas that already in 1990 had higher unemployment by the same group. In this case, the interpretation of the results becomes: Areas where unemployment accounted for by a "protected group" was higher in 1990, conditional on the share of people in the area of the same group, the vote-

[33]On January 1, 1990 approximately 24,200 people were unemployed, on January 1, 1994 the same number was 632,100. Linearly extrapolating between January 1, 1990 and January 1, 1991 leads to an approximate number of unemployed in March, 1990 to be (24,200+23,115=)47,315. This is 7.5% of total unemployment in 1993.

share of the Communist Party was higher.

I conclude that the results from the analysis of the cross-county variation in vote-shares are consistent with the interpretation that "protected" groups were aware that the communist system benefits them and they voted to preserve the system.

6 Channel Two: Improving Allocative Efficiency

This section expands on the results of the decomposition related to the recovery in output. The recovery in output was largely accounted for by reallocation gains, wherein more productive firms in the same industry increasingly commanded more inputs. This result suggests that the large-scale reforms undertaken to liberalize markets as the transition started bore their fruit by allowing an increase in the efficiency of resource-allocation.

The role of capital-reallocation in the recovery was particularly large: 46% of the recovery in output was accounted for by a within-industry improvement in the extent to which more productive firms commanded a larger share of capital. To understand how these gains materialized, I exploit quasi-experimental variation related to the privatization of the banking system to quantify the role of the liberalization of access to finance in the output gains. In particular, I exploit the interaction of a predetermined state-owned bank branch network and the staggered privatization of state-owned banks to which the branches belonged. To the best of my knowledge, this experiment is the largest ever analyzed in which a financial system of a country was transformed from state-owned and run to market-owned and run in a short period of time.

6.1 Background on the banking sector

The Hungarian banking sector[34] during communism was characterized by state dominance. In the monobank system the central bank performed both commercial banking and central banking functions. The central bank therefore had a branch network across the country through which firms could access the commercial banking arm of the central bank. Starting in the 1980s, small steps toward opening up the banking market took place; for example, a bank with foreign participation dealing in foreign transactions was allowed to operate. The first large change in the banking system took place in 1987, when the monobank system was replaced by a two-tier system. In other words, starting in 1987 all commercial banking activity was

[34]This section heavily relies on the description in Neale and Bozsik (2001) and draws from István and Szakadát (1997) and Várhegyi (1995).

performed by licensed commercial banks and the central bank stopped providing such services. The loan portfolio of the central bank was separated and distributed among the major state commercial banks.

The towns in which the new, licensed commercial banks had a branch in 1987 were towns in which the Central Bank of Hungary (CBofH) had branches going back decades, as I show in Table 7. The earliest year for which I could find the Central Bank's branch network is 1969. All towns that had a branch of the Central Bank in 1987 also had one in 1969. Additionally, other than the 19 state capitals, all the towns ceased to have a branch of the CBofH starting in 1987. The 19 remaining state branches stopped providing commercial bank activities as well, because in the new two-tiered system, only commercial banks were allowed to provide commercial banking services.

The loan porfolio was distributed across the new banks. The distribution exhibited some amount of specialization, in that OKHB, one of the state-owned banks founded in 1987, was largely allocated loans to the state firms from the agricultural, food processing, retail and tourism sector, while BFHB, another state-owned bank founded in 1987, was given the energy and infrastructure sector and some share of the retail sector.[35]

In the late 1980s, in the spirit of modernizing the financial and banking system, more banks were founded in the country, many as joint ventures with foreign entities. Thus, in the early 1990s the Hungarian banking system consisted of four types of banks: first, large state-owned banks present from the time the commercial banking system was started; second, medium sized state-owned banks; third, joint ventures between a foreign bank and a Hungarian counterparty. Fourth, starting in 1989 it was possible for foreign banks to found a fully operational commercial bank in the country, thus many such banks entered the market.

In the early 1990s, the lax standards of communist times' loan origination together with the downturn of post-communist economies, and the introduction of tighter prudential regulation (capital-adequacy ratios to comply with European Commission regulations) led to many of the state-owned banks being undercapitalized. Therefore, the Hungarian state injected a large amount of funding into the system. After the banking system had been stabilized, the individual banks were on the way to being privatized. Especially after the recapitalization, it became clear that strategic investors that can make investments into the computerization system, bring know-how on lending and new products, and are able to provide better access for funding to international financial markets will be necessary to provide for the continued improvement of the banking system.

[35]This initial specialization quickly disappeared in the 1990s as these state commercial banks, together with newly established commercial banks, competed for the business of new firms (pp158 in **??**).

6.2 Access to market-based finance and local outcomes

I am interested in identifying the effect of a private, as opposed to a state-run, banking system, on outcomes, in particular, reallocation gains. The OLS regression of interest is

$$ln(\text{allocat. efficiency of } \mathrm{K}_{ct}) = \beta_1 \#\text{ of branches}_{ct} + \beta_2 \#\text{ of private branches}_{ct} + \alpha_c + \delta_t + \epsilon_{ct} \tag{15}$$

where α_c is county fixed effect, δ_t is year fixed effect, and the $ln(\text{allocat. efficiency of } \mathrm{K}_{ct})$ is a measure of allocative efficiency of capital in county c and year t. This measure is similarly defined to the allocative efficiency in Olley and Pakes (1996), except it is defined at the county-year level as opposed to the industry-year level:

$$\sum_j \sum_{i(j)} (s_{i(jc)t} - \overline{s_{jct}})(a_{i(jc)t} - \overline{a_{jct}}), \tag{16}$$

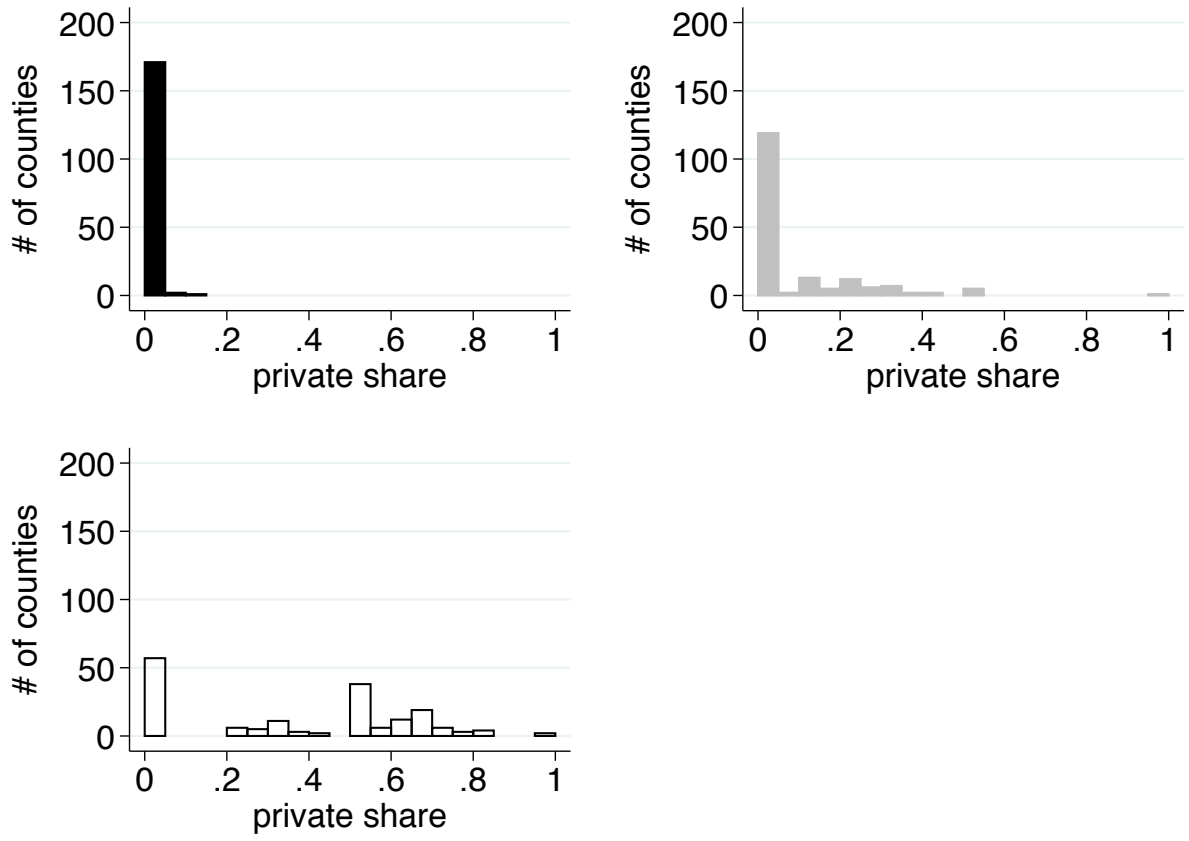
where i stands for firm, j stands for i's industry, c stands for the county in which i is located and t stands for year. $s_{i(jc)t}$ denotes the market share of firm i in industry j in county c. $\overline{s_{jct}}$ stands for the mean market share of firms in industry j in year t that are located in county c. The definitions of $a_{i(jc)t}$ and $\overline{a_{jct}}$ are analogous for productivity. The advantage of the localized allocative efficiency measure defined in equation (16) is its ability to capture improvements of local allocative efficiency over time, even if allocative efficiency in the rest of the country improves faster than in the locality of interest.[36] In other words, I am not interested in cross-county reallocation; instead, I am interested in within-county reallocation gains over time, as associated with the financial system becoming more privately owned in the county in question.

The extent to which the banking system was privately owned and ran changed over time as shown in Figure 7. The ideal experiment to identify the role of access to privatized as opposed to state-run finance, consists in a helicopter randomly dropping a privatized banking system to replace the state-run banking system in an area. To try to replicate this experiment as closely as I can, I use the staggered nature of the privatization of the banking system. In particular, I use the privatization of the first banks established in the country at the eve of the introduction of the two-tiered banking system. The branches of these, to-be-privatized state-owned

[36] Using the standard definition (industry-year specific means as opposed to industry-county-year specific means) would have the disadvantage that improving allocative efficiency in an industry-locality pair would be captured as a worsening of allocative efficiency if the average firm in the same industry in the entire country sees a larger gain in productivity compared to the firms in the locality-industry pair. Instead, the definition in equation (16) captures the improvement in local allocative efficiency in this example, as an actual improvement.

banks had been present in the given locality since before 1969.[37]

FIGURE 7: SHARE OF PRIVATE BANK BRANCHES IN ALL BANK BRANCHES, ACROSS COUNTIES



Notes: The histograms show the share of private bank branches among all bank branches across counties, in three years: 1990, when the privatizations had just started, 1995, and 1999, the last year of my sample.

6.2.1 Branch network in the distant past as instrument

The instrumental variable for the variable "# of private branches" is the "# of privatized branches" for counties where the existence of the state-owned branch was determined decades prior to the quasi-experiment I am exploiting. To define the instrumental variable, I interact the year of privatization of a given state-owned bank b with the network of counties in which the bank inherited presence from the

[37]This is the first year for which I could find information on the network of branches of the CBofH.

Table 7: Branch-Network of Central Bank of Hungary vs New Commercial Banks

	# of towns where CBofH branch	# of towns with commercial bank branch where CBofH branch in past	
year	present	present	not present
1969	115		
1971	104		
1972	103		
1976	100		
1982	81		
1987		81	0
1990		94	12

Notes: This table shows the number of towns in which the Central Bank of Hungary (CBofH) had a branch. The third and fourth columns refer to the branch-network of the state-owned commercial banks that in 1987 took over the lending activities of the CBofH. All years from the pre-period with available data are shown. The number of towns where CBofH was present narrows over time, but there is no entry into new towns in the time period shown.

CBofH.

$$\begin{aligned} \#\text{ of privatized branches}_{bct} = 1\{&\text{inherited branch from CBofH}_{bc1987}\} \\ &\times 1\{\text{t=year of privatization}_{bt}\} \\ &\times \#\text{ branches}_{bct}, \end{aligned} \tag{17}$$

where c stands for county and t stands for year. Table (7) shows that all towns in which the new commercial banks had a branch in 1987 were towns where the CBofH had a branch in the earliest year I could find data on, in 1969. The variable of interest then is a county-level variable,

$$\#\text{ privatized branches}_{ct} = \sum_b \#\text{ privatized branches}_{bct}. \tag{18}$$

The privatization of a bank impacted all its branches: When a bank became privatized it became privatized as a whole. The buyer did not have a possibility to choose only certain branches to be privatized.

The identifying assumption requires that when a bank's headquarter becomes privatized, this event has no means to influence local allocative efficiency across counties in ways other than through the privatization of the pre-existing branch the bank had in the county. For the identifying assumption to hold, the bank that becomes privatized next cannot be the one with branches in counties that are growing relative to other counties exactly when the privatization happens. I

show in Figures A.17 and A.18 that treated counties, according to the definition of my instrumental variable, do not exhibit a differential growth trend relative to the control counties. In particular, Figures A.17 and A.18 show the coefficients β_t from the regression

$$y_{ct} = \delta_t + \beta_t \times 1\{\text{inherited branch from CBofH}_{bc1987}\} \times \delta_t + \epsilon_{ct}, \qquad (19)$$

where δ_t are year dummies and y_{ct} are various outcome variables: number of inhabitants, number of working age inhabitants, unemployment rate, number of personal cars and phonelines, number of people working in manufacturing, number of retail establishments,[38] total taxbase per taxpayer. I find that areas which had a bank branch of the CBofH in the 1980s are typically larger in almost all these variables, except the unemployment rate. However, these treated counties do not grow differentially compared to other counties.[39] The lack of differential growth trends makes the setup appropriate for my analysis.

The first stage regression is

$$\#\text{ private branches}_{ct} = \alpha + \gamma_1 \#\text{ privatized branches}_{ct} + \delta_t + \gamma_c + \epsilon_{ct}, \qquad (20)$$

where c stands for county, t stands for year and the # privatized branches is the instrument as created in equations (17) and (18). The results of the first stage are shown in Table (A.19). The F-statistic exceeds 88 and the R^2 is high.

The main specification of interest is

$$ln(\text{alloc. efficiency of K})_{ct} = \beta_1 \#\text{ branches}_{ct} + \beta_2 \#\text{ private branches}_{ct} + \gamma_c + \delta_t + \epsilon_{ct}, \qquad (21)$$

where in the reduced form specification, # private branches$_{ct}$ is replaced by the # privatized branches$_{ct}$ as described in the previous paragraphs. The results are shown in Table 8.

The reduced form results indicate that allocative efficiency gains for an additional privatized bank, in areas that received the privatization treatment (as defined in the IV in this section) are, on average, 25% of total cross-county allocative efficiency gains in the 1990s. [40] To explore whether the treated counties exhibit pretrend before the treatment, I explore the results of a distributed lag model. For each county that is treated according to my instrument (as defined by my instrumental

[38] The variable "number of retail establishments" has a slightly different definition between 1991 and 1996, which explains the observed jump between these two years.

[39] At most, these counties grow slower in terms of telephone-lines, for example.

[40] The allocative efficiency of capital, across counties between 1992 and 1999 improves by 1 unit. All of the empirical results in this section are based on data between 1992 and 1999. To calculate allocative efficiency gains by county, location information on firms is needed. The location information becomes close to comprehensive starting in 1992 only.

variable), I define the event to be the first year in which the county experienced the privatization of the bank branch of a state-bank located in the county. Prior to this year, the value of the instrument is 0. Post this year, the value of the instrument is the number of branches present in the area, belonging to a bank that had a branch in the county by inheriting it from the CBofH in 1987.

The distributed lag model in equation (22) and Figure 8 shows that there is no obvious pre-trend prior to the privatization experiment, the to-be-treated counties look at most slightly worse in terms of capital allocation prior to the privatization.

Table 8: OLS and reduced form results

	OLS	reduced form
	(1)	(2)
	alloc. effic. K	alloc. effic. K
# branches	0.0710*	0.0952***
	(1.65)	(2.67)
# private branches	0.0709***	
	(3.37)	
# privatized branches		0.246***
		(3.98)
N	1378	1378
County	Y	Y
Year	Y	Y
r2	0.547	0.553

t statistics in parentheses

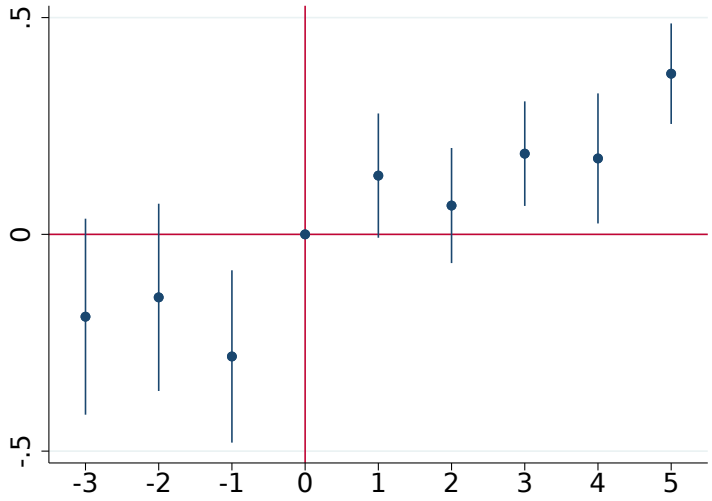
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the results corresponding to the regression equation (21). The outcome variable is the allocative efficiency of capital. Standard errors are clustered by county. The unit of observation is a county-year. The time period for the regression analysis is 1992-1999.

$$ln(\text{alloc efficiency K})_{ct} = \beta_1 \#\text{ branches}_{ct} + \sum_{k=-3}^{k=5} \beta_k \#\text{ privatized branches (IV)}_{ct+k} + \gamma_c + \delta_t + \epsilon_{ct} \tag{22}$$

To summarize, I find that the privatization of the banking system is associated with large gains in the allocative efficiency of capital during the 1990s in Hungary. This suggests that privatizing the banking system early in the 1990s might have allowed the allocative gains to materialize earlier and thereby allowing GDP to return to the pre-reform trend in less than 16 years.

FIGURE 8: DISTRIBUTED LAG MODEL, ALLOCATIVE EFFICIENCY OF CAPITAL, EVENT: BANK-PRIVATIZATION



Notes: This graph shows the β_t coefficients from regression equation (22). The specification is intuitively, the event study version of the reduced form regression displayed in column (2) of Table 8. The time period for the regression analysis is 1992-1999.

7 Conclusion

This paper studies the sharp decline and the slow recovery in post-communist countries, through the lens of microdata from Hungary. Using a novel decomposition, I identify that the decline and the recovery were driven by two major, but different factors. The declining labor input accounts for the majority of the decline. Improved allocative efficiency of both labor and capital account for most of the recovery. I find evidence that a significant share of firms in the pre-period employed inefficiently many people, and that these firms, in the transition, decreased their employment by an additional 40% relative to the rest of the firms. I find that these firms differentially decreased employment especially for particular groups: low-educated workers, blue-collar workers, women and older workers. The evidence is consistent with the communist firms providing a social safety net, beyond producing and selling goods and services. To understand the recovery, I exploit a quasi-experiment: the state-owned banking system became privatized in a staggered way during the 1990s. I exploit the predetermined nature of the branch network of the to-be-privatized state-banks and interact it with the staggered nature of the privatization of the same banks. I find evidence which is consistent with the liberalization of the banking system being complementary to the liberalization of the corporate sector. I find that the allocative efficiency gains might have materialized faster, had the banking

system been privatized earlier, thereby shortening the especially long 16 years of recovery to trend of the country's GDP.

A Appendix

A.1 Derivation of the decomposition in the two-inputs case

In reality, firms use both labor and capital to produce value added, as in equation (1). The intuition for the decomposition in the two-inputs case is similar to but slightly more involved than the one-input case.

I assume firms' production function is Cobb-Douglas in labor and capital, as shown in equation (1) and reproduced here:

$$Y_{i(j)t} = A_{i(j)t} L_{i(j)t}^{\alpha_j} K_{i(j)t}^{\beta_j}$$

In this section, I derive the terms of my output decomposition under the Cobb-Douglas assumption with constant returns to scale, $\alpha_j + \beta_j = 1$. To simplify notation, I omit the industry subscript j with the understanding that the goal is to decompose industry j's output between two years, t and $t+1$.
To save on notation, I introduce the following variables:

Mean terms: (23)

Mean productivity within an industry-year pair:

$$\tilde{A}_t \equiv \frac{\sum_i A_{it}}{N_t}$$

Labor's mean contribution to output within an industry-year pair:

$$\tilde{L}_t \equiv \frac{\sum_i L_{it}^{\alpha}}{N_t}$$

Capital's mean contribution to output within an industry-year pair:

$$\tilde{K}_t \equiv \frac{\sum_i K_{it}^{\beta}}{N_t}$$

Scale-invariant covariances: (24)

scale-invariant covariance term between A_{it}, L_{it}^{α} :

$$\widetilde{\text{cov}}(A_{it}, L_{it}^{\alpha}) \equiv \frac{\sum_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha} - \tilde{L}_t)}{N_{jt}^{\beta}}$$

scale-invariant covariance term between A_{it}, K_{it}^{β} :

$$\widetilde{\text{cov}}(A_{it}, K_{it}^{\beta}) \equiv \frac{\sum_i (A_{it} - \tilde{A}_t)(K_{it}^{\beta} - \tilde{K}_t)}{N_{jt}^{\alpha}}$$

scale-invariant covariance term between L_{it}^{α}, K_{it}^{β} :

$$\widetilde{\text{cov}}(L_{it}^{\alpha}, K_{it}^{\beta}) \equiv \sum_i (L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)$$

where N_t represents the number of firms in the industry in year t.

The scale-invariant covariance terms are used to filter out the mechanical (non-economic) effect of changing the number of firms between two periods. The sums, instead of being divided by N_{jt}, are divided by N_{jt}^{β}, N_{jt}^{α}, and 1, respectively. To take a concrete example of the mechanical effect this correction filters out, consider that as the number of firms between two periods increases in an economy, the average unit has to be smaller in terms of labor and capital. Solely because the mean labor's contribution and the mean capital's contribution is now lower, the extent to which firms differ from each other in terms of inputs might change. As such, this mechanical effect (distinctly from other changes in the dispersion of L_{it}^{α} and K_{it}^{β}) might change the standard deviation of L_{it}^{α} and K_{it}^{β}. Defining the scale-invariant covariance terms by the division of the terms as indicated in equations (24) exactly takes away the above described mechanical (non-economic) effect.[41] Similarly to the one-input case, the expected value of output across firms is

$$\begin{aligned} E(Y_{it}) =& E(A_{it})E(L_{it}^{\alpha})E(K_{it}^{\beta}) \\ &+ \operatorname{cov}(A_{it}, L_{it}^{\alpha})E(K_{it}^{\beta}) + \operatorname{cov}(A_{it}, K_{it}^{\beta})E(L_{it}^{\alpha}) + \operatorname{cov}(L_{it}^{\alpha}, K_{it}^{\beta})E(A_{it}) \\ &+ E\left((A_{it} - E(A_{it}))(L_{it}^{\alpha} - E(L_{it}^{\alpha}))(K_{it}^{\beta} - E(K_{it}^{\beta}))\right), \end{aligned} \tag{26}$$

where I used the result of Bohrnstedt and Goldberger (1969) on the covariance of products of random variables. Similar to the one-input case, I write down the empirical counterpart to equation (26) and sum across the N_t firms to obtain total

[41] To explain the scale-invariant covariance through an example, take the covariance between A_{it} and L_{it}^{α}:

$$\frac{\sum_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha} - \tilde{L}_t)}{N_{jt}} = \sigma_{jt}^{A} \times \sigma_{jt}^{L} \times \operatorname{corr}(A_{it}, L_{it}^{\alpha}). \tag{25}$$

where σ_{jt}^{A} denotes the standard deviation of A_{it} and σ_{jt}^{L} denotes the standard deviation of L_{it}^{α}. Expression (25) is proportional to $\frac{1}{N_{jt}^{\alpha}}$ via σ_{jt}^{L} being proportional to $\frac{1}{N_{jt}^{\alpha}}$. As such, the $\operatorname{cov}(A_{it}, L_{it}^{\alpha})$ will change as the number of firms changing potentially influences the standard deviation σ_{jt}^{L}. Because this effect is mechanical, I want to take it out from the change in the comovement of productivity and labor's contribution. Multiplying the $\operatorname{cov}(A_{it}, L_{it}^{\alpha})$ by $\frac{1}{N_{jt}^{\alpha}}$ cancels out this mechanical effect and leads me to the scale-invariant expression defined above, $\widetilde{cov}(A_{it}, L_{it}^{\alpha})$. The expression I use embeds the case in which the standard deviation of L_{it}^{α} and K_{it}^{β} does not change between two periods via the mechanical effect of changing number of firms.

value added in year t as

$$\sum_i Y_{it} = \underbrace{N_t \tilde{A}_t \tilde{L}_t \tilde{K}_t}_{\text{random allocation}} + \underbrace{\begin{array}{l} \widetilde{\text{cov}}(A_{it}, L_{it}^{\alpha}) N_t^{\beta} \tilde{K}_t + \widetilde{\text{cov}}(A_{it}, K_{it}^{\beta}) N_t^{\alpha} \tilde{L}_t + \widetilde{\text{cov}}(L_{it}^{\alpha}, K_{it}^{\beta}) \tilde{A}_t \\ + \sum_i (A_{it} - \tilde{A}_{it})(L_{it}^{\alpha} - \tilde{L}_{it})(K_{it}^{\alpha} - \tilde{K}_{it}). \end{array}}_{\text{sorting of productivity and inputs}} \tag{27}$$

Following the same sequence of steps as with one input only, I decompose $\Delta(N_t \tilde{A}_t \tilde{L}_t \tilde{K}_t)$ into components that identify the extent to which each of the three components, ΔA_t, $\Delta(N_t^{\alpha} \tilde{L}_t)$, and $\Delta(N_t^{\beta} \tilde{K}_t)$, contribute to the change in this quantity.[42]

$$\Delta N_t \tilde{A}_t \tilde{L}_t \tilde{K}_t = \underbrace{\Delta \tilde{A}_t (N_t \tilde{L}_t \tilde{K}_t)}_{\text{contribution of } \Delta\text{A}} + \underbrace{\Delta(N_t^{\alpha} \tilde{L}_t) \tilde{A}_t N_t^{\beta} \tilde{K}_t}_{\text{contribution of } \Delta\text{L}} + \underbrace{\Delta(N_t^{\beta} \tilde{K}_t) \tilde{A}_t N_t^{\alpha} \tilde{L}_t}_{\text{contribution of } \Delta\text{K}} \tag{28}$$
$$+ \underbrace{\begin{array}{l} \Delta \tilde{A}_t \Delta(N_t^{\alpha} \tilde{L}_t) N_t^{\beta} \tilde{K}_t \\ \Delta \tilde{A}_t \Delta(N_t^{\beta} \tilde{K}_t) N_t^{\alpha} \tilde{L}_t \\ \Delta(N_t^{\alpha} \tilde{L}_t) \Delta(N_t^{\beta} \tilde{K}_t) \tilde{A}_t \\ \Delta \tilde{A}_t \Delta(N_t^{\alpha} \tilde{L}_t) \Delta(N_t^{\beta} \tilde{K}_t) \end{array}}_{\text{contribution of higher-order terms}}$$

Combining equations (27) and (28) allows me to write down the full decomposition

[42] Formally, this decomposition is a Taylor expansion of the function $f(\tilde{A}, (N^{\alpha} \tilde{L}), (N^{\beta} \tilde{K}))$ around the point $(\tilde{A}_t, (N_t^{\alpha} \tilde{L}_t), (N_t^{\beta} \tilde{K}_t))$. Because the function is a third-order polynomial, any term of order higher than three will be 0. As such, the decomposition I write down is exact and is not an approximation.

of $\Delta \sum_i Y_{it}$ as

$$\Delta \sum_i Y_{it} = \underbrace{\Delta \tilde{A}_t \left((N_t \tilde{L}_t \tilde{K}_t) + \Sigma_i (L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t) \right)}_{\text{contribution of } \Delta\text{A}} \tag{29}$$

$$+ \underbrace{\begin{array}{l} \Delta(\widetilde{\text{cov}}(A_{it}, L_{it}^{\alpha}))(N_t^{\beta} \tilde{K}_t) + \Delta(\widetilde{\text{cov}}(A_{it}, K_{it}^{\beta}))(N_t^{\alpha} \tilde{L}_t) + \\ + \Delta(\Sigma_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)) + \end{array}}_{\text{contrib of } \Delta\text{allocation, productivity}}$$

$$+ \underbrace{\Delta(N_t^{\alpha} \tilde{L}_t) \left(\tilde{A}_t N_t^{\beta} \tilde{K}_t + \widetilde{\text{cov}}(A_{it}, K_{it}^{\beta}) \right)}_{\text{contribution of } \Delta\text{L}} + \underbrace{\Delta(N_t^{\beta} \tilde{K}_t) \left(\tilde{A}_t N_t^{\alpha} \tilde{L}_t + \widetilde{\text{cov}}(A_{it}, L_{it}^{\alpha}) \right)}_{\text{contribution of } \Delta\text{K}} \tag{30}$$

$$+ \underbrace{\Delta(\widetilde{\text{cov}}(L_{it}^{\alpha}, K_{it}^{\beta}))\tilde{A}_t}_{\text{contribution of } \Delta\text{allocation, inputs}} \tag{31}$$

$$+ \underbrace{\begin{array}{l} \Delta \tilde{A}_t \Delta(N_t^{\alpha} \tilde{L}_t) N_t^{\beta} \tilde{K}_t \\ \Delta \tilde{A}_t \Delta(N_t^{\beta} \tilde{K}_t) N_t^{\alpha} \tilde{L}_t \\ \Delta(N_t^{\alpha} \tilde{L}_t) \Delta(N_t^{\beta} \tilde{K}_t) \tilde{A}_t \\ \Delta \tilde{A}_t \Delta(N_t^{\alpha} \tilde{L}_t) \Delta(N_t^{\beta} \tilde{K}_t) \\ \Delta \widetilde{\text{cov}}(A_{it}, L_{it}^{\alpha}) \Delta(N_t^{\beta} \tilde{K}_t) + \Delta \widetilde{\text{cov}}(A_{it}, K_{it}^{\beta}) \Delta(N_t^{\alpha} \tilde{L}_t) \\ \Delta(\widetilde{\text{cov}}(L_{it}^{\alpha}, K_{it}^{\beta})) \Delta(\tilde{A}_t) \end{array}}_{\text{contribution of higher-order terms}}$$

Contribution of Δaggregate productivity. Similarly to the one input case the contribution of the change in mean productivity and the contribution of the change in allocative efficiency related to firms' productivity sum to the "contribution of Δaggregate productivity" term.

Contribution of ΔA. Holding everything else constant, this term shows the extent to which output changes if mean productivity changes between two years. The effect works through two channels: first, suppose that inputs and productivity are randomly assigned and the mean firm's productivity increases, but labor and capital are unchanged. Because N_t firms are in the economy, output will increase by the change in productivity ($\Delta \tilde{A}_t$) times aggregate inputs' contribution to output, which is just $N_t \tilde{L}_t \tilde{K}_t = \sum_i L_{it}^{\alpha} K_{it}^{\beta}$. Second, in reality, productivity and inputs are not randomly distributed across firms. Therefore, a changing average productivity will also change output through the baseline allocative efficiency level, because productivity and allocative efficiency levels are complements. This second channel increases output exactly by the change in productivity times the baseline allocative efficiency level of labor and capital [43]: $\Delta \tilde{A}_t (\Sigma_i (L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)$.

[43] To be more precise, "of labor's contribution to output and capital's contribution to output".

Contribution of Δallocative efficiency, productivity. The higher the allocative efficiency in an economy, the larger the output. This group of terms captures all of the productivity-related output-changing effects of allocative efficiency. For the first term, the larger the covariance between A_{it} and L_{it}^{α} in an economy, the higher output will be. The effect of a change in allocative efficiency between productivity and labor's contribution works through the level of capital's aggregate contribution ($N_t^{\beta}\tilde{K}_t$). The reason is that allocative efficiency of productivity and labor are complementary to capital's contribution. The second term is interpreted symmetrically to the first one. The last term captures the change in the "triple allocative efficiency," that is the extent to which higher productivity firms have higher levels of both inputs contributions'.

Contribution of ΔL. This term captures the size of the output change that is accounted for by a change in labor's aggregate contribution. The total contribution of labor to output in the model economy is $N_t^{\alpha}\tilde{L}_t$, where $\tilde{L}_t$ is as defined in equation (23).[44] Holding everything else constant, if this total contribution of labor changes between two periods, it will impact output through two channels. First, the unchanged total contribution of productivity and capital will now be combined with an increased aggregate contribution of labor (i.e. more labor is working with the same productivity and capital), which increases output. Second, because the allocative efficiency of productivity and capital is complementary to labor, the higher the covariance between A_{it} and K_{it}^{β}, the greater the improvement in output due to increased aggreate labor. The interpretation of the term **contribution of ΔK** is very similar.

Contribution of Δallocative efficiency, inputs. This term captures the extent to which the allocative efficiency between labor's contribution and capital's contribution across firms changes output relative to the scenario in which inputs are randomly assigned across firms. This term operates through the mean productivity level, because labor's and capital's allocative efficiency is complimentary to productivity at the firm-level.

Contribution of higher-order terms. Writing down any second-order Taylor-expansion involves two types of terms. First-order terms isolate the change of the

[44]To see why labor's aggregate contribution is $N_t^{\alpha}\tilde{L}_t$, assume all firms are equal in terms of inputs and productivity. I call this representative firm's labor input $\hat{L}_{it}$. Then total labor in the economy is $N_t\hat{L}_{it}$. The N_t firms can be replaced by one large firm with $\hat{L}_t = N_t\hat{L}_{it}$ employees without changing output. Therefore, the total contribution of labor to output in this economy is $\hat{\tilde{L}}_t^{\alpha} = N_t^{\alpha}\hat{L}_{it}^{\alpha}$, that is N_t^{α} times the average contribution of labor to output across firms. To conform with the real world in which not all firms have the same labor, replace the average contribution of labor term by $\tilde{L}_t$ which, as per the definition in equation (23), is exactly the average contribution of labor in my model economy.

outcome variable of interest as only one factor is changing. The sum of the first-order terms predict some change in the outcome variable. The second-order terms are the terms that make the correction to the sum of the first-order terms in order to arrive at the true change in the outcome variable of interest. In other words, they correct the extent to which the sum of the first-order terms over-/understate the true change in the quantity decomposed. This last group of terms collects all the second-order terms that emerged in the decomposition exercise. Any such decomposition based on a Taylor expansion is a valid tool of analysis of changes in an outcome variable if the second-order terms are small relative to the first-order terms. In my application of the decomposition, the second-order terms will indeed be small relative to the first-order terms.

A.2 Generalization of the decomposition, two inputs case

In this section I show the formula for the full decomposition of output change as a sum of components accounted for by different factors of interest to economists modeling output change. These factors are (i) the role of aggregate labor (as Solow (1957)); (ii) the role of aggregate capital (as Solow (1957)); (iii) the role of aggregate productivity (as Solow (1957)); (iv) the role of allocative efficiency (as Olley and Pakes (1996) for productivity, this paper for output); (v) the role of net entry (as Foster et al. (2001) for productivity, but this paper for output); (vi) the role of dispersion of productivity (as Hsieh and Klenow (2009)); (vii) the role of dispersion in inputs.

To simplify notation, I reproduce the definition of notation I introduced before in equations (23) and equations (24) and introduce additional simplifying notation.

Relative to the decomposition in the main text and in Appendix A.1, I further separate the change in the scale-invariant covariance terms into correlation and distributional effects. Next, I further separate changing distributional effects into the number of firms and dispersion. Next, I further separate the change in dispersion into dispersion of productivity across firms versus dispersion of inputs. As such, it is possible to quantitatively decompose the change in an industry's output into the role of the changing aggregate contribution of inputs, the role of mean productivity, the role of correlations between productivity and inputs, the role of net entry through allocation forces[45], the role of productivity dispersion and the role of input dispersion.

[45]To complete the role of net entry, it is similarly possible to decompose the changing aggregate contribution of labor (capital) into the role of changing number of firms and mean contribution of labor (capital).

Mean terms:

Mean productivity within an industry-year pair:

$$\tilde{A}_{jt} \equiv \frac{\sum_i A_{it}}{N_{jt}}$$

Labor's mean contribution within an industry-year pair:

$$\tilde{L}_{jt} \equiv \frac{\sum_i L_{it}^{\alpha_j}}{N_{jt}}$$

Capital's mean contribution within an industry-year pair:

$$\tilde{K}_{jt} \equiv \frac{\sum_i K_{it}^{\beta_j}}{N_{jt}}$$

Scale-invariant covariances:

scale-invariant covariance between A_{it} and $L_{it}^{\alpha_j}$:

$$\widetilde{\text{cov}}(A_{it}, L_{it}^{\alpha_j}) \equiv \frac{\sum_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha_j} - \tilde{L}_t)}{N_{jt}^{\beta_j}}$$

scale-invariant covariance between A_{it} and $K_{it}^{\beta_j}$:

$$\widetilde{\text{cov}}(A_{it}, K_{it}^{\beta_j}) \equiv \frac{\sum_i (A_{it} - \tilde{A}_t)(K_{it}^{\beta_j} - \tilde{K}_t)}{N_{jt}^{\alpha_j}}$$

scale-invariant covariance between L_{it}^{α} and K_{it}^{β}:

$$\widetilde{\text{cov}}(L_{it}^{\alpha_j}, K_{it}^{\beta}) \equiv \frac{\sum_i (L_{it}^{\alpha_j} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)}{N_{jt}}$$

Standard deviations:

$$\text{standard deviation of } A_{i(j)t} \equiv \sigma^A_{jt}$$

$$\text{standard deviation of } L^{\alpha_j}_{i(j)t} \equiv \sigma^L_{jt}$$

$$\text{standard deviation of } K^{\beta_j}_{i(j)t} \equiv \sigma^K_{jt}$$

Correlations:

$$\text{correlation between } A_{it} \text{ and } L^{\alpha_j}_{it}:$$

$$\text{corr}(A_{it}, L^{\alpha_j}_{it}) \equiv \frac{\sum_i (A_{it} - \tilde{A}_t)(L^{\alpha_j}_{it} - \tilde{L}_t)}{N_{jt}\sigma^A_{jt}\sigma^L_{jt}}$$

$$\text{correlation between } A_{it} \text{ and } K^{\beta_j}_{it}:$$

$$\text{corr}(A_{it}, K^{\beta_j}_{it}) \equiv \frac{\sum_i (A_{it} - \tilde{A}_t)(K^{\beta_j}_{it} - \tilde{K}_t)}{N_{jt}\sigma^A_{jt}\sigma^K_{jt}}$$

$$\text{correlation between } L^{\alpha}_{it} \text{ and } K^{\beta}_{it}:$$

$$\text{corr}(L^{\alpha_j}_{it}, K^{\beta}_{it}) \equiv \frac{\sum_i (L^{\alpha_j}_{it} - \tilde{L}_t)(K^{\beta}_{it} - \tilde{K}_t)}{N_{jt}\sigma^L_{jt}\sigma^K_{jt}}$$

where N_{jt} stands for the number of firms in industry j and year t.

$$
\begin{aligned}
\Delta \sum_i Y_{it} = & \underbrace{\Delta \tilde{A}_t \left((N_t \tilde{L}_t \tilde{K}_t) + \Sigma_i (L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t) \right)}_{\text{contribution of } \Delta \text{A}} \\
& + \underbrace{\begin{array}{l} \Delta(\text{corr}(A_{it}, L_{it}^{\alpha})) N_t^{\alpha+\beta} \sigma_t^A \sigma_t^L \tilde{K}_t + \Delta(\text{corr}(A_{it}, K_{it}^{\beta})) N_t^{\alpha+\beta} \sigma_t^A \sigma_t^K \tilde{L}_t + \\ \Delta(\text{corr}(L_{it}^{\alpha}, K_{it}^{\beta})) N_t \sigma_t^L \sigma_t^K \tilde{A}_t + \Delta \frac{\Sigma_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)}{N_t \sigma_t^A \sigma_t^L \sigma_t^K} (N_t \sigma_t^A \sigma_t^L \sigma_t^K) \end{array}}_{\text{contribution of } \Delta \text{correlation}} \\
& + \underbrace{\Delta(N_t^{\alpha} \tilde{L}_t) \left(\tilde{A}_t (N_t^{\beta} \tilde{K}_t) + \widetilde{\text{cov}}(A_{it}, K_{it}^{\beta}) \right)}_{\text{contribution of } \Delta \text{L}} \\
& + \underbrace{\Delta(N_t^{\beta} \tilde{K}_t) \left(\tilde{A}_t (N_t^{\alpha} \tilde{L}_t) + \widetilde{\text{cov}}(A_{it}, L_{it}^{\alpha}) \right)}_{\text{contribution of } \Delta \text{K}} \\
& + \underbrace{\begin{array}{l} \Delta(N_t^{\alpha}) \sigma_t^A \sigma_t^L \text{corr}(A_{it}, L_{it}^{\alpha}) N_t^{\beta} \tilde{K}_t + \Delta(N_t^{\beta}) \sigma_t^A \sigma_t^K \text{corr}(A_{it}, K_{it}^{\beta}) N_t^{\alpha} \tilde{L}_t \\ \Delta(N_t) \left(\sigma_t^L \sigma_t^K \text{corr}(L_{it}^{\alpha}, K_{it}^{\beta}) \tilde{A}_t + \sigma_t^A \sigma_t^L \sigma_t^K \frac{\Sigma_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)}{N_t \sigma_t^A \sigma_t^L \sigma_t^K} \right) \end{array}}_{\text{contribution of } \Delta \text{net entry}} \\
& + \underbrace{\begin{array}{l} \Delta \sigma_t^A (N_t (\sigma_t^L \tilde{K}_t \text{corr}(A_{it}, L_{it}^{\alpha}) + \sigma_t^K \tilde{L}_t \text{corr}(A_{it}, K_{it}^{\beta}) + \\ \sigma_t^L \sigma_t^K \frac{\Sigma_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_{it})}{N_t \sigma_t^A \sigma_t^L \sigma_t^K}) \end{array}}_{\text{contribution of } \Delta \text{productivity dispersion}} \\
& + \underbrace{\begin{array}{l} \Delta(\sigma_t^L)(N_t(\sigma_t^A \tilde{K}_t \text{corr}(A_{it} L_{it}^{\alpha}) + \sigma_t^K \tilde{A}_t \text{corr}(L_{it}^{\alpha}, K_{it}^{\beta}))) \\ \Delta(\sigma_t^K)(N_t(\sigma_t^A \tilde{L}_t \text{corr}(A_{it} K_{it}^{\beta}) + \sigma_t^L \tilde{A}_t \text{corr}(L_{it}^{\alpha}, K_{it}^{\beta}))) \\ \Delta(\sigma_t^L \sigma_t^K) \sigma_t^A N_t \frac{\Sigma_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_{it})}{N_t \sigma_t^A \sigma_t^L \sigma_t^K} \end{array}}_{\text{contribution of } \Delta \text{input dispersion}} \\
& + \underbrace{\begin{array}{l} N_t^{\alpha} \tilde{L}_t \Delta \tilde{A}_t \Delta(N_t^{\beta} \tilde{K}_t) + N_t^{\beta} \tilde{K}_t \Delta \tilde{A}_t \Delta(N_t^{\alpha} \tilde{L}_t) + \tilde{A}_t \Delta(N_t^{\alpha} \tilde{L}_t) \Delta(N_t^{\beta} \tilde{K}_t) + \\ \Delta \tilde{A}_t \Delta(N_t^{\alpha} \tilde{L}_t) \Delta(N_t^{\beta} \tilde{K}_t) \\ \Delta \widetilde{\text{cov}}(A_{it}, L_{it}^{\alpha}) \Delta(N_t^{\beta} \tilde{K}_t) + \Delta \widetilde{\text{cov}}(A_{it}, K_{it}^{\beta}) \Delta(N_t^{\alpha} \tilde{L}_t) \\ \Delta(\Sigma_i (L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)) \Delta(\tilde{A}_t) \\ \Delta(\text{corr}(A_{it}, L_{it}^{\alpha})) \Delta(N_t^{\alpha} \sigma_t^A \sigma_t^L) N_t^{\beta} \tilde{K}_t + \Delta(\text{corr}(A_{it}, K_{it}^{\beta})) \Delta(N_t^{\beta} \sigma_t^A \sigma_t^K) N_t^{\alpha} \tilde{L}_t \\ \Delta(\text{corr}(L_{it}^{\alpha}, K_{it}^{\beta})) \Delta(N_t \sigma_t^L \sigma_t^K) \tilde{A}_t \\ \Delta \frac{\Sigma_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)}{N_t \sigma_t^A \sigma_t^L \sigma_t^K} \Delta(N_t \sigma_t^A \sigma_t^L \sigma_t^K) \\ \Delta(N_t^{\alpha}) \Delta(\sigma_t^A \sigma_t^L) \text{corr}(A_{it}, L_{it}^{\alpha}) N_t \beta \tilde{K}_t + \Delta(N_t^{\beta}) \Delta(\sigma_t^A \sigma_t^K) \text{corr}(A_{it}, K_{it}^{\beta}) N_t \alpha \tilde{L}_t \\ \Delta(N_t) \left(\Delta(\sigma_t^L \sigma_t^K) \text{corr}(L_{it}^{\alpha}, K_{it}^{\beta}) \tilde{A}_t + \Delta(\sigma_t^A \sigma_t^L \sigma_t^K) \frac{\Sigma_i (A_{it} - \tilde{A}_t)(L_{it}^{\alpha} - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)}{N_t \sigma_t^A \sigma_t^L \sigma_t^K} \right) \\ \Delta(\sigma_t^L) \Delta(\sigma_t^A) N_t \tilde{K}_t \text{corr}(A_{it}, L_{it}^{\alpha}) + \Delta(\sigma_t^K) \Delta(\sigma_t^A) N_t \tilde{L}_t \text{corr}(A_{it}, K_{it}^{\beta}) + \\ \Delta(\sigma_t^K) \Delta(\sigma_t^L) N_t \tilde{A}_t \text{corr}(L_{it}^{\alpha}, K_{it}^{\beta}) + \Delta(\sigma_t^A) \Delta(\sigma_t^L \sigma_t^K) N_t \frac{\Sigma_i (A_{it} - \tilde{A}_t)(L_{it} \alpha - \tilde{L}_t)(K_{it}^{\beta} - \tilde{K}_t)}{N_t \sigma_t^A \sigma_t^L \sigma_t^K} \end{array}}_{\text{contribution of higher-order terms}}
\end{aligned} \tag{32}
$$

A.3 Implementation of the Perpetual Inventory Method

I observe the tangible assets (TA_{it}) variable at the firm-year level. From this accounting variable, I construct the service-flow of the capital stock according to the perpetual inventory method (Becker et al., 2006). The algorithm consists of two steps.

1. I obtain deflated investment in year t+1 by

$$\text{Deflated Investment}_{t+1} = \frac{TA_{t+1} - TA_t + \text{Reported Depreciation}_{t+1}}{\text{Investment Deflator}_t}$$

   where the Investment Deflator$_t$ is a year-specific investment deflator.

2. I obtain the firm's flow of capital services by adding each year's deflated investment to the first year's deflated tangible assets.[46]

$$K_{t+1} = \frac{TA_0}{\text{Investment Deflator}_0} + \sum_{k=1}^{t+1}(\text{Deflated Investment}_k \times (1 - \text{Depreciation Rate})).$$

The second step assumes all the tangible assets available in the first year of the firm's existence were purchased in that year.

[46]The first year refers to the firm's first year of existence.

A.4 Robustness checks for decomposition results

Table A.9: Decomposition Results, Proxy-based Productivity Meausures, excluding industries with missing elasticities

	fall (1987-93)	recovery (1993-99)
contribution of Δaggregate productivity	6	98
contribution of ΔL	−110	−9
contribution of ΔK	−5	11
contribution of Δ realloc L, K	11	−7
contribution of non-linearities	−2	7
sum	−100	100

Notes: This table shows the decomposition results using the proxy-based productivity estimation method. This method operates well with many observations per industry. The method returns negative elasticities for industries mining, electricity, "other" industry, transportation, water management. These industries have a relatively low number of firms. The decomposition results in this table exclude the industries with missing elasticity estimates. The results are qualitatively similar to the results reported in the main text.

Table A.9 shows the decomposition results excluding industries for which the proxy-based method returns negative elasticities. The results are qualitatively similar compared to when these industries are included using elasticities from the costshare-based method, or when using costshare-based elasticities for all industries. Labor's contribution to the output decline is the largest, while capital's is small. The average productivity within industry contributes to only 2% of the fall in output, while allocative efficiency related to productivity (whether more productive firms command more of the inputs) improves but contributes only 7% to output gains. [47] The recovery is largely accounted for by improvements in allocative efficiency. Average productivity increasing contributes only 2% to gains in output, while 96% of output gain is accounted for by reallocation of resources to more productive firms.

Table A.15 shows the decomposition results using the costshare-based method and dropping the 1% tail of the productivity distribution for each industry-year pair. The results are similar to those reported in the main text.

As described in section 2.1, the post-period was characterized by a boom of firm entry(Ecostat, 1998) among which also many small firms entered. Therefore, a natural question to ask is whether the role of declining contribution of labor is still large when including in the analysis firms that have less than 20 employees. I perform this robustness check by including smaller and smaller firms in the post-period's

[47] The sum of these two constitute the contribution to output change of the change in aggregate productivity. All numbers are rounded to the nearest integer.

Table A.10: Decomposition Results, Costshare-based method, drop 1% productivity tails

	fall (1987-93)	recovery (1993-99)
contribution of Δaggregate productivity	−20	113
contribution of ΔL	−85	−15
contribution of ΔK	−24	16
contribution of Δ realloc L, K	13	−21
contribution of non-linearities	17	7
sum	−100	100

Notes: This table shows the decomposition results of a sample in which for each industry-year, I drop the firms that belong to the top and bottom 1% of the productivity distribution in the given year-industry pair.

sample until reaching a similar coverage of value added in the post as I have in the pre-period. The trade-off is that including all possible small firms in the sample in the post-period would result in comparison which is not valid as a significant number of small firms existed in the pre-period, however I do not have data on those. Performing the decomposition between two years on two samples that do not have a similar representation of the true undelying population of firms can give misleading results. In 1987, my sample (firms with at least 20 employees) covers 84% of value added in the industries analyzed. In 1993, the set of firms with at least 20 employees cover 71% of value added. I include in the post-period firms with at least 10 employees resulting in a coverage ratio to 81%. The results are reported in Table A.11, column (2) uses the costshare-based method, while column (3) uses the proxy-based method. Column (3) reports the decomposition for industries for which the proxy-based method results in non-negative elasticities. Both methods provide similar results to the ones in the main text: labor's contribution to output is the most important explanatory factor for the decline in output. The change in aggregate productivity and capital's contribution are small relative to labor's contribution. Both decompositions show average productivity improves and allocative efficiency declines. Similar to the argument in the main text, this result is mainly driven by the entry of new productive firms that are small and therefore allocative efficiency is measured to decline. Overall, the role of labor's contribution to output is approximately unchanged relative to the main analysis.

Table A.11: Decomposition Results, Fall in output between 1987 and 1993, including small firms in the post period

	costshare	proxy
contribution of Δaggregate productivity	−32	−21
contribution of ΔL	−99	−121
contribution of ΔK	−31	−8
contribution of Δ realloc L, K	37	45
contribution of non-linearities	25	6
sum	−100	−100

Notes: This table shows the decomposition results for a different sample of firms: in 1987 the sample consists of firms that had at least 20 employees. In 1993 the sample consists of firms that had at least 10 employees.

Table A.12: Decomposition Results, Costshare-based method, elasticities recovered from 1991

	fall (1987-93)	recovery (1993-99)
contribution of Δaggregate productivity	20	113
contribution of ΔL	−103	−13
contribution of ΔK	−29	9
contribution of Δ realloc L, K	7	−14
contribution of non-linearities	4	4
sum	−100	100

Notes: This table shows the decomposition results using output elasticities recovered via the costshare-based method from year 1991.

Table A.13: Decomposition Results, Costshare-based method, elasticities recovered from 1993

	fall (1987-93)	recovery (1993-99)
contribution of Δaggregate productivity	−11	107
contribution of ΔL	−96	−10
contribution of ΔK	−24	10
contribution of Δ realloc L, K	17	−13
contribution of non-linearities	15	8
sum	−100	100

Notes: This table shows the decomposition results using output elasticities recovered via the costshare-based method from year 1993.

Table A.14: Decomposition Results, Costshare-based method, elasticities recovered from 1999

	fall (1987-93)	recovery (1993-99)
contribution of Δaggregate productivity	−13	101
contribution of ΔL	−88	−9
contribution of ΔK	−26	14
contribution of Δ realloc L, K	17	−13
contribution of non-linearities	10	8
sum	−100	100

Notes: This table shows the decomposition results using output elasticities recovered via the costshare-based method from year 1999.

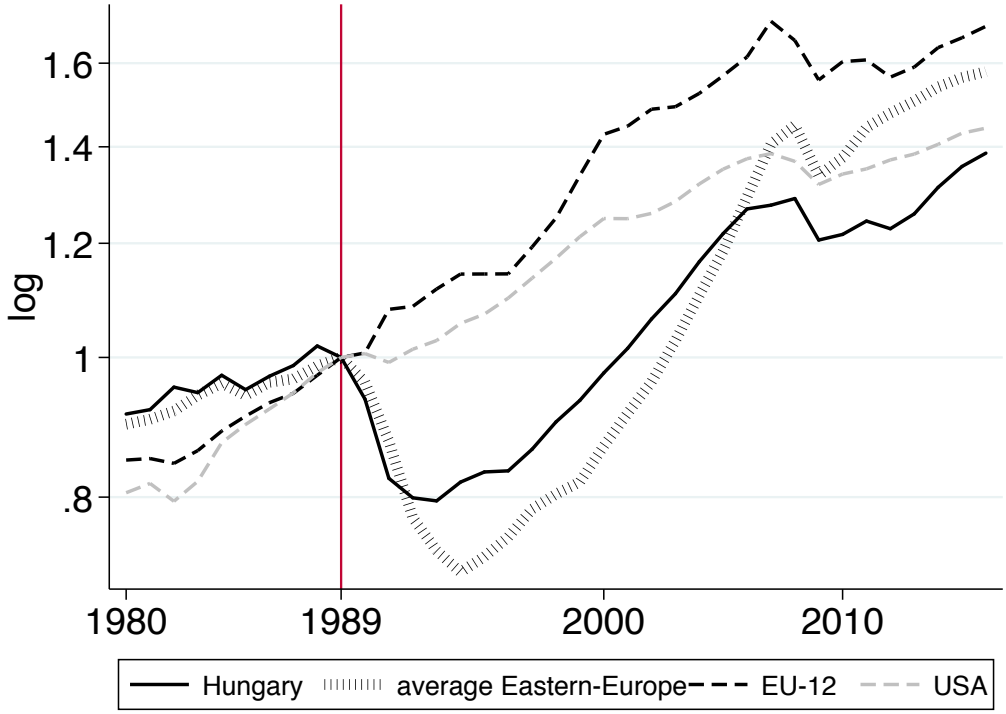
Table A.15: Decomposition Results, Costshare-based method, elasticities averaged across years 1991-1999

	fall (1987-93)	recovery (1993-99)
contribution of Δaggregate productivity	−11	108
contribution of ΔL	−93	−10
contribution of ΔK	−25	11
contribution of Δ realloc L, K	16	−16
contribution of non-linearities	13	7
sum	−100	100

Notes: This table shows the decomposition results using output elasticities recovered via the costshare-based method and averaged across years 1991-1999.

A.5 Additional Tables and Figures

FIGURE A.9: GDP PER CAPITA IN POST-COMMUNIST COUNTRIES VS. THE REST OF THE WORLD, 1989=1



Notes: This graph shows GDP per capita for different groups of countries. Average Eastern-Europe excludes Hungary and is the unweighted average of GDP/capita in Belarus, Czechia, Estonia, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, and Ukraine, the countries for which GDP data exists for long enough in the past. The data are reported in 2011 US dollars and their value is normalized to 1 in 1989. Data source: Maddison Historical Statistics (2017)

FIGURE A.10: GDP PER CAPITA IN THE US (1929=1) VS IN HUNGARY (1989=1)

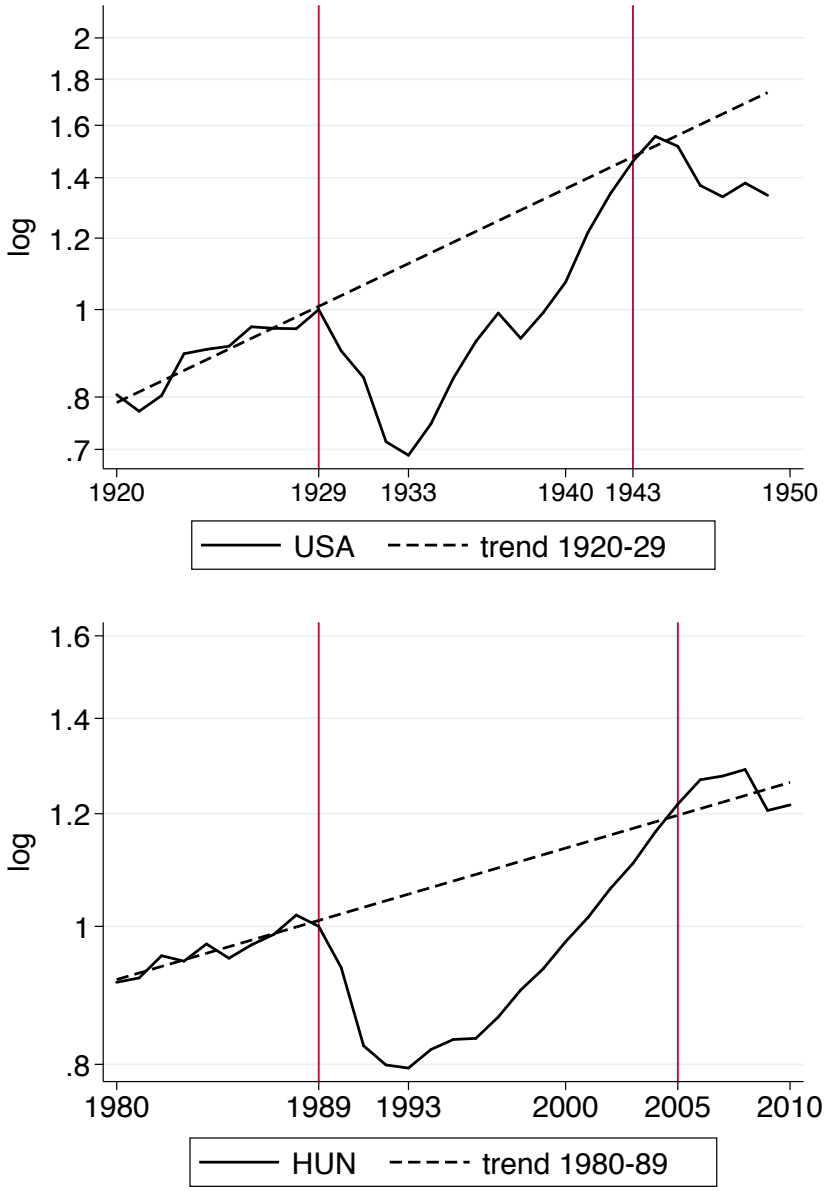
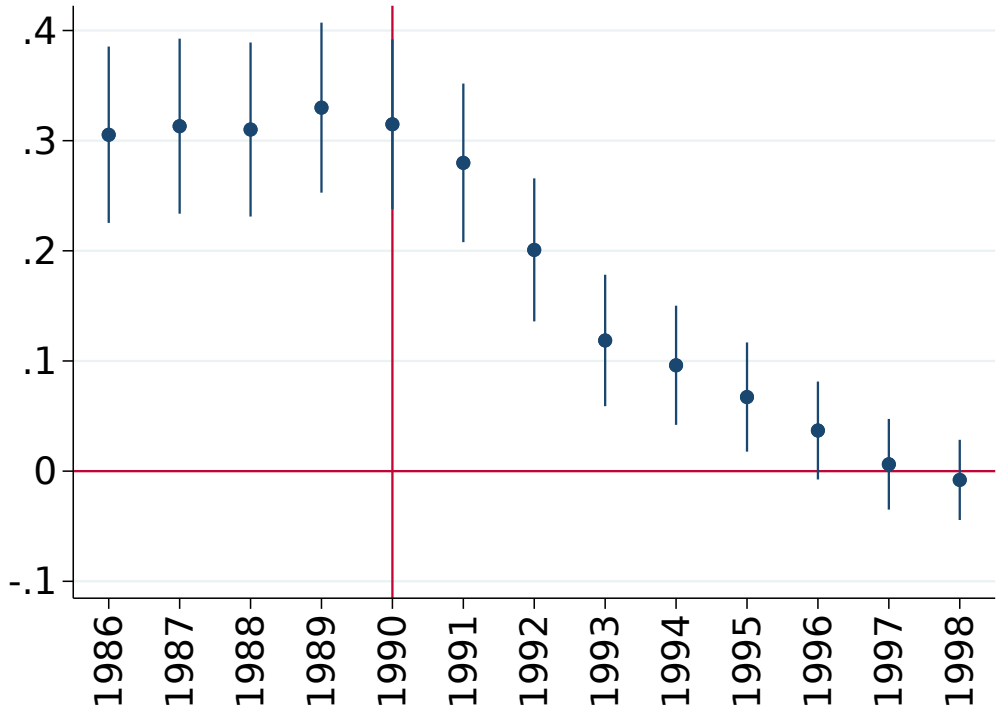
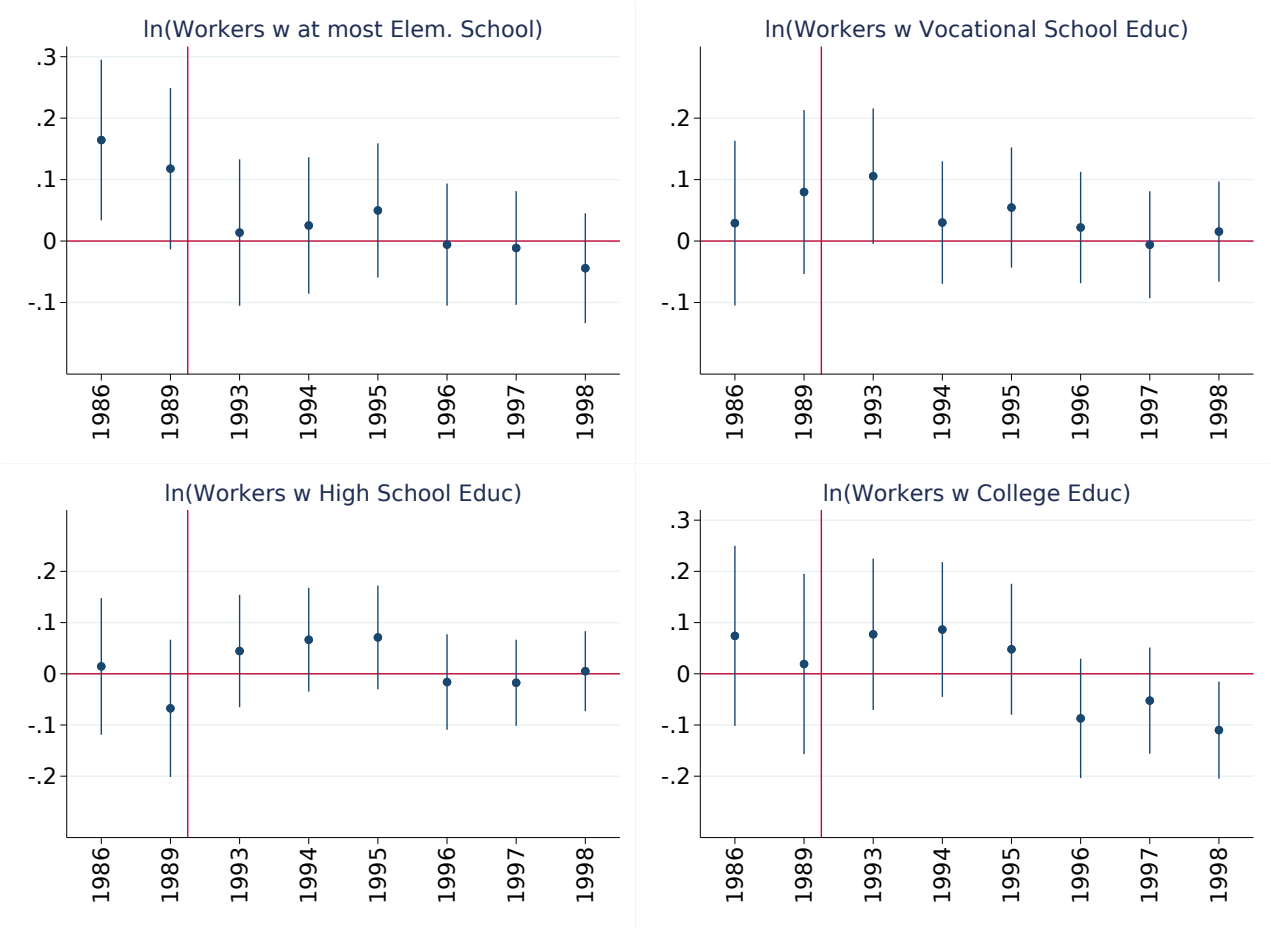


FIGURE A.11: SAMPLE: FIRMS THAT EXISTED IN THE PRE-PERIOD AND SURVIVED UNTIL AT LEAST 2000



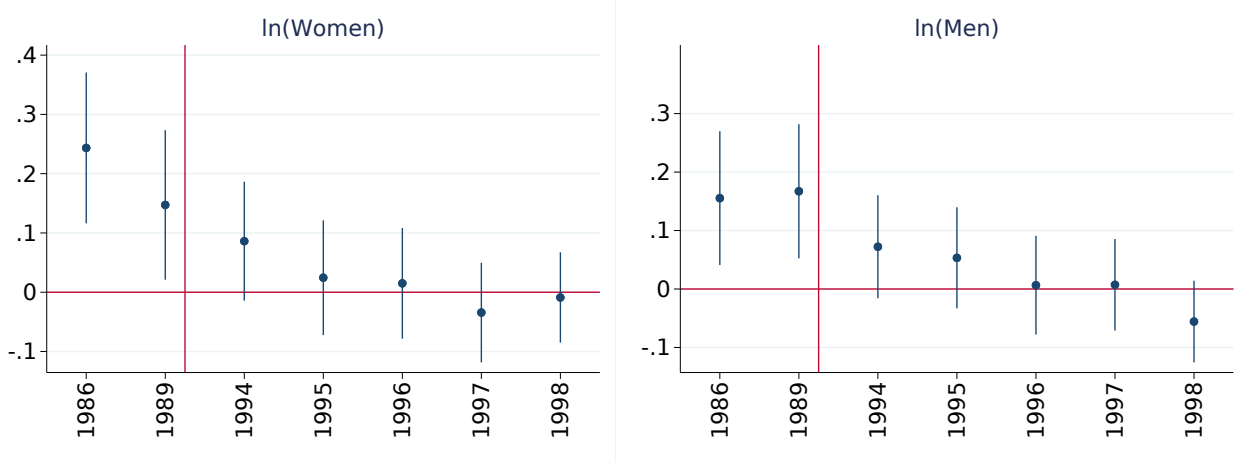
Notes: This graph shows the β_t coefficients from equation (11). The sample of firms for this regression is all firms that existed before 1989 and survived until post-1999. Standard errors are clustered by firm. The productivity measures are recovered using the costshare-based method as explained in the text.

FIGURE A.12: OVEREMPLOYER FIRMS' LABOR TRAJECTORY RELATIVE TO NON-OVEREMPLOYERS, WITHIN FIRM, COST-SHARE BASED METHOD, BY EDUCATION



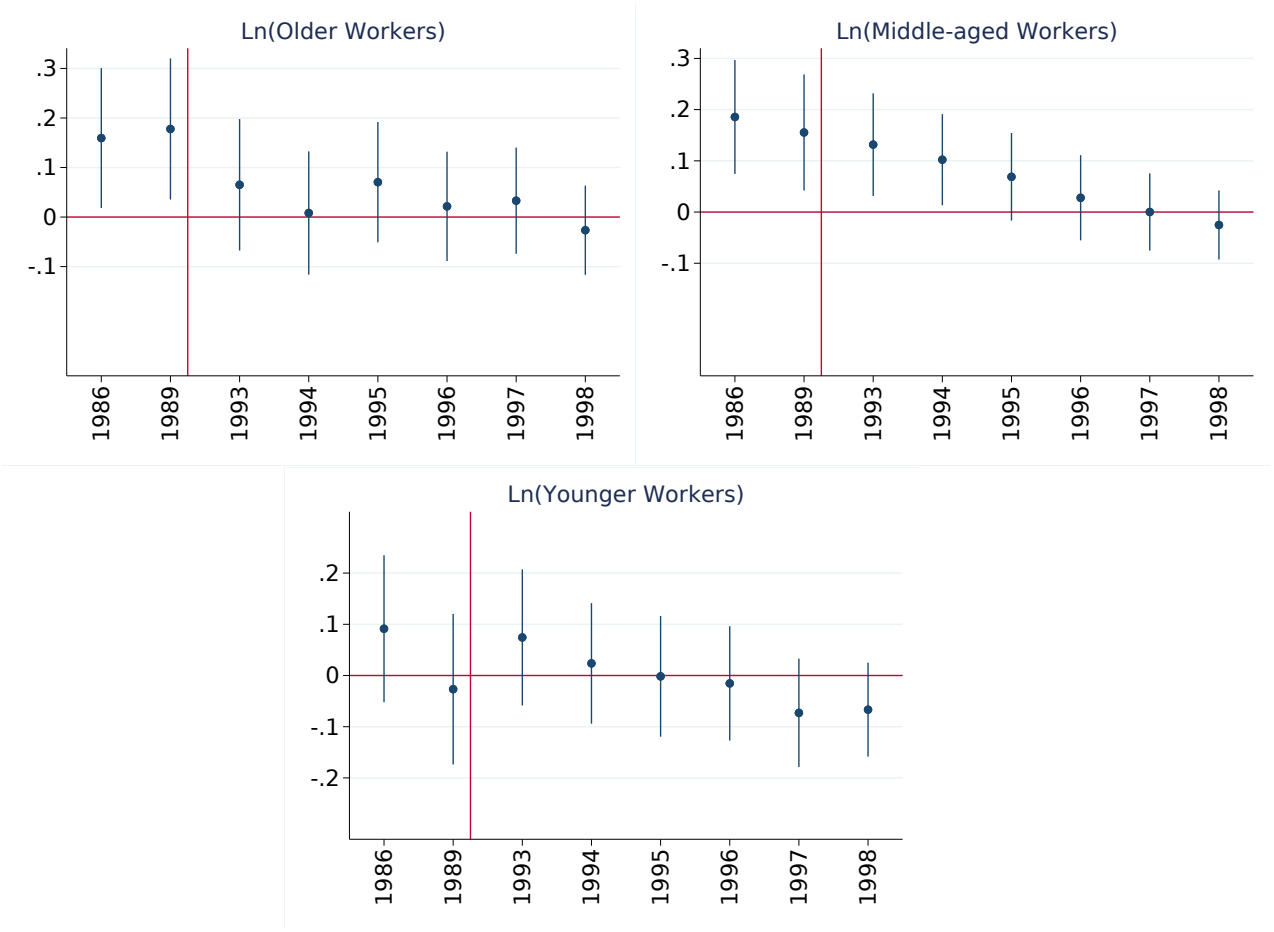
Notes: These graphs show the β_t coefficients from equation (11), where in the four regressions the left-hand-side variables are the log of employment in the appropriate group of employees. In the case of the above four graphs, it is employees with at most elementary school, employees with at most vocational school education, employees with high school education and employees with college education. Firm fixed effects included. Standard errors are clustered by firm.

FIGURE A.13: OVEREMPLOYER FIRMS' LABOR TRAJECTORY RELATIVE TO NON-OVEREMPLOYERS, WITHIN FIRM, COST-SHARE BASED METHOD, BY GENDER



Notes: These graphs show the β_t coefficients from equation (11), where in the two regressions the left-hand-side variables are the log of employment in the appropriate group of employees. In the case of the above two graphs, it is female and male employees. Firm fixed effects included. Standard errors are clustered by firm.

FIGURE A.14: OVEREMPLOYER FIRMS' LABOR TRAJECTORY RELATIVE TO NON-OVEREMPLOYERS, WITHIN FIRM, COST-SHARE BASED METHOD, BY AGE



Notes: These graphs show the β_t coefficients from equation (11), where in the three regressions the left-hand-side variables are the log of employment in the appropriate group of employees. In the case of the above three graphs, it is employees in the old, middle-age, and young age-cateogires. The age categories are: (i) young 15-30, (ii) middle-aged 31-50, and (iii) old 51+. Firm fixed effects included. Standard errors are clustered by firm.

FIGURE A.15: OVEREMPLOYER FIRMS' LABOR TRAJECTORY RELATIVE TO NON-OVEREMPLOYERS, WITHIN FIRM, COST-SHARE BASED METHOD, BY SKILL

Notes: These graphs show the β_t coefficients from equation (11), where in the two regressions the left-hand-side variables are the log of employment in the appropriate group of employees. In the case of the above two graphs, it is employees with blue collar versus white collar jobs. Firm fixed effects included. Standard errors are clustered by firm.

TABLE A.16: CROSS MUNICIPALITY VOTE-SHARE OF THE COMMUNIST PARTY IN 1990

	Communist Party Voteshare in 1990		
	(1)	(2)	(3)
ue_rate	0.0477***		
	(3.75)		
ln(taxbase/capita)	-0.0121**	-0.00917*	-0.00826
	(-2.44)	(-1.83)	(-1.64)
UE share by elem.sch.		0.0742***	
		(4.40)	
UE share by vocat. sch.		0.0256	
		(0.76)	
UE share by high sch.		-0.127*	
		(-1.89)	
UE share by college		-0.436	
		(-1.46)	
UE share by blue-collar			0.0647***
			(4.87)
UE share by white-collar			-0.280***
			(-3.64)
Constant	0.0948***	0.0826***	0.0773***
	(3.40)	(2.95)	(2.76)
Observations	3106	3106	3106
state	Y	Y	Y
municiptype	Y	Y	Y

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the results of the regression corresponding to equation (14). The sample is the set of municipalities in Hungary.

Table A.17: Summary statistics of cross-municipality unemployment variables in 1993

	mean	median	sd
		%	
elem. sch. UE	7.1	6.1	4.7
vocational sch. UE	4.6	4.3	2.3
high sch. UE	1.5	1.4	1.0
college UE	0.0	0.0	0.0
blue collar UE	12.1	11.1	6.1
white collar UE	1.2	1.1	0.1

Notes: This table reports summary statistics for unemployment shares across municipalities in 1993.

TABLE A.18: CROSS MUNICIPALITY VOTE-SHARE OF THE COMMUNIST PARTY IN 1990, CONTROLLING FOR EMPLOYED SHARES

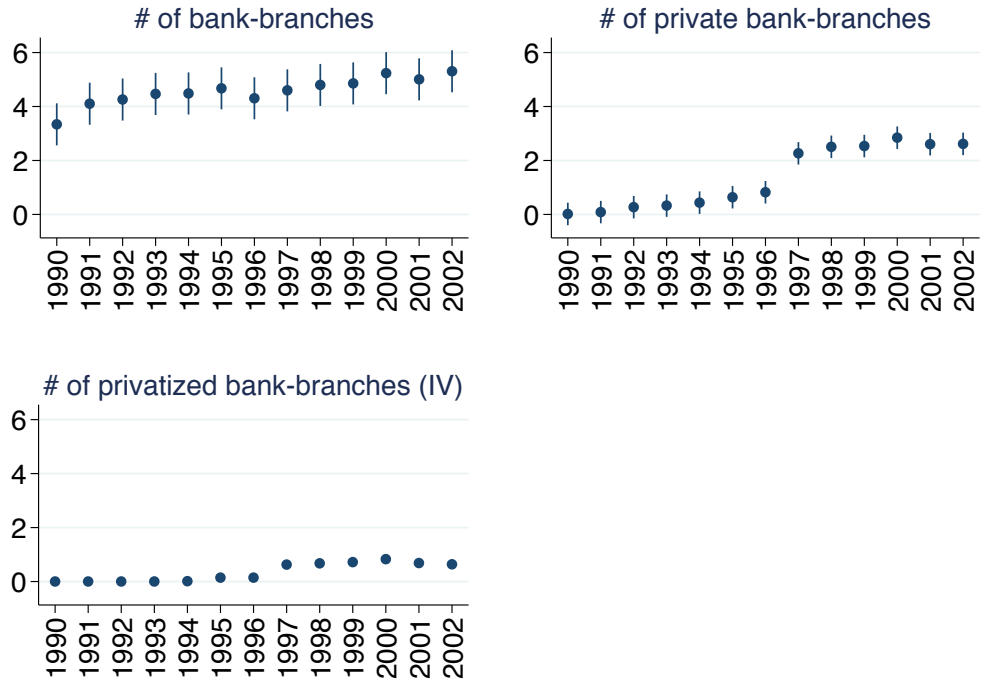
	Communist Party Voteshare in 1990	
	(1)	(2)
UE share by elem.sch.	0.106***	
	(3.29)	
UE share by vocat. sch.	0.0540	
	(0.81)	
UE share by high sch.	-0.0865	
	(-0.70)	
UE share by college	-1.441***	
	(-2.67)	
E share elem. sch.	0.00687	
	(0.83)	
E share voc. sch.	0.00753	
	(0.89)	
E share high sch.	0.000299	
	(0.03)	
ln(taxbase/capita)	-0.000479	0.00331
	(-0.07)	(0.46)
UE share by blue-collar		0.128***
		(5.57)
UE share by white-collar		-0.522***
		(-3.70)
E share blue-collar		0.00686*
		(1.77)
Constant	0.0292	0.00732
	(0.70)	(0.18)
Observations	1508	1328
state	Y	Y
municiptype	Y	Y

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the results corresponding to regression equation (14) with additional controls of employment share in a municipality by education. The sample is those municipalities for which the employment share is available.

FIGURE A.16: AVERAGE NUMBER OF BRANCHES ACROSS COUNTIES



Notes: These graphs show the average number of bank branches, private bank branches and privatized bank branches (IV) across counties, over time. The IV is defined in equations (17) and (18).

Table A.19: First stage regression

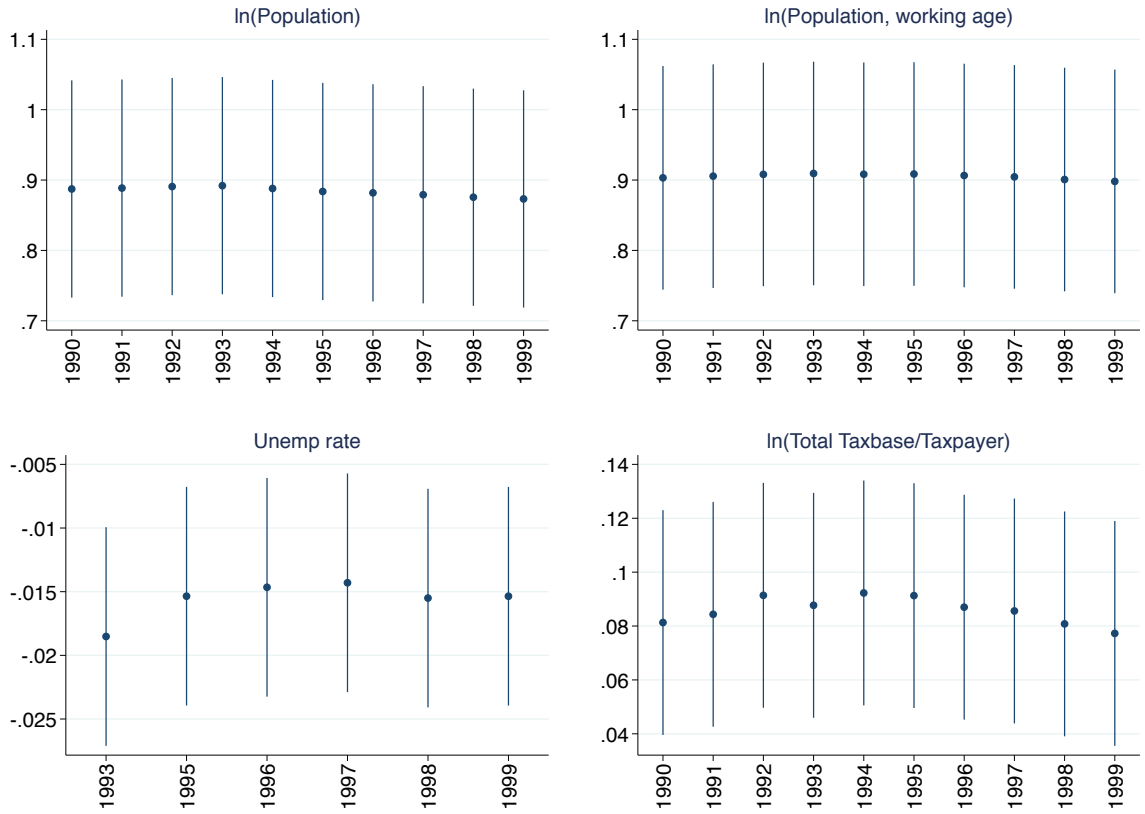
	(1)
	# private branches
# privatized branches	1.795***
	(11.62)
# branches	0.736***
	(9.61)
N	1392
County	Y
Year	Y
F	88.45
r2	0.924

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

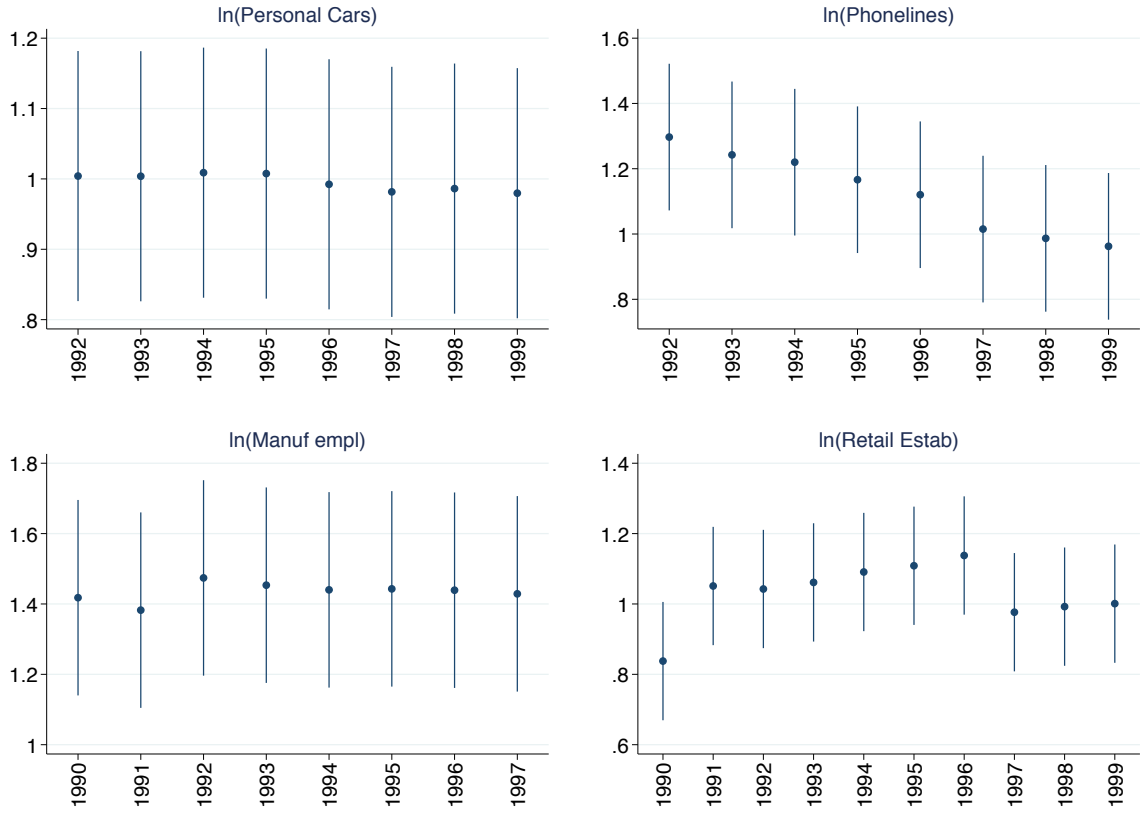
Notes: This table shows the results of the first stage regression, displayed in equation (20). The potentially endogenous variable is the # of private branches in a county, while the instrumental variable is the # of privatized branches among the set of branches which existed decades prior to the quasi-experiment. The instrument is defined in equations (17) and (18). The observation in this regression is a year-county pair.

Figure A.17: Treated relative to Untreated Counties I



Notes: This graph shows the β_t coefficients from the regression equation (19), where the left-hand-side variable is different across graphs and is indicated in the title. The treated counties are those counties which inherited a branch from the Central Bank of Hungary (CBofH) in 1987. The untreated counties are the ones which did not inherit a branch. The β_t coefficients displayed represent the extent to which the average treated county is different from the average untreated county in a given year. Treated status is constant across the whole time period.

Figure A.18: Treated relative to Untreated Counties II



Notes: This graph shows the β_t coefficients from the regression equation (19), where the left-hand-side variable is different across graphs and is indicated in the title. The treated counties are those counties which inherited a branch from the Central Bank of Hungary (CBofH) in 1987. The untreated counties are the ones which did not inherit a branch. The β_t coefficients displayed represent the extent to which the average treated county is different from the average untreated county in a given year. Treated status is constant across the whole time period. The number of retail establishment is differently defined between 1991 and 1996 which is why there are two jumps in the displayed series.

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