KOÇ UNIVERSITY-TÜSİAD ECONOMIC RESEARCH FORUM
WORKING PAPER SERIES

TRANSITION TO DEMOCRACY, REAL WAGES AND PRODUCTIVITY: THE TURKISH EXPERIENCE

Erol Taymaz
Ebru Voyvoda
Kamil Yılmaz

Working Paper No: 2111
July 2021

KOÇ UNIVERSITY-TÜSİAD ECONOMIC RESEARCH FORUM
Rumelifeneri Yolu 34450 Sarıyer/Istanbul

Transition to Democracy, Real Wages and Productivity: The Turkish Experience[#]

Erol Taymaz[*] METU
Ebru Voyvoda[**] METU
Kamil Yilmaz [***] Koç University

July 2021

Abstract

We analyze the behavior of plant-level real wages and productivity in Turkish manufacturing after the transition to democracy in 1987 and test whether wages under democracy causes productivity. The Turkish experience provides almost an experimental case: real wages in manufacturing increased by 120% in the 1987-93 period due to (exogenous) political changes, together with unprecedented total factor productivity and labor productivity growth. While these observations provide support for the "democracies pay higher wages" hypothesis, they also stimulate further evaluation of the consequences of such politically-motivated 'exogenous' wage hikes on economic performance. Our analysis shows that real wage hikes during the democratic transition forced firms to increase productivity to stay competitive. The findings also help explain why countries that undergo an orderly transition from autocracy to democracy may achieve rapid productivity gains.

***JEL Classification*:** D24, E24, J24, P16.
***Keywords*:** Democratic transition, Real wages, Total factor productivity, Labor productivity, Labor unions, Efficiency wages, Long-run growth.

Authors thank the Scientific and Technological Research Council of Turkey (TUBITAK) for financial support through Grant No. 106K050. This study is based on the data from the Turkish Statistical Institute's Industrial Analysis Data Base. The usual disclaimer applies.

* Erol Taymaz, Department of Economics, METU, Ankara, 06800 Turkey. etaymaz@metu.edu.tr.
** Ebru Voyvoda, Department of Economics, METU, Ankara, 06800 Turkey. evoyvoda@metu.edu.tr.
*** Kamil Yılmaz (corresponding author), Department of Economics, Koç University, Rumelifeneri Yolu Sariyer, Istanbul 34450, Turkey. kyilmaz@ku.edu.tr.

> The relationship between authoritarianism or democracy and development is not so simple. Authoritarianism is neither necessary nor sufficient for economic development. That it is not necessary is illustrated not only by today's industrial democracies but by scattered cases of recent development success: Costa Rica, Botswana, and now India. That it is not sufficient is amply evident from disastrous authoritarian regimes in Africa and elsewhere.
>
> Pranap Bardhan, *Financial Times*, August 22, 2008

I. Introduction

Two decades into the 21st century, there are still many countries ruled by autocratic regimes. China's rise to become the second-biggest economy and the world's manufacturing powerhouse and the rise of autocratic, populist governments in several developed and developing countries brought the question of 'democracy and growth' to the forefront of the economists' agenda. As the central pillar of the discussion/analysis focuses on 'whether the transition from non-democracy to democracy is conducive to economic growth,' it becomes crucial and urgent to understand the democracy-economic performance nexus. This is especially important in developing economies that are more prone to large swings in their political regimes.

To serve the purpose, democratization experiences of several middle and high-income developing countries in the last quarter of the 20th century provide ideal ground to test critical hypotheses and extract valuable lessons. Countries like Chile, South Korea (hereafter, "Korea"), Taiwan, and Turkey experienced democratic transitions in the late 1980s and early 1990s. One commonly observed economic consequence of these countries' democratization episodes has been the sharp increases in real wage rates. Democratization could empower the labor unions, which in return would push for increases in real wages that were kept under pressure during the autocratic regime. In addition, in a democratic rule, political parties may find it legitimate to promise wage increases to attract more votes at the ballot box. Whatever the causes are, the real wage hikes during the transition to democracy also provide a link between an orderly democratization process and rapid productivity gains during the transition period.

Rodrik (1999) provides an important contribution to the analysis of the consequences of transition in political regimes on wages and labor income share. Utilizing data to characterize episodes of transition from autocracy to democracy, and vice versa for a large group of countries between 1960-94, Rodrik's analysis strongly suggests that democracies are associated with higher wages and a significant factor share for labor (in manufacturing). Moreover, the causality runs from democracy to wages. Controlling for labor productivity, income levels, and other possible determinants, and based on evidence from instrumental variables and panel regressions with country fixed effects, Rodrik's

results support a robust and significant association between democratization and manufacturing wages.[1]

The implications of the featured impact of the democratic transition and the resulting increase in real wages on economic performance demand a `*further evaluation of the relationship between wages and productivity during the transition*.` Such a question is undoubtedly a crucial part of the analysis on `democratization and the consequent economic performance` where the literature is scant, often emphasizing heterogeneous experiences across countries and heterogeneous short-run and long-run impacts (Rodrik and Wacziarg 2005, Gerring et al. 2005, Persson and Tabellini, 2006, Acemoglu et al., 2019, Eberhardt, 2019).

One hypothesis regarding the economic consequences of the transition to democracy leading to higher wages would argue that *democratization introduces economic inefficiencies by raising real wages* (Rodrik, 1999). The response of employers and owners of capital during the transition process is crucial in shaping the economic consequences of democratization, fostering real wages. Here, the determinants of the wage bargaining process and the market and firm-level selection dynamics are critical in understanding the direction of causality in the relationship between real wages and productivity.

In this paper, we analyze the behavior of real wages and plant-level productivity in the Turkish manufacturing sector in the aftermath of the 'transition to democracy' in 1987. The Turkish experience provides an almost ideal experimental case to analyze the relationship between the transition to democracy, rising real wages, and productivity**.** The year marks a fundamental date in Turkey's experience of democratization, for it is the year of the first parliamentary elections following the lift of the ban of ex-political leaders, hence increased political competition. The ban on labor union activity was also lifted in 1987. However, the labor laws in place were still not labor-friendly, hence constrained the unions to represent the workers' interests thoroughly. In this respect, Turkey's experience contrasts with that of Chile, Korea, and Taiwan, where democratization followed the empowerment of the labor unions and civil society organizations.[2]

In the Turkish case, intensified political competition led the incumbent government to use state resources to gain the upper hand in general and local elections. One such move that directly affected the manufacturing industry was to increase public sector real wages. The private sector wages

[1] Acemoglu et al. (2015) replicates and extends the analysis in Rodrik (1999) by employing different democracy measures. Using Rodrik's original specification, they also find that democracies pay higher wages and the transition to democracy is associated with increased real wages. The authors also estimate the specification including the lagged dependent variable where they report the effect to become smaller and no longer statistically significant. Despite this finding, Acemoglu et al (2015) discuss that the democracies are associated with relatively rapid structural transformation, which may have ambiguous short-run and long-run effects on income distribution.

[2] Therefore, the experiences of Chile, Korea and Taiwan may suggest further evaluation of the two-way causality.

then followed suit in part due to the pressure from labor unions. Consequently, average real wages in manufacturing increased 120% within five years between 1987-93. However, the wage hikes did cause neither decline in business activity nor increased unemployment because productivity in manufacturing also increased at an unprecedented rate in the same period.

We estimate productivity for all ISIC 4-digit sectors using plant-level data for the 1983-2001 period. Real wages and productivity increased in all sectors (except for printing and publishing) during 1983-87. Our results show strong bidirectional causality: productivity causes wages, but wages also cause productivity. We further explore alternative mechanisms through which manufacturing plants achieved productivity improvements in response to wage increases: Substitution of factors of production, technology transfer, selection effects, and efficiency wage behavior. Our plant-level data further allow us to evaluate the wage-productivity relationship for different groups of manufacturing firms (state-owned, foreign, private domestic large, small and medium-sized). Therefore, we identify heterogeneities in wage and productivity dynamics and the resulting causal inferences in the period following the transition to democracy.

The paper is organized as follows. After this introductory section, the transition towards democracy is summarized in Section 2, and a descriptive analysis of wage and productivity growth was presented in Section 3. Next, we tested the hypothesis that wages caused productivity in Section 4 and presented the data on several mechanisms that link wages to productivity. Finally, section 5 concludes the paper.

II. Transition to Democracy and the Real Wages

A military regime was established in Turkey after the coup d'etat in September 1980. The military junta banned all political activities until the parliamentary election of 1983. Along with the approval of the new Constitution in a referendum in November 1982, Kenan Evren, who was the General Chief of Staff of the Turkish military at the time, was elected as the President for a seven-year term, and the top brass of the military regime became the Presidential Advisory Council. Thus, even though the Turkish Republic continued to be envisioned as a "parliamentary democracy," the 1982 Constitution increased the President's executive power.

Only three political parties were allowed by the military regime to participate in the 1983 parliamentary election. Parties that were banned after the coup and their leaders were not allowed to participate in the elections. Moreover, the military junta ensured that the newly established parties had no ties with the political parties of the pre-1980 period. Consequently, 1983-87 was a period of the military regime over which then-ex-generals had substantial institutional control over the government.

A careful review of the historical accounts shows the transition to democracy did not take place effectively until 1987.[3] During the military regime, including the 1983-87 period, labor unions were closed, and civil society organizations were kept under tight control. Before the elections, the military junta enacted two new laws governing industrial relations in May 1983.[4] The new framework constrained the labor unions' ability to pursue their objectives, such as improving the living standards of their members and banning all strikes. Consequently, the economy-wide real wages declined by 40% from 1980 to 1987.

The turning point in this process was the referendum of September 1987. As the military regime's clout has waned over time, the public became disillusioned with the incumbent Ozal government. It became more sympathetic towards the leaders banned from active political life by the military regime. It was challenging to keep charismatic politicians from active political life for a long time. Encouraged by a more sympathetic public opinion, these leaders and their supporters forced the Ozal government to call for a referendum to lift the ban on these leaders.

In the September 1987 referendum, the public approved the former political leaders' return to active political life with a small margin. However, after the referendum, the political competition intensified, and the incumbent Ozal government felt political pressure.

Although his party could hold on to its majority in the parliament, the opposition's strong showing in the elections was an unexpected result for Prime Minister Turgut Ozal. A new era had begun with intensified competition in political life. In only five years, from 1987 to 1992, the country had a snap parliamentary election in November 1987, municipal and local elections in March 1989, and another snap parliamentary election in October 1991. All the past promises and efforts to keep inflation under control had been forgotten. The public sector borrowing requirement (PSBR) doubled in 1987 and reached 8.3% of GNP. With the increased intensity of political competition, the incumbent party used government resources to garner support from different society segments. From 1987 to 1992, the real increase in wages and salaries in state-owned manufacturing plants reached 200%.

The transition to democracy and the resulting unconstrained political competition significantly impacted labor markets in Turkey. The manufacturing industry's real wage index[5] (1983=100) recorded a substantial increase from 86 in 1988 to 219 in 1993, a 155% increase over five years

[3] Rodrik (1999) undertakes a cross-section study of a group of countries with autocratic regimes that moved into democracy over time. In the case of Turkey, Rodrik (1999) takes 1983 as the year of transition from military rule to democracy. He chooses 1983 because, after the 1980 coup d'etat, the first parliamentary election took place in November 1983. However, a closer look at the recent Turkish history shows that it is not correct to call the 1983 general election free.

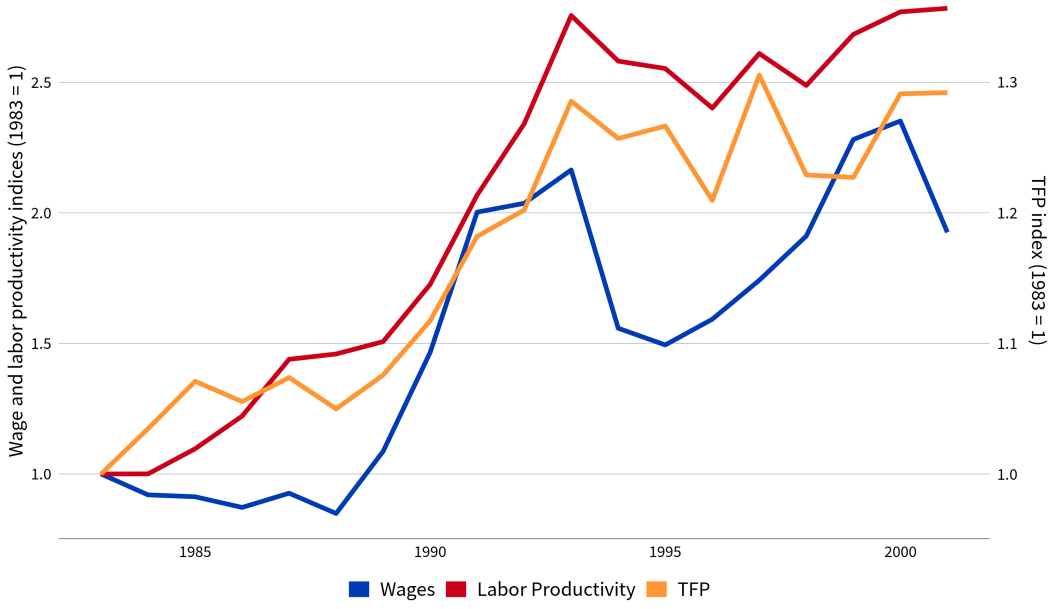
[4] These were the Labor Union Law No. 2821 and the Law on Collective Bargaining Agreement, Strike and Lockout No. 2822.

[5] "Real wages" or simply "wages" refer to real product wages, i.e., wages deflated by product prices (at the 3- or 4-digit ISIC level, 1994 base year).

(Figure 1).[6] A big chunk of the real wage increases took place between 1988 and 1991. Real wages continued to increase from 1991 to 1993 at a lower rate. The real wage rate declined substantially during and immediately after the 1994 economic crisis as the inflation rate reached above 100 percent per year.

Populist economic policy was not the only force behind the rapid wage hikes during this period. Another prominent factor was the increased activism among the labor unions. The 1982 Constitution and the new labor laws imposed severe restrictions on labor unions. Despite these restrictions, once the military regime ended permanently, the unions moved to make up for the workers' real income losses. Using industrial action, they pushed for higher wages, and in most cases, they secured them. Strike activity started to gather momentum in 1987. Approximately 2 million workdays were lost in 1987 and 1988. The number of lost workdays increased to about 3 million in 1989, 3.5 and 3.8 million in 1990 and 1991 (see Figure 2). The number of participating workers in the strikes increased slightly to 180 thousand in 1991 and declined sharply in 1992. Labor unions organized widespread strikes in 1995 following the 1994 crisis, but they failed to organize strikes afterward. Labor union membership and collective agreement coverage have declined almost continuously since the late 1980s until today.[7]

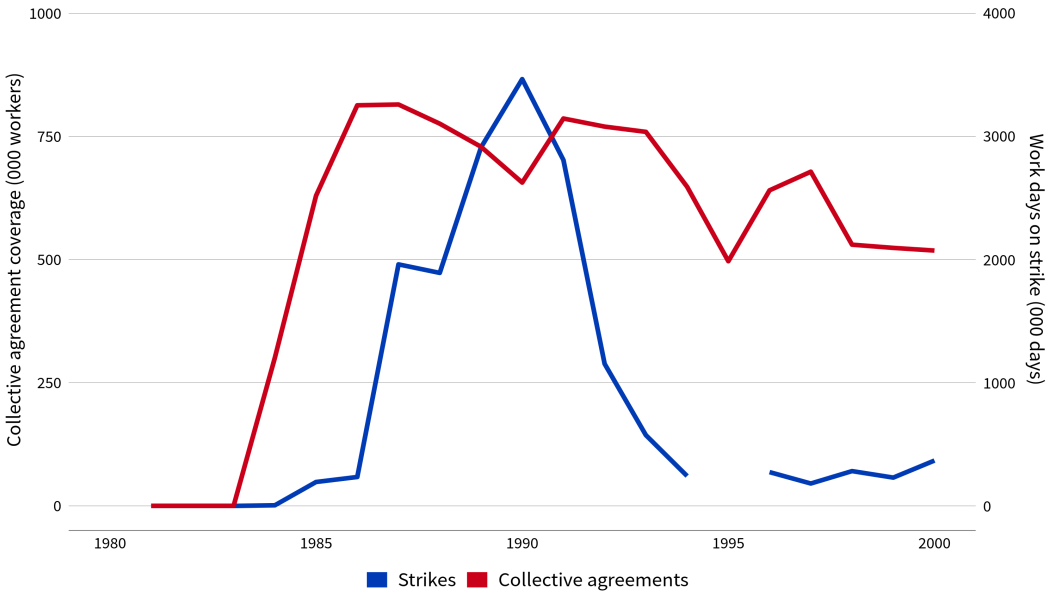
Figure 1. Indices of real wages, labor productivity, and total factor productivity in Turkish manufacturing (1983=100)



[6] Production functions were estimated for all ISIC Rev.2 4-digit sectors by using plant level data for the 1983-2001 period, total factor productivity levels were calculated for all plants on the basis of estimated parameters. For details, see the Appendix.

[7] Compared with the union activity in Korea that experienced a democratic transition of its own during the same period, the interruption to the manufacturing production was relatively low in Turkey. While in Turkey the number of workdays lost in strikes increased only gradually from 2 million in 1987 to almost 3 million in 1992, in Korea the working days lost reached 7 million in 1987 and stayed above 5 million for two more years, to decline gradually to over a million in the following three years (see ILO Statistics on work stoppages, https://ilostat.ilo.org/topics/work-stoppages/].

Figure 2. Strikes and workdays lost in Turkey, 1980-2000



Note: The number of days on strike reached 4.8 million in 1995 (not shown in the figure).
Source: Ministry of Labor and Social Security, Labor Statistics.

The transition to democracy in 1987 led to political competition and allowed labor unions to intensify their activities to push for higher wages and the compensation of the decline between 1980-87. Thus, *real* wages increased by 21 % *per year* in manufacturing industries in the successive "democratic" period (1988-93). The increase in real wages in state-owned enterprises was even higher (27 %). Manufacturing firms responded to wage hikes by productivity improvements: labor productivity increased at an unprecedented rate, on average, by 14 % *per year* from 1988 to 1992. TFP growth rate in the same period was also remarkable (4.1 %, see Figure 1). Unfortunately, this period was ended by the 1994 crisis caused by increasing public deficits and a series of policy "mistakes" (for details, see Ozatay, 2000).

The 1990s, described as the "lost decade" by researchers, is characterized by growing public deficit, high inflation, and increased uncertainty, eventually leading to crises in 1994 and 2001. As a result, real wages and productivity stagnated throughout the period. From peak-to-peak (1993 to 2000), real wages increased by only 1.2 % per year, whereas the growth rate of labor productivity and TFP was almost zero (0.1 %). Consequently, the Turkish economy was hit in 2001 by its worst crisis experienced since the Second World War.

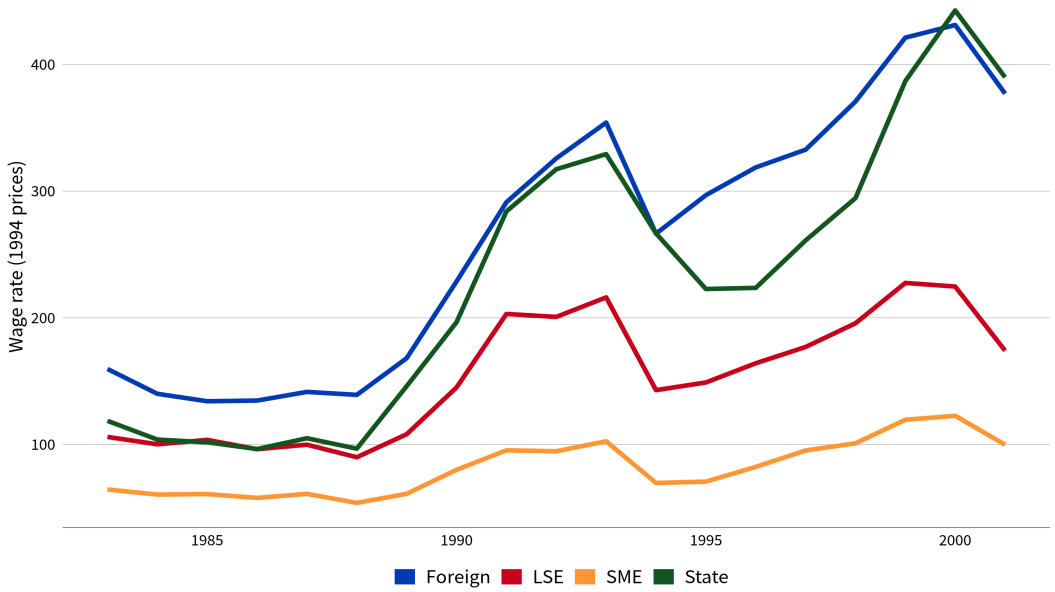
III. Real wages and productivity

This section studies the dynamics of wages and productivity for different categories of plants to understand if all firms had been affected in the same way.

We classify firms into four categories: state-owned, foreign, private domestic large scale, and private domestic small and medium-sized. Foreign firms are those where foreigners hold 10 % or more of the shares, LSEs employ 150 or more employees, and SMEs employ 10-149 employees. For the whole period (1983-2001), shares of state-owned, foreign, large, and small and medium-sized establishments were 3.6 %, 2.5 %, 9.3 % and 84.5 %, respectively, whereas their employments shares were, 20.5 %, 9.4 %, 39.3 %, and 30.8 %, respectively. Foreign establishments were, on average, slightly smaller than an average LSE.

As may be expected, foreign firms paid higher wages than domestic private firms throughout the period for which the data are available, partly because they employed more skilled workers (Figure 3). During the democratic transition period after 1987, real wages in all categories of firms increased rapidly. The highest increase was observed in state-owned enterprises (27.7 % per year from 1988 to 1992), followed by foreign firms (20.5 %) and LSEs (19.2 %). The growth rate of real wages was lower among SMEs than other firms, but it reached 13.7 % per year.

Figure 3. Real wages in Turkish manufacturing by firm size and ownership, 1983-2001

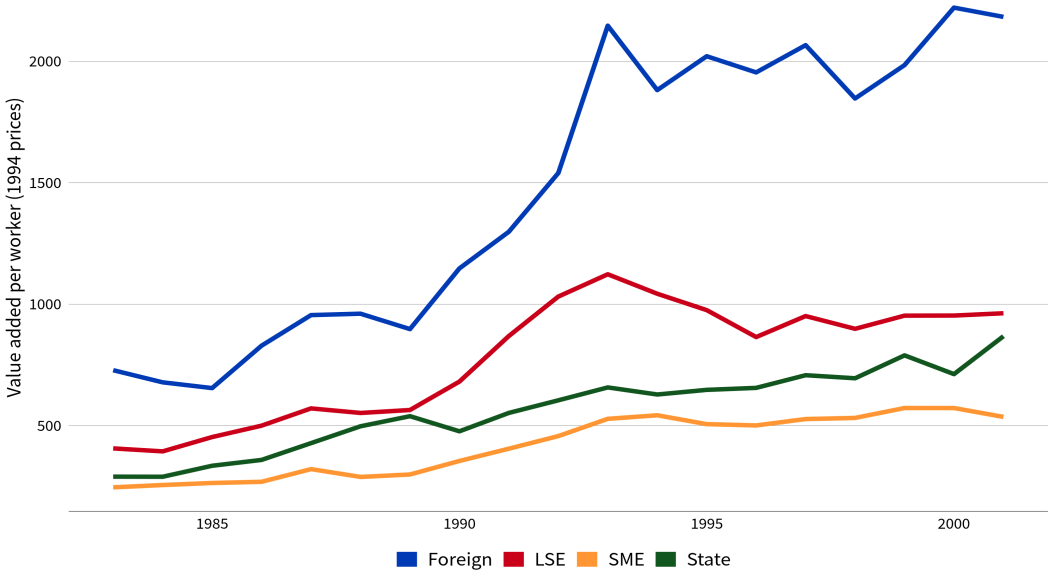


A closer look at Figure 3 reveals that state-owned firms were leading others in terms of the timing of wage hikes as well. These observations can be explained by the fact that political competition was intensified following the 1987 parliamentary election. Moreover, during the same period, labor unions intensified their activities and secured higher wages for the workers covered by collective agreements. The level of unionization was much higher in large firms than in small firms.

For example, in the early 1990s, the unionization rate was only about 20 % (30 %) for establishments employing 10-24 (25-29) workers, but it exceeded 65 % for those employing 100-249 workers and reached 95 % for the largest category employing more than 250 workers (Akkaya, 1992, cited in Mahiroğulları, 2001: 176.). During periods of rapid wage hikes driven by populist policies, the firms with more union activity, i.e., large firms, were likely to be affected more. In other words, consistent with the strong presence of the union activity, the average real wages increased faster (and earlier) in large plants than small ones.

In Figure 4, we plot the average labor productivity in four categories of firms in Turkish manufacturing. Again, as was the case with wages, foreign firms had higher labor productivity than domestic firms and large firms than small ones. This finding is common to almost all three-digit ISIC industries that are covered by Turkstat annual surveys.

Figure 4. Labor productivity in Turkish manufacturing by firm size and ownership, 1983-2001

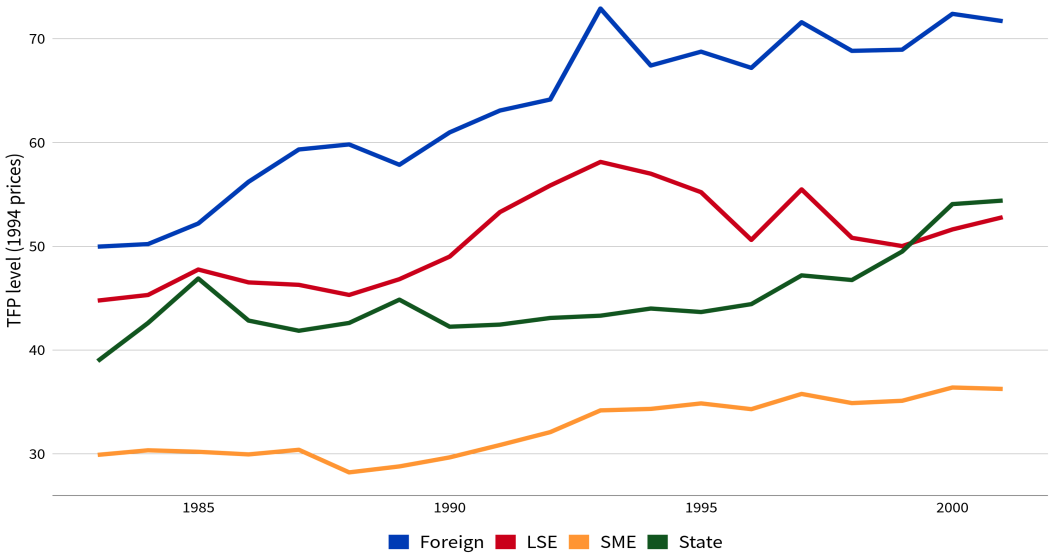


Although state-owned firms experienced faster growth in real wages in the 1988-1993 period, they achieved the lowest, though significant, growth in labor productivity: "only" 5.7 % per year. Average annual growth rates of labor productivity were 17.4 % and 15.3 % for foreign firms and LSEs, respectively, whereas SMEs' labor productivity growth rate was almost equal to their real wage growth: 12.8 %. Labor productivity grew at a meager rate (about 1 % per year) in state-owned establishments and SMEs, and it remained almost at the same level in foreign firms and declined somewhat in LSEs after its peak in 1993. In other words, real wages and labor productivity stopped growing in Turkish manufacturing after 1993.

Next, we present and discuss plant-level TFP in the manufacturing industry from 1983 to 2001 (Figure 5). TFP level of domestic firms was stagnant until 1988, while foreign firms achieved

relatively rapid TFP growth in the 1983-1988 period (3.7 % per year). Domestic firms' TFP increased rapidly following the wage hikes after 1988: LSEs' TFP increased 5.1 % per year from 1988 to 1993 and, after reaching its peak in 1993, declined considerably in the rest of the 1990s. SMEs achieved a rapid increase in TFP in the same period (3.9 % per year), but the growth rate declined to 0.9 % per year after 1993. Foreign firms also had a rapid increase in TFP (4.0 %) from 1988 to 1993, but they also share the same fate (no TFP growth) with domestic firms after 1993. Only the state-owned enterprises experienced TFP growth in the late 1990s, possibly due to the composition effect following the privatization of many state-owned enterprises in the 1990s.[8]

Figure 5. Total factor productivity in Turkish manufacturing by firm size and ownership, 1983-2001



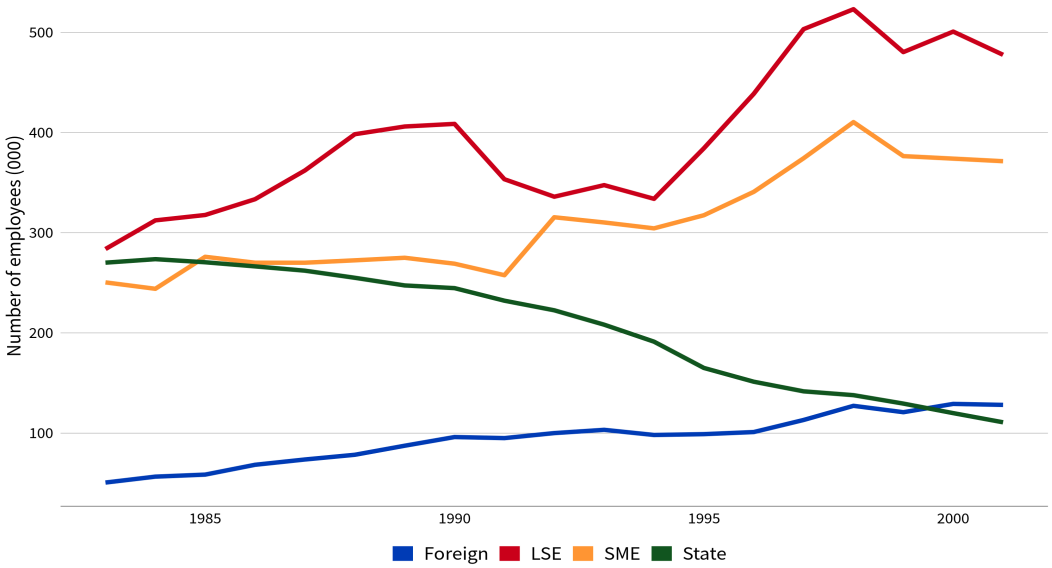
To understand the dynamics of productivity and its response to wage hikes during the transition to democracy, we present the data on employment level in Figure 6 because (labor) productivity could be increased by firing less productive workers and/or exit of less productive firms. Wage hikes of 1988-1993 did not cause a significant change in employment trends except for LSEs.

Employment in state-owned enterprises declined almost continuously because of scaling down in the 1980s and privatization in the 1990s. On the other hand, employment in foreign firms increased steadily from 1983 (51,000) to 2001 (128,000) thanks to foreign entry (the number of foreign firms increased more than three-fold in the same period). Employment in SMEs also had an upward trend until the late 1990s.[9]

[8] There were 404 state-owned enterprises in the dataset in 1983. It fluctuated around 400 in the 1980s and reached 428 in 1992 before dropping to 254 in 2001, following the privation of a large number of enterprises.
[9] SME employment had jumps in census years, 1985 and 1992, because some firms established before the census year were identified during the business census.

It seems that employment in LSEs had a negative impact due to wage hikes. LSEs experienced very high real wage increases in 1989, 1990, and 1991 (20 %, 34 %, and 40 %, respectively). Consequently, employment declined by 13.5 % in 1991 and 4.9 % in 1992. Following the sharp decline in real wages after the 1994 crisis, employment in LSEs bounced back 50 % from its lowest position in 1994 to its peak level in 1998. Apparently, LSEs had flexible employment relations and were able to adjust employment levels in either direction quickly.

Figure 6. Number of employees in Turkish manufacturing by firm size and ownership, 1983-2001

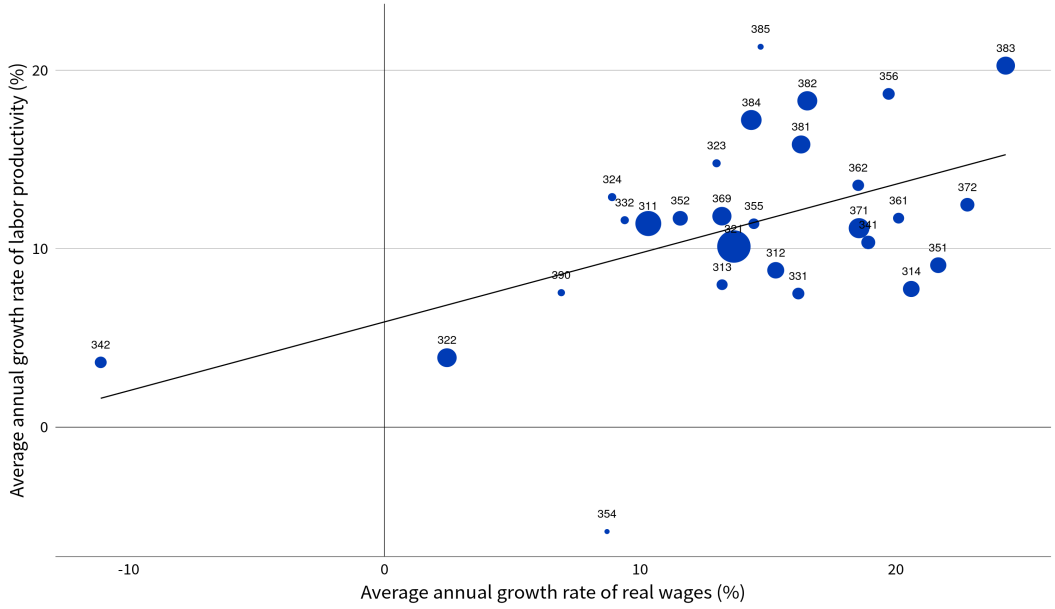


Our descriptive analysis indicates that real wages increased earlier and faster in state-owned enterprises and large firms after the transition to democracy due to populist policies and the labor union activity demanding higher wages. Firms of all sizes and types responded to wage hikes by increasing their productivity. Since growth rates of real wages varied significantly across sectors, sectoral data could provide additional insights on the relationship between wages and productivity.

The relationship between the average annual (log) growth rates of real wage rates (horizontal axis) and labor productivity (vertical axis) at the 3-digit ISIC Rev. 2 industries is reflected in Figure 7. The circle sizes are proportional to the number of employees in the sector. Except for printing, publishing, and allied industries (ISIC 342), real wages increased in all sectors.

As the real wage rate increases, labor productivity increases as well. The statistically significant slope coefficient of 0.39 shows that as the average real wage rate increases by 140 % from 1988 to 1993, labor productivity increases by 55 %. However, this linear regression result does not necessarily imply that causality runs from real wages to productivity. Therefore, we will test causality between real wages and productivity by using the data at the plant level in the next section.

Figure 7. Growth rates of real wages and labor productivity, 1988-1993
(3-digit ISIC Rev.2 sectors)



IV. Productivity and Real Wages: The Direction of Causality

A. Theories

The literature provides various theories that imply causal relations between productivity and wages. In its textbook version, the neo-classical theory predicts a strong relationship between wages and productivity in the short run. Under the assumptions of profit-maximizing firms, perfectly competitive labor markets, constant returns to scale, exogenous technology, etc., real wages should equate to the marginal product of labor (MPL). If the marginal product of labor increases by a technology shock, the wage rate will also increase by the same proportion. The share of wages in output will remain constant and be equal to the output elasticity of labor, i.e., wages are determined by exogenously given technology and productivity.

If wages are determined by a (Nash) *bargaining between labor (unions) and firms*, there will be a positive correlation between wages and productivity. In conventional bargaining models, the wage rate is a weighted average of (labor) productivity of the firm and the reservation wage (fallback wage or outside wage), where weights depend on workers' bargaining power. Thus, if productivity increases by an exogenous technology shock, the wage rate will also increase, given workers' bargaining power. If workers' bargaining power increases (due to changes in laws and regulations) or workers' reservation wage increases (due to changes in labor market conditions, such as the introduction of generous unemployment insurance), wages will increase even if there is no change in productivity.

The bargaining model suggests that the greater the union coverage is, the stronger is the correlation between productivity and wages. However, causality still runs from productivity to wages, as in the case of the standard theory. In the bargaining model, wages and productivity could increase together (so that there will be a positive correlation between wage and productivity growth) because of a third factor: labor union power. Increased union power would increase the bargaining power of workers and, hence, wages. In addition, unions may directly affect productivity growth through increased participation (the union "voice" effect), which will further increase wages (Barth, Bryson and Dale-Olsen 2020; Garnero, Rycx and Terraz 2020).

Several theories suggest that wages can also determine productivity in the short term or the long term. For example, the influential *efficiency wage theory* suggests that productivity depends on wages because higher wages induce employees to work harder or be more efficient (Shapiro and Stiglitz 1984).[10] A related theory on wages affecting productivity is the so-called *fair wage theory*. If workers consider their wages as 'fair, 'they work harder/more efficiently. 'Fairness' here could mean socially acceptable and/or relatively more equal wages. Thus, if wages increase above the subsistence level or become relatively more equal, productivity may increase (for empirical evidence on the effects of wage inequality on labor productivity, see Policardo, Punzo, and Carrera 2019).

Wages can enhance productivity also through *firm- and market-level selection effects*. The first response of the firms against wage rises is to stop their less productive activities so that the average productivity will increase in response to a wage rise. The selection effect may work at the market level, too, if wages are set centrally. Setting wages centrally will compress wage dispersion across firms, and wage compression from below would force less productive firms to become more productive or to exit from the market so that resources, including labor, will flow to more productive firms and industries. As a result, average productivity at the sectoral level will increase even if there is no productivity improvement at the firm level (Hibbs Jr and Locking, 2000).

Other things held constant, improvements in wages lead to an increase in the cost of production. The wage bill is an important component of variable costs. To keep the unit cost of production under control, firms need to increase productivity. They have several options available on hand. The first thing that comes to mind is reducing *X-inefficiencies* by restructuring and reorganizing production, distribution, and marketing activities (Leibenstein, 1966). Thus, a rise in wages would force firms operating in non-competitive markets to use existing resources more efficiently.[11]

[10] Applying causality tests on aggregate manufacturing data for six industrialized countries, Millea (2002) finds that wages causes productivity in a subgroup of countries with specific institutional arrangements that make workers more responsive to efficiency wages.

[11] Here, firms may reduce their costs also by employing l*abor informally*, or relying on *subcontractors* for inputs because, subcontractors are likely to be small firms that may employ informal labor (Taymaz and Kiliçaslan, 2005).

There is also burgeoning theoretical literature that analyzes the possible link between wage rate and productivity-enhancing activities such as process innovation. Doms, Dunne, and Troske (1997) relies on the complementarity between technology and skills to explain that plants with large workforces are more likely to adopt new technologies: Wages are positively related to workforce skills that allow new technologies to be adopted at lower costs. A related strand of the literature argues that higher wages induce firms to invest in labor-saving technologies like mechanization and automation.[12] In a dynamic factor demand model, Mohnen et al. (1986) find that the long-run wage rate elasticity of R&D is reasonably large. Also, Flaig and Stadler (1994) emphasize the dynamic impact of wages on R&D and innovation behavior. As firms anticipating innovations, higher wages may lead to higher productivity in the long term (for dynamic monopoly and oligopoly models, see Bester, Milliou and Petrakis 2012; Bester and Petrakis 2004).

Finally, a general rise in wages can increase productivity under specific market conditions through the demand channel. For example, under the conditions of lower capacity utilization, a general rise in wages will increase the aggregate demand, which will lead to an increase in capacity utilization rates and, hence productivity growth.

B. Estimation results on causality

Our analysis of the causality between real wages and productivity relies on the Granger causality test in a panel data environment. Granger causality is used mainly in a time series framework, and we apply it to our panel data. First, we regress productivity on its lag and the lagged real wage rate and test whether the lagged real wage rate coefficient is statistically significantly different from zero. Similarly, we regress the real wage rate on its lag and the lagged productivity term and test whether the lagged productivity term's coefficient is statistically significantly different from zero.

As the rate of increase in wage rate and the plant-level response may differ across sectors, we apply the Granger causality test to each 3-digit ISIC industry using data for private plants for the 1987-93 period. We first test causality between labor productivity and wages (presented in the first part of Table 1), followed by the causality between TFP[13] and wages (the second part). For each relationship, we regress the productivity term on its first lag (LP_{-1} or TFP_{-1}) and the first lagged plant-level real wage rate ($Wage_{-1}$, all in logarithms) as well as year-fixed effects and wages similarly. A statistically significant coefficient of the lagged wage variable in the productivity equation shows that real wages cause productivity in that sector. Table 1 presents the data for estimated coefficients and their significance levels for 28 3-digit industries.[14]

[12] Chennells and Van Reenen (1997) conclude from their analysis of British plant data that this substitution effect may be an important factor.

[13] TFP values are calculated for each plant-year based on production functions estimated. Production functions are estimated for all 4-digit ISIC industries by using the Wooldridge method. For details, see Appendix.

[14] Because of the lack of sufficient number of observations, petroleum refineries (ISIC 353) sector is not included.

Estimation results for labor productivity regressions show that the lagged wage variable has a positive and statistically significant coefficient (at the 5% level) in all sectors. Thus, based on this estimate, we cannot reject the hypothesis that causality runs from wages to labor productivity.

Table 1. Granger causality test results (1987-93)

Sector	Between labor productivity and wages				Between total factor productivity and wages			
ISIC	LP equation		Wage equation		TFP equation		Wage equation	
code	$Wage_{-1}$	LP_{-1}	$Wage_{-1}$	LP_{-1}	$Wage_{-1}$	TFP_{-1}	$Wage_{-1}$	TFP_{-1}
311	0.214**	0.514**	0.752**	0.0277**	0.0516**	0.569**	0.761**	0.0737**
312	0.114**	0.495**	0.748**	-0.0435**	-0.0104	0.769**	0.746**	-0.106**
313	0.409**	0.644**	0.830**	0.0660**	0.174**	0.624**	0.836**	0.140**
314	0.309*	0.0439	0.685**	-0.0473**	0.0544	0.589**	0.549**	0.0195
321	0.269**	0.588**	0.811**	0.0267**	0.102**	0.677**	0.793**	0.117**
322	0.207**	0.533**	0.680**	0.0307**	0.0886**	0.635**	0.650**	0.120**
323	0.303**	0.390**	0.750**	0.0359*	0.0496**	0.685**	0.764**	0.0316
324	0.365**	0.505**	0.763**	0.0234	0.132**	0.452**	0.808**	-0.0432
331	0.349**	0.531**	0.831**	0.0517**	0.113**	0.528**	0.800**	0.227**
332	0.489**	0.367**	0.750**	0.0347*	0.122**	0.318**	0.769**	0.0463
341	0.351**	0.581**	0.872**	0.0462**	0.0650**	0.826**	0.844**	0.110**
342	0.292**	0.601**	0.797**	0.0683**	0.0819**	0.636**	0.820**	0.105**
351	0.299**	0.540**	0.600**	0.101**	0.0876**	0.785**	0.522**	0.337**
352	0.445**	0.490**	0.873**	0.0523**	0.110**	0.640**	0.884**	0.107**
354	0.203*	0.720**	0.865**	0.0215	0.0703*	0.766**	0.798**	0.193**
355	0.533**	0.490**	0.819**	0.0789**	0.145**	0.674**	0.795**	0.224**
356	0.359**	0.445**	0.723**	0.0611**	0.0980**	0.557**	0.712**	0.226**
361	0.477**	0.618**	0.875**	0.0492*	0.220**	0.657**	0.842**	0.131**
362	0.319**	0.645**	0.931**	0.0325	0.172**	0.717**	0.856**	0.165**
369	0.541**	0.487**	0.797**	0.0747**	0.202**	0.681**	0.740**	0.192**
371	0.319**	0.587**	0.824**	0.0521**	0.0952**	0.671**	0.806**	0.179**
372	0.483**	0.489**	0.852**	0.0634**	0.147**	0.543**	0.832**	0.264**
381	0.424**	0.465**	0.787**	0.0700**	0.146**	0.579**	0.782**	0.198**
382	0.406**	0.442**	0.834**	0.0552**	0.158**	0.573**	0.816**	0.169**
383	0.436**	0.499**	0.834**	0.0698**	0.123**	0.705**	0.849**	0.127**
384	0.363**	0.539**	0.807**	0.0678**	0.154**	0.538**	0.786**	0.214**
385	0.397**	0.521**	0.822**	0.0737**	0.129**	0.517**	0.860**	0.0796
390	0.382**	0.525**	0.789**	0.0421**	0.119**	0.630**	0.795	0.112**

Note: ** (*) means statistically significant at the 1% (5%) level, two-tail test.
All models include year fixed effects.

The highest coefficient for the lagged wage variable is estimated for the non-metallic minerals industry (0.54) and the lowest one for animal feed (0.11). The average value of the lagged wage variable for all sectors in the labor productivity equation is equal to 0.36, i.e., a 10 % increase in the wage rate causes a 3.6 % increase in labor productivity in the short run (in one year)[15]. These estimation results show that wages have a substantial effect on labor productivity even in the short term.

[15] The share of wages in value added was about 20 % in the same period. Therefore, given these estimated values, an increase in wages does *not* reduce profits (valued added *minus* wages).

The coefficient of the lagged labor productivity variable in the wage equation is positive and statistically significant in 24 out of 28 sectors, and its average value is 0.05. In other words, an increase in labor productivity causes a rise in the wage rate, but the effect is relatively small: A 10 % increase in labor productivity leads to only a 0.5 % increase in wages.

Causality tests between TFP and wages provide additional evidence for the hypothesis that an increase in wages causes productivity growth. In all but two sectors (animal feeds and tobacco), wages cause TFP, and the average value of the lagged wage variable in the TFP equation is 0.11, i.e., a 10 % increase in the wage rate leads to 1.1 % in output given the same level of all inputs. On the other hand, TFP causes wages in all but four sectors (animal feeds, tobacco, footwear, and furniture), and the average value of the coefficient of the lagged TFP in the wage equation is 0.13. Thus, a 10 % increase in TFP leads to a 1.3 % increase in the wage rate in the short run.

Results on the effects of wages on labor productivity and TFP are pretty consistent. If wages increase, as explained above, firms will attempt to increase their productivity through various adjustments. For example, firms may increase their capital and/or input intensity (which means higher capital-labor and input-labor ratios) by switching towards capital-intensive techniques or lowering employment. In either case, labor productivity may increase even without any increase in TFP. In other words, in response to an increase in wages, labor productivity grows faster than TFP, a result obtained in all sectors.

C. Mechanisms of causality

Our empirical analysis shows that wages caused productivity growth in Turkish manufacturing in the 1988-1993 period, but it is silent about the mechanisms through which wages affect productivity. Therefore, this section will focus on some plant-level characteristics that could shed light on how manufacturing plants achieved productivity improvements in response to real wage hikes.

We summarized theories that may explain the productivity-enhancing effects of wages in the short and long run in section IV.A. The empirical analysis reveals short-run run effects are economically and statistically significant, and the period under investigation is only five years. For that reason, in our analysis, we focus on short-run effects.

During the period of wage hikes (1988-1993), the number of manufacturing plants increased to some extent (about 10 %). However, the manufacturing industry did not create new employment, and the total number of employees remained almost constant during this period. Although total employment did not change much, there seems to be a reallocation of labor from state-owned enterprises and LSEs towards foreign firms and SMEs (see Figure 6).

An economy-wide wage hike could speed up the selection process at both firm and market levels, i.e., resources, including labor, would be reallocated towards more productive firms within the

market and activities within the firm. At the market level, when the selection process eliminates less productive firms, the remaining firms would be more homogeneous. We use the standard deviation of log wages, log labor productivity, and log TFP as a simple measure of homogeneity. It seems that all these three variables declined slightly from 1988 to 1993, indicating homogeneity in manufacturing increased to some extent, but the degree of change is minimal (Table 2). We also calculated the shares of entry and exits in total employment each year. In the 1983-1987 period, the entering firms accounted for 4.00 % of total employment in a year, and employment loss due to exits was 3.38 %. During the period of wage hikes (1988-1993), entry and exit shares were 4.12 % and 3.19 %, respectively. These results show that the selection process at the market level played a limited role in raising aggregate productivity.

Table 2. Main economic variables, 1983, 1988 and 1993

	1983	1988	1993
Number of plants	9247	9308	10562
Number of employees (000)	855	1004	969
VA per worker*	342	499	942
W/VA ratio (%)	29.6	17.2	23.2
VA/Q ratio (%)	33.1	35.6	40.9
SD of log real wages	0.77	0.69	0.67
SD of log labor productivity	1.05	1.05	1.00
SD of log TFP	0.73	0.71	0.67
Exit share in employment (%)**	3.38	3.19	
Entry share in employment (%)**	4.00	4.12	
Subcontract input share (%)	1.76	2.37	3.36
Subcontract output share (%)	2.40	2.71	4.14
Technology transfer share (%)	7.5	7.9	10.0
Skilled labor share (%)	21.3	20.9	22.6
Capacity utilization rate (%)***	74.3+	76.7	79.5
Capital intensity (K/L ratio)	43	57	80
Energy intensity (E/L ratio)*	59	72	88
Input intensity (M/L ratio)*	563	821	1281

* 1994 prices
** Period average (1983-87 and 1988-93)
*** Ministry of Development, Main Economic Indicators (2007-2015)
\+ 1984 data (production weighted)

There is no data available about the flows of hiring and firing of workers and the age composition of the workforce. However, the share of skilled employees (administrative personnel) in the total workforce increased by 1.7 percentage points from 1988 to 1993. Given that total employment did not change, the increased share of skilled employees could indicate that the selection process at the firm level also had a limited role in raising productivity.

Another dimension of the selection process is related to informality and subcontracting. Although the data shows that manufacturing employment did not increase in the 1988-1993 period, firms could employ informal labor to reduce their wage costs. In such a case, the growth rate of labor productivity would be overestimated. However, the informality effect could be limited because

informal employment is very low in LSEs that experienced a higher productivity growth rate than SMEs.[16]

Plant-level response to rapid real wage increases may also take the form of an increase in the use of subcontracted inputs. While the average subcontracted input share (in total intermediate inputs) was almost 2.37 % in 1988, this share increased to 3.36 % in 1993. Similarly, the share of production subcontracted by parent firms increased from 2.71 % to 4.14 %. Since the increase in subcontracted input and output shares were still too low, their effect on productivity growth is likely to be small as well.[17]

Firms would consider substituting capital (and other inputs) for labor in the wake of real wage hikes. As shown in Table 2, capital, energy, and input intensities increased considerably during the 1988-1993 period. Still, the increase in these variables is part of a long-term trend, not a short-term response specific to that period. For example, capital, energy, and input intensities increased 5.8, 3.9, and 7.9 % per year in the 1983-1988 period, and their growth rates were slightly higher in the 1988-1993 period (6.9, 4.2, and 9.3 %, respectively). It is possible that wage hikes increased the speed of factor substitution to some extent, and factor substitution could explain why labor productivity responded more than TFP because substituting other production factors for labor could increase labor productivity but not TFP.

X-inefficiency theory suggests that factors of production are not efficiently used, especially in non-competitive industries, and a wage shock forces firms to be more efficient. The data on capacity utilization rates (CURs) provide some support for this theory. Turkey experienced a balance of payments crisis in 1979 and 1980. The CURs recovered in the first half of the 1980s thanks to growing domestic demand and reached their long-term average around 1988. However, the CURs further increased to their above-average level in 1993 (79.5 %) in response to wage hikes. The increase in CURs explains part of the rapid increase in energy and input intensities in the same period.

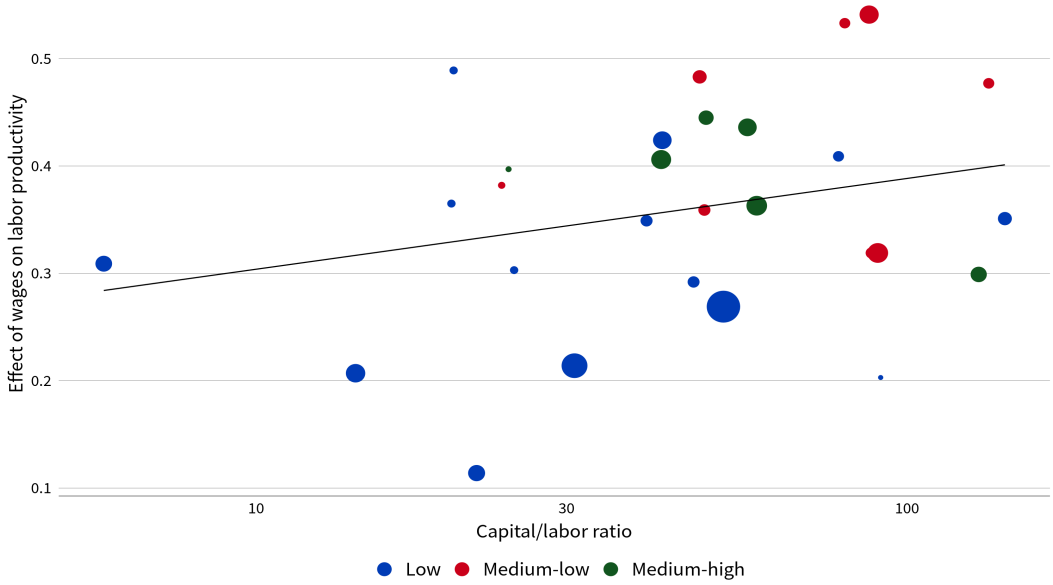
Although we do not analyze long-term factors, it is interesting to note an increase in the proportion of firms that transferred technology from abroad in the 1988-1993 period ("Technology transfer share" row in Table 2). While 7.9 % of firms had technology transfer agreements in 1988, that ratio increased to 10 % in 1993. There were two factors behind this trend. First, the number of foreign firms increased in this period, and a foreign firm is five times more likely to transfer technology than a

[16] The Labor Force Surveys provide the data on the extent of informal employment by firm size but unfortunately, they are not available for the 1980s. In the mid 2000s, the share of informal employment was above 50 % in manufacturing firms employing less than 10 people, but it becomes less than 10 % for those employing more than 50 people (Taymaz, 2009).

[17] Among 3-digit ISIC industries, the textile and wearing apparel industry makes the most use of subcontracting to procure inputs. In this sector, the average subcontracted input share increased from 3 % in 1984 to slightly over 6 % in 1993 and stayed, more or less, constant afterwards.

domestic firm. Second, the tendency to transfer technology from abroad increased from 38 % to 43 % among foreign firms and from 9 % to 10 % among LSEs.

Figure 8. Capital intensity and significance of wages for productivity



Finally, the relevance of wages for productivity is related to capital intensity and technological intensity. Figure 8 presents the correlation between the size of the wage coefficient estimate in the labor productivity equation as a measure of the importance of wages for labor productivity and capital intensity. Each circle represents an ISIC 3-digit sector, and the size of the circle is proportional to the number of employees in 1988. Capital/labor ratio refers to the sectoral capital/wage bill ratio in the same year[18]. Sectors are classified as low, medium-low, and medium-high technology, following Galindo-Rueda and Verger (2016).

It seems that there is a weak positive correlation between the significance of wages for labor productivity and capital intensity at the sectoral level: the higher the capital intensity, the higher the increase in labor productivity in response to a unit increase in real wages. The correlation is statistically significant at the 13 % level. The correlation becomes statistically significant at 3 % when TFP is considered instead of labor productivity. Technology intensity, on the other hand, does not seem to affect the wage-productivity relationship.

A sudden, exogenous, and sharp increase in wages after the transition to democracy led to a quick and substantial increase in (labor) productivity through the intensification of work in all types of (private) firms. The analysis on possible mechanisms that link wages to productivity indicates that a number of factors could explain how productivity increased in response to wage hikes: selection processes at the market and firm-level, subcontracting, the substitution of labor by other factors of

[18] We also checked capital/number of employees ratio but the results were almost the same.

production, and the X-inefficiency all played a role, but their impact is likely to be small compared to the size of the increase in labor productivity and TFP. Thus, we tend to conclude that the efficiency wage theory could explain most of the story.

D. Robustness checks

We have carried out several checks to assess the robustness of our main finding that wages had caused productivity in the 1988-93 period in Turkey. Our primary model is based on observations for all private establishments in the 1988-93 period. Granger causality tests were performed for all 3-digit ISIC sectors using two different productivity measures: Labor productivity (real value-added per employee) and TFP values based on Wooldridge estimates (Table 1). Causality test results for labor productivity and TFP were summarized in the first two rows of the first part of Table 3. We run the same sets of tests using TFP values obtained from different production function estimation methods and for different firm groups.

Production function estimation method: Production functions for all 4-digit ISIC sectors were estimated by using four different methods, Wooldridge (WRDG), Levinsohn and Petrin (LP), Olley and Pakes (OP), and system-GMM (for details, see the Appendix). Causality tests based on other production function estimations methods are summarized in the first part of Table 3. LP, OP, and WRDG results are pretty similar: Causality runs from wages to TFP in 26 out of 28 sectors. On the other hand, the system-GMM methods produce slightly different results; causality from wages to TFP is supported in 23 sectors only. Nevertheless, the average value of the coefficient of the lagged wage variable in the TFP equation is quite similar (between 0.091 and 0.114) in all estimates. Interestingly, when other methods are used, statistical support for causality from TFP to wages was obtained in a fewer number of sectors, and the average value of the coefficient of the lagged TFP variable in the wage equation gets smaller.

Categories of firms: The baseline causality tests were performed using data for all *private* firms operating in the 1988-93 period. Causality tests were run for all firms (including state-owned enterprises) for labor productivity and TFP measures (see rows "All firms" in Table 3). For labor productivity, causality is observed in 26 sectors (instead of 28 sectors with private firms only), and the average coefficient of the lagged wage variable is slightly lower. There is not much change in the case of TFP.

Because of entry and exit, the causality tests are conducted using unbalanced panel data set. Test results could be affected by the fact that entry and exit are not random. Causality tests were run for only a balanced sample for the 1988-1993 period, i.e., only those firms that existed throughout the period were used in causality tests (see row "Balanced panel"), and the results are almost identical.

Table 3. Robustness checks

	Sectors with positive coefficient				Coefficient (average)			
	Prod eq		Wage eq		Prod eq		Wage eq	
	W→P	P→P	W→W	P→W	W→P	P→P	W→W	P→W
Private firms								
Labor productivity	28	27	28	24	0.359	0.511	0.774	0.052
TFP (WRDG)	26	28	28	22	0.114	0.626	0.760	0.145
TFP (LP)	26	28	28	20	0.094	0.562	0.795	0.081
TFP (OP)	26	28	28	15	0.093	0.508	0.798	0.062
TFP (System-GMM)	23	25	28	8	0.091	0.259	0.824	0.021
Labor productivity estimates								
Baseline (all private)	28	27	28	24	0.359	0.511	0.774	0.052
All firms	26	28	28	24	0.305	0.550	0.774	0.052
Balanced panel	26	27	27	20	0.369	0.510	0.789	0.043
Post-1994 period	28	28	28	25	0.312	0.554	0.746	0.068
4-digit sectors	57	59	61	46	0.353	0.481	0.769	0.051
TFP (WRDG) estimates								
Baseline (all private)	26	28	28	22	0.114	0.626	0.760	0.145
All firms	26	28	28	22	0.105	0.644	0.779	0.134
Balanced panel	25	28	27	20	0.124	0.642	0.779	0.126
Post-1994 period	26	28	28	27	0.123	0.584	0.748	0.156
4-digit sectors	54	60	61	45	0.113	0.572	0.764	0.145

Note: There are 28 3-digit and 61 4-digit sectors.

The period analyzed in this paper (1988-1993) is a period of rapid wage and productivity increases, while wild fluctuations and poor growth characterize the post-1994 period. Causality test was run for the 1994-2000 period to check if wage-productivity causality is specific to certain political-economic conditions (see the row "Post-1994 period"). Neither the number of sectors with statistically significant causality between wages and productivity nor the average coefficient change in the post-1994 period, i.e., wages cause productivity even when the growth rate of wages is low.

Finally, causality tests were run at the ISIC 4-digit level to account for inter-sectoral differences in causality dynamics (the rows "4-digit sectors"), but there was no qualitative change in our findings.

The battery of tests conducted here provides strong evidence supporting the hypothesis that there is a bi-directional causality relation between wages and productivity. If productivity increases, wages will also increase, but wage increases also cause a significant increase in productivity.

V. Conclusion

The coup d'etat of September 1980 led to a break in democratic rule in Turkey. Seven years later, the general elections resumed, and the country went back to unhindered democracy in 1987. Utilizing plant-level data for 1983-2001, we analyze the behavior of real wages and productivity in Turkish manufacturing following the transition to democracy. As the Turkish experience provides an almost

ideal experimental case, our aim here is to understand the impact of the political shift on real wages and to evaluate the mechanisms of the bi-directional relationship between wages and productivity.

We have several important findings to report. Our descriptive analysis indicates that from 1988 to 1993, the average real wage rate in the Turkish manufacturing industry increased by 120%. The real wage hikes started first in the public sector, followed by the private sector. We discuss that populism and increased activity of the labor unions were the most critical factors that led to the rapid growth of real wages during the transition to democracy.

The same period was also marked with unprecedented TFP and labor productivity increases in the manufacturing industry, albeit with a one-year lag. After a careful evaluation of the impact of other factors, we hypothesize that real wage increases forced firms to implement strategies to elevate their productivities to competitive levels. Our econometric analysis indicates a robust and significant causal relationship between real wages and productivity (both labor and total factor productivity) for almost all sectors of the Turkish manufacturing industry. When real wages increase, firms attempt to increase their productivity through various adjustments. This result does not change when we control for increased import penetration over the same period.

We further explore possible mechanisms of causality, the means through which firms respond to rising wages. The analysis of investment behavior for different plant-size groups shows that investment-per-worker increased (with a lag) during rapid wage hikes. There was also increased reliance on subcontracted inputs, albeit less intensively. Our investigation on firm and industry-level effects shows that the selection process played a limited role in raising productivity at the industry level. Substitution effects and X-inefficiency factors also play relatively minor roles in the sizeable labor productivity and TFP increases. Therefore, we argue that the efficiency wage behavior was the most likely mechanism at work, especially for private firms passing the effects of real wage increases on productivity.

Our estimation results provide strong empirical support to the hypothesis that wages Granger-cause productivity. Transition to democracy, especially after a period of wage repression, as in the "near experimental" case of Turkey, provides conditions for exogenous wage increases. Political competition, participation in political activities, and labor union activity are among the crucial mechanisms that led to wage increases followed by faster productivity growth under democracy.

Appendix: Data sources and production function estimation

We use a data set collected by the Turkish Statistical Institute (Turkstat) for the Turkish manufacturing industry throughout the study. Turkstat conducted the Annual Surveys of Manufacturing Industries (ASMI) for all private establishments with ten or more employees and all public establishments for 1981-2001. In addition, it conducted the Census of Industry and Business Establishments (CIBE) for all establishments in 1980, 1985, and 1992 only. The CIBE provided the population of establishments for the subsequent ASMIs. Moreover, Turkstat added new establishments to the survey population by using the entry data from the Chamber of Industry.[19] For this study, we use data for the 1983-2001 period because sectoral price indices are available since 1983. There are about 10,000 plants in a given year.

"Establishment" is the statistical unit. Establishment (or "plant") is defined in the survey as a functional and decision-making unit that operates at a single location. All data, including the accounting data, are collected at the establishment level. Since most of the firms had only one establishment during the period under consideration, the terms "firm," "plant," and "establishment" are used interchangeably.

The data is well suited for our purposes because it contains information on variables commonly used to estimate firm-level production functions. Specifically, the dataset covers production, sales, employees, material inputs, electricity, fuels, investment, and depreciation values.

Output is measured by total output (sales + increases in output inventories) at constant 1994 prices. All deflators are obtained from Turkstat at ISIC 4- or 3-digit level. Four categories of inputs are used: capital (K), labor (L), energy (E), and raw materials (M). The "capital" input is defined theoretically as the services of capital goods in value terms. Since the data for capital services and the replacement value of fixed assets are not available, we use a proxy variable, depreciation allowances deflated by capital goods price index (the base year 1994), to measure the "capital" input. We also experimented with calculating the capital stock at the plan level using the perpetual inventory method, but the results were similar. The labor input (L) is measured as the total number of employees. Energy (E) is measured as the value of fuel and electricity consumption at 1994 prices. Finally, the raw materials variable (M) is measured as the expenditures on inputs (raw materials, supplementary materials, packaging materials, etc.) adjusted for stock changes and deflated by sector-specific input price deflators (at 1994 prices).

TFP estimates are based on Cobb-Douglas production function defined as follows:

[A1] $$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_e e_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it}$$

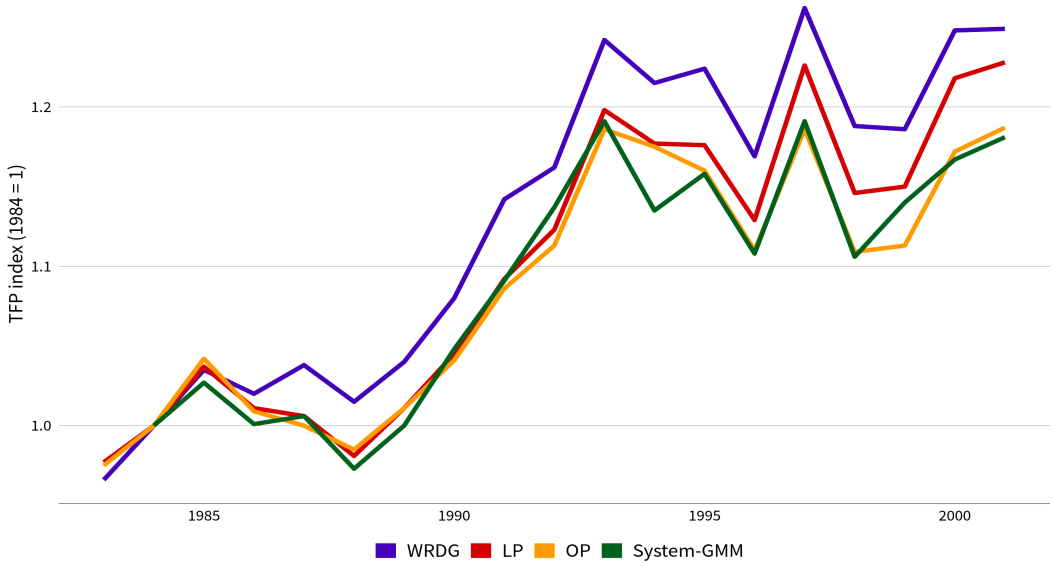
[19] Thus entry can be observed in every year of the data. We observe a larger number of "new" plants at CIBE years because those that were not included in the Chamber of Industry data were identified at the Census.

where *y, k*, *l*, *e*, and *m* are output, capital, labor, energy, and raw materials, respectively, all in log form. ω is the firm-specific total factor productivity component in log form, and η is the i.i.d. error term. Subscripts *i* and *t* denote firm and time, respectively.

The productivity term, ω, is not observed by the econometrician. Still, it is known by the firm manager so that the manager can adjust some inputs after observing the productivity term at time *t*. This phenomenon creates an endogeneity problem because the productivity term will be correlated with flexible inputs.

There are various methods proposed to estimate the production function under endogeneity. In this paper, we estimate production functions by using Olley and Pakes (1996), Levinsohn and Petrin (2003), Wooldridge (2009), and system-GMM (Blundell and Bond, 1998) methods. In the case of system-GMM, a dynamic production function is estimated. The model includes the first lags of output and all inputs.

Figure A1. TFP indices for Turkish manufacturing, 1983-2001



Note: WRDG Wooldridge, LP Levinsohn and Petrin, OP Olley and Pakes methods.

Table A1. Correlation coefficients for plant-level TFP estimates (in logs)

	WRDG	LP	OP	System-GMM
WRDG	1.000			
LP	0.980	1.000		
OP	0.954	0.970	1.000	
System-GMM	0.514	0.515	0.497	1.000

Note: All coefficients are statistically significant at the 1 % level. There are 153,238 observations.

Figure A1 presents manufacturing TFP indices estimated by these methods. All estimates exhibit similar aggregate trends. Moreover, as shown in Table A1, and plant-level TFP estimates

based on these four methods are significantly correlated with each other, and the correlations are even more significant when they are estimated at the 3- or 4-digit sector level.

Despite similarities between estimates based on different methods, we run the causality tests for all four estimates, as summarized in Table 3 in the paper, and found that the main findings are not sensitive to production function estimation methods.

References

Acemoglu, Daron, Suresh Naidu, Pascual Restrepo, and James A. Robinson, 2015, "Democracy, Redistribution, and Inequality," in Atkinson, Anthony B. and François Bourguignon (Eds.), *Handbook of Income Distribution*, Elsevier, Vol. 2B, Ch. 21: 1985-1966.

_____, 2019, "Democracy Does Cause Growth," *Journal of Political Economy*, 127(1): 47-100, February.

Akkaya, Yüksel, 1992, "Türkiye'de Sendikalaşma ve Bazı Özellikleri," (Unionization in Turkey and Some Characteristics,) *İktisat Dergisi* (Economic Journal) 332 (November).

Barth, Erling, Alex Bryson and Harald Dale-Olsen. 2020. "Union Density Effects on Productivity and Wages," *Economic Journal* 130 (631): 1898-1936.

Bester, Helmut, Chrysovalantou Milliou and Emmanuel Petrakis. 2012. "Wage Bargaining, Productivity Growth, and Long-Run Industry Structure," *Labour Economics* 19 (6): 923-30.

Bester, Helmut and Emmanuel Petrakis. 2004. "Wages and Productivity Growth in a Dynamic Monopoly," *International Journal of Industrial Organization* 22 (1): 83-100.

Blundell, Richard and Stephen Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics* 87: 115-143.

Chennells, Lucy and John Van Reenen, 1997, "Technical Change and Earnings in British Establishments," *Economica* 64:587-604.

Doms, Mark, Timothy Dunne, and Kenneth R. Troske, 1997, "Workers, Wages, and Technology," *Quarterly Journal of Economics* 112(1): 253-290.

Eberhardt, Marcus, 2019, "Democracy Does Cause Growth: Comment," Discussion Paper No. DP13659, CEPR: London.

Flaig, Gebhard and Manfred Stadler, 1994, "Success Breeds Success. The Dynamics of the Innovation Process," *Empirical Economics* 19: 55-68.

Galindo-Rueda, Fernando, and Fabien Verger, 2016, *OECD Taxonomy of Economic Activities Based on R&D Intensity*, Science, Technology and Industry Working Papers 2016/04, Paris: OECD.

Garnero, Andrea, François Rycx and Isabelle Terraz. 2020. "Productivity and Wage Effects of Firm-Level Collective Agreements: Evidence from Belgian Linked Panel Data," *British Journal of Industrial Relations* 58 (4): 936-72.

Gerring, John, Philip Bond, William T. Barndt, and Carola Moreno, 2005, "Democracy and Economic Growth: A Historical Perspective," *World Politics* 57: 323-64.

Gordon, Robert J., 1987, "Productivity, Wages and Prices Inside and Outside of Manufacturing in the U.S., Japan, and Europe," *European Economic Review*, 31(3): 685-733

Griliches, Zvi, and Jacques Mairesse, 1998, "Production Functions: The Search for Identification," in Z. Griliches, *Practicing Econometrics: Essays in Method and Application*, Cheltenham, UK: Elgar.

Hibbs Jr, Douglas A., and Håkan Locking. 2000. "Wage Dispersion and Productive Efficiency: Evidence for Sweden," *Journal of Labor Economics* 18 (4): 755-82.

Leibenstein, Harvey, 1966, "Allocative Efficiency vs. X-Efficiency," *American Economic Review* 56(3): 392-415.

Levinsohn, James and Amil Petrin. 2003. "Estimating Production Functions Using Inputs to Control for Unobservables," *Review of Economic Studies* 70: 317-341.

Mahiroğulları, Adnan, 2001, "Türkiye'de Sendikalaşma Evreleri ve Sendikalaşmayı Etkileyen Unsurlar", (Periods of Unionization in Turkey and the Factors Affecting the Unionization) *C.Ü. İktisadi ve İdari Bilimler Dergisi* (C.U. Journal of Economics and Administrative Sciences) 2(1): 161-190.

Millea, Meghan, 2002, "Disentangling the Wage-Productivity Relationship: Evidence from Select OECD Member Countries," *International Advances in Economic Research,* 8: 314–323.

Minier, Jenny A., 1998, "Democracy and Growth: Alternative Approaches," *Journal of Economic Growth* 3: 241–266.

Mohnen, Pierre A., M. Ishak Nadiri and Ingmar P. Prucha, 1986, "R&D, Production Structure and Rates of Return in the US, Japanese and German Manufacturing Sectors," *European Economic Review* 30: 749-771.

Olley, G. Steven and Ariel Pakes, 1996, "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica* 64: 1263-1297.

Ozatay, Fatih, 2000, "The 1994 Currency Crisis in Turkey," *Journal of Policy Reform* 3(4): 327-352.

Ozler, Sule and Kamil Yilmaz, 2009, "Productivity Response to Reduction in Trade Barriers: Evidence from Turkish Manufacturing Plants," *Review of World Economics*, 145(2): 339-360.

Persson, Torsten and Guido, Tabellini, 2006, "Democracy and Development: The Devil in the Details," Working Paper No. 1193. NBER: Cambridge, MA.

Policardo, Laura, Lionello F. Punzo and Edgar J. Sanchez Carrera. 2019. "On the Wage–Productivity Causal Relationship," *Empirical Economics* 57 (1): 329-43.

Przeworski, Adam, and Fernando Limongi, 1993, "Political Regimes and Economic Growth," *Journal of Economic Perspectives*, VII (Summer): 51–69.

Rodrik, Dani, 1999, "Democracies Pay Higher Wages," *Quarterly Journal of Economics* 114(3): 707-738.

Rodrik, Dani, and Romain Wacziarg, 2004, "Do Democratic Transitions Produce Bad Economic Outcomes?" Harvard University and Stanford University, December 2004.

Shapiro, Carl and Joseph E. Stiglitz. 1984. "Equilibrium Unemployment As a Worker Discipline Device," *American Economic Review* 74 (3): 433-44.

Taymaz, Erol, 2009. *Informality and Productivity Differentials between Formal and Informal Firms in Turkey*, Background Paper prepared for the World Bank's Country Economic Memorandum (CEM), Ankara.

Taymaz, Erol and Yilmaz Kiliçaslan, 2005, "Determinants of Subcontracting and Regional Development: An Empirical Study on Turkish Textile and Engineering Industries," *Regional Studies* 39: 633-645.

Vergeer, Robert and Alfred Kleinknecht. 2010. "The Impact of Labor Market Deregulation on Productivity: A Panel Data Analysis of 19 OECD Countries (1960-2004)," *Journal of Post Keynesian Economics* 33 (2): 371-408.

Voyvoda, Ebru and A. Erinç Yeldan, 2001, "Patterns of Productivity Growth and the Wage Cycle in Turkish Manufacturing," *Review of Applied Economics* 15(4): 375-396.

Wooldridge, Jeffrey M. 2009. "On Estimating Firm-level Production Functions using Proxy Variables to Control for Unobservables," *Economics Letters* 104: 112-114.