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FRONTIER AND SUPERSTAR FIRMS IN ITALY

by Francesca Lotti* and Enrico Sette*

Abstract

We study the dynamics of firms in the top decile of the TFP distribution in Italy (frontier firms). Using granular microdata from the census of corporations, we show their main characteristics, their weight in terms of revenues and employment, and measure their persistency in the top deciles of the TFP distribution. Frontier firms are more profitable, less likely to go bankrupt and younger; they invest more and use less long-term bank debt to finance their assets; and they are larger in terms of revenues, but not in terms of employees. Finally, we gauge their contribution to aggregate TFP growth, finding that TFP growth of frontier firms has intensified over time, as did the divide between firms at the top and the bottom of the TFP distribution. However, the market share of frontier firms only increased over time in the business services and transportation sectors; there is no increase, and in some cases, there is actually a decrease in other industries, notably in manufacturing. Hence, we do not find strong evidence of superstar firm effects, except in business services.

JEL Classification: D24, O47, L16.

Keywords: productivity, firm dynamics, reallocation, market power.

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Introduction and related literature^{*}

“If globalization or technological changes advantage the most productive firms in each industry, product market concentration will rise as industries become increasingly dominated by superstar firms with high profits and a low share of labor in firm value-added and sales.” (Autor et al, 2018).

If the most productive firms become more and more productive, they might achieve a position of dominance in their markets; when these “frontier” firms become “superstars” thanks to their market power, they can use it strategically to slow down creative destruction through rent-seeking behaviors, with negative consequences on prices, wages, capital accumulation and innovation, factors that can hold back economic growth and consumer welfare.

While the existence and the economic relevance of frontier firms has recently been documented in an international context (OECD, 2015), the emergence of superstar behavior begun to draw the scholars’ attention since the seminal contribution of Sherwin Rosen (1981). Rosen argued that modern technologies would make it possible for the superstar performers in any industry to greatly expand the scope of their market while reducing market opportunities for everyone else. From a theoretical point of view, the mechanism behind this observation lies mainly in the convexity of the earnings function, that maps talents (i.e. productivity) into the distribution of rewards (i.e. revenues)¹: accordingly, a small difference in productivity becomes magnified in large revenues differentials. Adler (1985) argues that superstars might even emerge among equally talented performers due to the positive network externalities of popularity. While the theories of Rosen and Adler were often compared when analyzing very specific markets - like football players, art, media tycoons – aiming at studying income distribution, only in the aftermath of the great recession the scholars’ attention was drawn to the fact that superstar firms were pulling away from the rest of the economy.

The emergence of superstar firms is a clear signal of a change in market structure with many implications ranging from the transmission of monetary policy to the design and implementation of antitrust legislation. However, the existence of companies at the national or global productivity frontier is a stylized fact and has no negative implications *per se*. Whether and how these companies become superstars and limit competition by exerting their market power is still underexplored: a few explanations have been put forward, but no unanimous conclusion has been reached (OECD, 2018).

^{*} We would like to thank Matteo Bugamelli, Federico Cingano, Sauro Mocetti and Paolo Sestito for their useful comments. We are grateful to Chiara Criscuolo and Peter Gal for providing figures on the global frontiers. The views expressed in the paper do not necessarily reflect those of the Bank of Italy.

¹ Other than convexity of the revenue function, Rosen’s model requires assumptions on the imperfect substitution between sellers, low (and possibly declining) marginal cost of output, and marginal cost falling as quality increases.

The most recent research on superstar firms (Furman and Orszag, 2015; de Loecker and Eeckhout, 2018 and Autor et al., 2017) observe rising industry concentration ratios in France, Germany, Japan, and the United States over the past decades, linking these developments to the decline of the labor share in GDP and to the corresponding increase in the profit share. Calligaris et al. (2018) and, recently, Crouzet and Eberly (2018) argue that these dynamics are due to weak investment in physical capital and growth in intangible capital, underlying the role of digital intensity, intellectual property, and managerial and technological capabilities. Bessen (2017) and Shapiro (2018) find that profits have increased substantially in some sectors in the United States and Europe, and they relate this trend to the role of intangible assets and of an increased regulation. Although interesting, understanding the channels through which a highly productive firm manages to become a superstar is beyond the scope of this paper, as at this stage we are mostly interested in characterizing the firms at the productivity frontier and documenting the existence of superstar effects in Italy.

In this note we study the key characteristics of frontier firms in Italy. Frontier firms are those at the productivity frontier, i.e. with TFP in the top decile of their sector (manufacturing, construction, trade, hospitality, transportation, business services). We study the evolution of the TFP of frontier firms over time. Next, we look at “superstar” effects, i.e. whether the market shares in terms of revenues and/or employment of the most productive firms have increased over time. In addition, we show how several key firm characteristics are distributed along deciles of the TFP distribution. Finally, we measure the persistency of firms in the each decile of the TFP distribution to assess to what extent frontier firms retain this characteristic over time.

We use a rich dataset of Italian firms, based on the register of incorporated firms (Cerved) that contains detailed information on balance sheets of corporations. This allows us to compute revenue TFP, applying Woolridge’s methodology (2011) with a second order polynomial². We explore a long time series spanning 22 years from 1995 to 2016, thus going from right after the 1992-1993 crisis to the most recent available data, encompassing several key events that have shocked the world economy with a heavy influence on Italy, too: the first years of the ICT revolution, the introduction of the Euro, the entry of China in the WTO and somehow the rise of globalization, the post Lehman crisis with the Great Recession, the Eurozone sovereign debt crisis.

² We estimated the production function with narrowly defined sectors (2-digit), to account for possible heterogeneity in the use of capital and labor.

The note has a descriptive nature and aims at establishing some stylized fact that will be the starting point for future work aiming, for example, at understanding how different types of exogenous shocks have shaped the TFP distribution.

In a nutshell, the main results are the following: from 1995 to 2016, frontier firms accounted for nearly 50 percent of TFP growth in manufacturing, more than 80 percent in the service sector.

TFP of frontier firms increased over the whole sample period: relative to the sectoral median, the increase is less pronounced in manufacturing, and is not present in transportation, and in business services. We also fail to detect “superstar” firms effect, as the share of employment of top performers did not increase, and it actually decreased in key sectors, such as manufacturing. In terms of revenues, it spiked after the Great Recession, but then it dropped to the levels prevailing before the crisis in manufacturing. We find some evidence of higher market shares in terms of both employment and revenues in transportation and, importantly, in business services. Finally, we find that frontier firms are characterized by a higher investment rate, are younger, and have a lower probability of default than other firms. The persistence in the top decile of the TFP distribution is high, but heterogeneous across sectors.

As a last step, thanks to data kindly shared with us by the OECD, we can compare the productivity frontier of Italian firms with that of “global” firms. This analysis is based on Andrews, Criscuolo and Gal (2015). While the definition of TFP is somewhat different from ours and the sectoral aggregation, too, the results can be informative about where do Italian firms stand. According to their methodology, Italian manufacturing firms lagged behind the global frontier (this includes 23 OECD countries), with limited evidence of a catch-up over time. In the service sector, Italian firms were tracking closely the global frontier until the burst of the 2007-2008 financial crisis, but then they started to lag behind.

This note relates to several strands of literature. First, the aforementioned work by Andrews, Criscuolo and Gal. (2015) that studies the characteristics and the performance of firms located in the top tail of the TFP distribution, at the technological frontier. According to their evidence, these firms are typically larger, more profitable, younger and more likely to patent and be part of a multinational group than other firms. In addition, the productivity of frontier firms kept growing during the 2000s, despite dropping aggregate productivity. Our work focuses on Italy and extends the analysis to a broader set of firms’ characteristics. Second, the literature on “superstar firms”, i.e. firms that capture a very large market share and as a consequence become “dominant” in their industry and more generally in the whole economy (Autor et al. 2017). The rise of superstar firms is associated with the

spread of information and communication technologies and/or globalization. Third, our work relates to several recent studies of the evolution of TFP in Italy (see Bugamelli and Lotti, 2018 for a detailed review of this literature).

2 Data and TFP estimation

We use data on firm balance sheet characteristics from Cerved which includes the universe of incorporated firms. Our data cover the period from 1995 to 2016. We match Cerved data with those on employment from the Italian Social Security Institute (INPS), and this allows us to obtain high quality information on both the capital stock and employment for the whole sample.

We estimate TFP by means of a Cobb Douglas production function, estimated with the procedure proposed by Wooldridge (2011), that provides consistent estimation within a single step GMM framework that allows to overcome the potential identification issues in the first stage in other routines based on the control function approach (like Olley-Pakes and Levinsohn-Petrin), providing robust standard errors that account for both serial correlation and possible heteroscedasticity.

We deflate the data using with 2-digit sectorial deflators (revenues, value added and investment).

Overall, our sample is based on more than 6 million observations (firm-year), including nearly one million distinct firms. Their distribution by year and sector is shown in Table 1. The strong increase in the number of firms until about 2004 reflects both a better coverage of Cerved and an increase in the number of limited liability companies. This is a well-known feature of these data.

3 Main Results

As a first step, we study the evolution of TFP for firms in the top decile of the distribution (“frontier firms”). In absolute value, this has increased significantly in all macro-sectors (Figure 1). When the evolution of the TFP of frontier firms is evaluated relative to the median TFP in the macro-sectors, the TFP of top performing firms increases less (Figure 2), and in the case of transportation it even decreases. For manufacturing firms, the TFP of frontier firms kept increasing, also relative to median TFP until 2010. Then the difference between frontier firms and the median narrowed, while the TFP of the top performers remained substantially flat. After 2010 the exit of low productivity firms is likely to have had a strong impact on median productivity, improving the selection of firms so as to raise median TFP faster than the increase of the TFP of frontier firms. Overall, this first evidence suggests a first empirical fact: between 1995 and 2015, the TFP of frontier firms increased

significantly, and so did the gap between TFP of firms in the top decile and firm in the bottom quantile of the TFP distribution (Figure 3).

Next, we study the evolution of the market shares, measured either by sales or by employment, of frontier firms (Figure 4). This allows us to detect the presence of “superstar” firm effects in our data. We detect the following behavior: in manufacturing, trade, hospitality (hotels, restaurants and catering), and construction, the share of employees of frontier firms drops over time. In manufacturing and trade, the share of revenues increases significantly during the crisis, but then it reverts back to pre-crisis levels (somewhat higher in trade). The behavior of the share of revenues seems to be driven by the heterogeneous impact of the crisis: this has been much stronger on firms at the bottom of the TFP distribution. The exit of many of these firms and the economic recovery explain the subsequent drop in the share of revenues of frontier firms. Transportation and business services show a very different behavior, instead: both the share of employees and the share of revenues of frontier firms increase over time. Then, only these sectors show some superstar effects. In the case of business services this may be due to the impact of new technology and/or to intangible capital (Ayyagari et al. 2018).

Further work to understand the drivers of the markedly different behavior of manufacturing and business services firms is needed. However, we can establish a second empirical fact: the evidence of “superstar firms” effects is limited. Frontier firms gained shares of market revenues during the crisis, but the effect vanished as the economy recovered.

The next step of the analysis is to characterize frontier firms. Table 2 shows averages of some key firm-level-characteristics (capital, revenues, value added, employment, age, investment) across deciles of the TFP distribution. Frontier firms have on average higher revenues and value added. They also tend to invest more and hold a larger amount of capital³. Interestingly, they are typically not the largest in terms of employment, with firms in the 7th-8th-9th decile having more employees, on average, and they are younger than firms in those deciles of the TFP distribution. In the case of manufacturing and business services, frontier firms are older only of firms in the bottom decile of the distribution, which disproportionately includes new entrant firms. Frontier firms are young relative to other firms, but not in absolute value, as on average they are 13-14 years old (they are somewhat younger in business services, but all firms in this sector are younger on average).

Table 3 expands the analysis to additional firm characteristics: the investment rate (capital to assets), the liquidity ratio (cash and cash equivalents to assets), bank debt to assets, distinguishing between

³ This is not the case in some sectors, for the presence of some very large firms in middle deciles of the TFP distribution.

debt short term and long term debt (expiring within one year or after one year, respectively), and operating profits (Earnings Before Interest, Taxes, Dividends, and Amortization). Frontier firms typically have on average the highest investment rate and the highest operating profitability. The pattern of the liquidity ratio is less clear-cut, instead. It increases with TFP in manufacturing and business services, it is about constant, it has an inverted u-shaped pattern, or it is even decreasing in transportation. The liquidity ratio typically reflects the need of firms to hold liquidity buffers against unexpected drop in the availability of external finance, so it may be increasing for firms with high expected investment opportunities that have a high cost of being credit constrained, but also for weaker firms that expected to incur losses and want to hedge against this risk.

The behavior of bank debt is interesting, too. Short-term debt, typically used to finance working capital is somehow evenly distributed across deciles of TFP, except somewhat in sectors such as hospitality or business services in which revenues are obtained faster and thus cash flow is better able to finance working capital turnover. Long term debt, typically used to fund investment, is instead decreasing along the TFP distribution. More productive firms finance a smaller fraction of their assets using long-term bank debt. This suggests that frontier firms make greater use of internal use and potentially of alternative sources such as trade debit (the vast majority of the firms in our sample are unlisted), than firms in the bottom deciles of the TFP distribution that are more reliant on bank debt.

Finally, Table 3 also shows further firm characteristics and it suggests that frontier firms have a higher return on equity, and a lower probability of default as measured by the Altman Z-score (with the exception of transportation and construction, in which the distribution of the z-score is not monotonically decreasing in TFP).

Overall, this evidence suggests that frontier firms have many “desirable” features: they are more profitable, they invest more, they are less likely to go bankrupt. They are younger, and use less long-term bank debt to finance their assets. They are larger in terms of revenues, but not in terms of employees. This may reflect a technological choice, i.e. a higher reliance on capital intensive technologies, efficiency, in that they are able to obtain more revenues with fewer workers, and/or some form of inefficient allocation of labor, which does not flow towards the most productive firms, although frontier firms have more employees than firms with TFP at or below the median, so the misallocation of labor, if any, is not dramatic.

The last step of the analysis consists in studying the persistence of firms in the status of frontier firm and more generally, the probability of transition across deciles of the TFP distribution. Table 4 shows the transition matrix from one year to the next. The table shows two patterns. First, persistence is

high, but there is still substantial mobility in and out the top decile. Second, there is large heterogeneity across sectors. In fact, between one fifth and one fourth of firms in the top decile of the distribution in year t , do not belong to the top decile anymore in year $t+1$. This share is even larger in the business services sector, and gets very large, around 40 percent, in construction and real estate. We also explore the decile distribution by age of the firm. Very young firms, i.e. those less than 3 years old, show a greater polarization in manufacturing, i.e. a relatively larger share of them is either in the top or in the bottom decile of the distribution. In other sectors young firms are typically mostly found in the lowest decile of the TFP distribution. Finally, we replicate the transition matrix of firms over a five years horizon. As expected we observe a lower probability of staying in the same decile than for the year to year transition matrix. Large movements (like a jump of more than two deciles up or down the distribution) are not a frequent phenomenon, particularly in the deciles in the right tail of the TFP distribution. In fact, the proportion of frontier companies that are within the top three deciles after 5 years is above 70 percent (Table 5). Being a high TFP firm is a rather persistent characteristic, as both the theoretical and empirical literature would suggest (Baily et al, 1992 and Foster et al, 2001). This provides further reassurance about the quality of the TFP measure we use in this work.

4. Contribution of frontier firms to aggregate TFP growth

Although they represent only 10 percent of the population of firms and they are not larger than the average, frontier firms contribute disproportionately to TFP growth. To gauge their contribution to overall TFP growth, we aggregate firm-level TFP using (lagged) revenue shares as weights. Figure 5 depicts the contribution of top firms to the annual growth rate of TFP throughout the period 1996-2016. While the contribution of top firms in manufacturing, hospitality and transportation ranges between 50 and 60 percent, top firms in the trade, business services and construction & real estate account for 80-90 percent of TFP growth. While these are average figures, the top firms TFP growth contribution exhibit a remarkably different path over time (Figure 6). Frontier firms in manufacturing and in the trade sector exhibited a remarkable resilience during the recession (2007-2013), while in the other sectors non-top firms were those that recorded a steadier performance. In more recent years (2014-2016) the contribution to aggregate TFP growth of top firms becomes more feeble (if not negative) in nearly all the sectors considered, due to an increase in productivity of non-top firms.

5. Conclusions and future work

This note studies frontier firms in Italy and the possible presence of “superstar firm” effects. We document the time-series evolution of the TFP of frontier firms, in absolute and relative to the average. We show the key characteristics of frontier firms and study their transition across deciles of the TFP distribution. We also measure their contribution to aggregate TFP growth.

The main findings are that TFP growth of frontier firms increased over time. However, the market share of frontier firms increases over time only in business services and transportation. It does not show any clear increase, and in some cases it drops in other sectors, notably in manufacturing. This applies to market shares measured both in terms of revenues and in terms of employment. This indicates that we detect “superstar firms” effects only in business services and in transportation. Further analysis is needed to better understand the drivers of these differences: it may be due to increased concentration and/or technology adoption or the interaction of the two. Overall, the evidence of superstar effects is rather weak and the disappointing performance of the productivity of Italy’s economy is not due to weak growth on the part of cutting-edge firms nor to their excessive market power, but it may be attributable to more general structural weaknesses in the production system as a whole. This result is consistent with the evidence provided by the OECD⁴ for which Italy was close to the global productivity frontier in services in the pre-recession period, but falling behind since then, especially in the laggard group; in manufacturing, there has always been a gap, which has widened further after the Great Recession (Andrews et al, 2015). This evidence is depicted on panel (a) of Figure 7. In order to increase the comparability of the results from their methodology with the one used in this paper, we created an aggregate for services⁵ and we defined the national frontier as the set of the 10 most productive companies in each 2-digit sector-year, according to our estimates of TFP. This definition of national frontier is depicted as a purple line in panel (b) of Figure 7, along with the TFP evolution of the top decile of the TFP distribution (our definition of frontier firms, green line). Using our methodology, we observe a more intense TFP dynamics for those firms at the frontier with respect to what emerges from the OECD data, whether we use the top 10 firms criterion or the top decile of the TFP distribution.

⁴ We thank Peter Gal for making available this evidence to us. The results are based on the methodology used in the paper “Frontier Firms, Technology Diffusion and Public Policy: Micro Evidence from OECD Countries”, by Dan Andrews, Chiara Criscuolo and Peter Gal (2015). In that paper, they estimate multi-factor productivity (MFP) using a simple Solow-residual based measure that applies the same industry-specific factor shares for each country and year. The “global frontier” is made by the top 100 globally most productive firms (within each industry and year), while the national frontier by the top 10 most productive firms (within each country, industry and year).

⁵ This aggregate contains Nace codes 45-63 and 68-82, as in Andrews et al (2015).

With respect to other firms along the TFP distribution, our frontier firms have also many “desirable” features: they are more profitable, they invest more, they are less likely to go bankrupt. They are younger, and use less long-term bank debt to finance their assets. They are larger in terms of revenues, but not in terms of employees. This may reflect a technological choice, i.e. a higher reliance on capital intensive technologies, efficiency, in that they are able to obtain more revenues with fewer workers, and/or some form of inefficient allocation of labor, which does not flow towards the most productive firms, although frontier firms have more employees than firms with TFP at or below the median, so the misallocation of labor, if any, is not dramatic. We also find that while there is some degree of dynamism at the top, being a high TFP firm is a rather persistent characteristic.

Finally, we compute the contribution of frontier firms to aggregate TFP. While this is sizable, its importance differs across sectors and years. In general, frontier firms account for a higher share of aggregate TFP in business services and a relatively low (below 40%) in manufacturing. The contribution of frontier firms became stronger during the crisis in manufacturing and trade, but the opposite occurs for business services and hospitality. Again, this is an issue that deserves further scrutiny.

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Figure 1: Time series plot of the TFP of frontier firms.

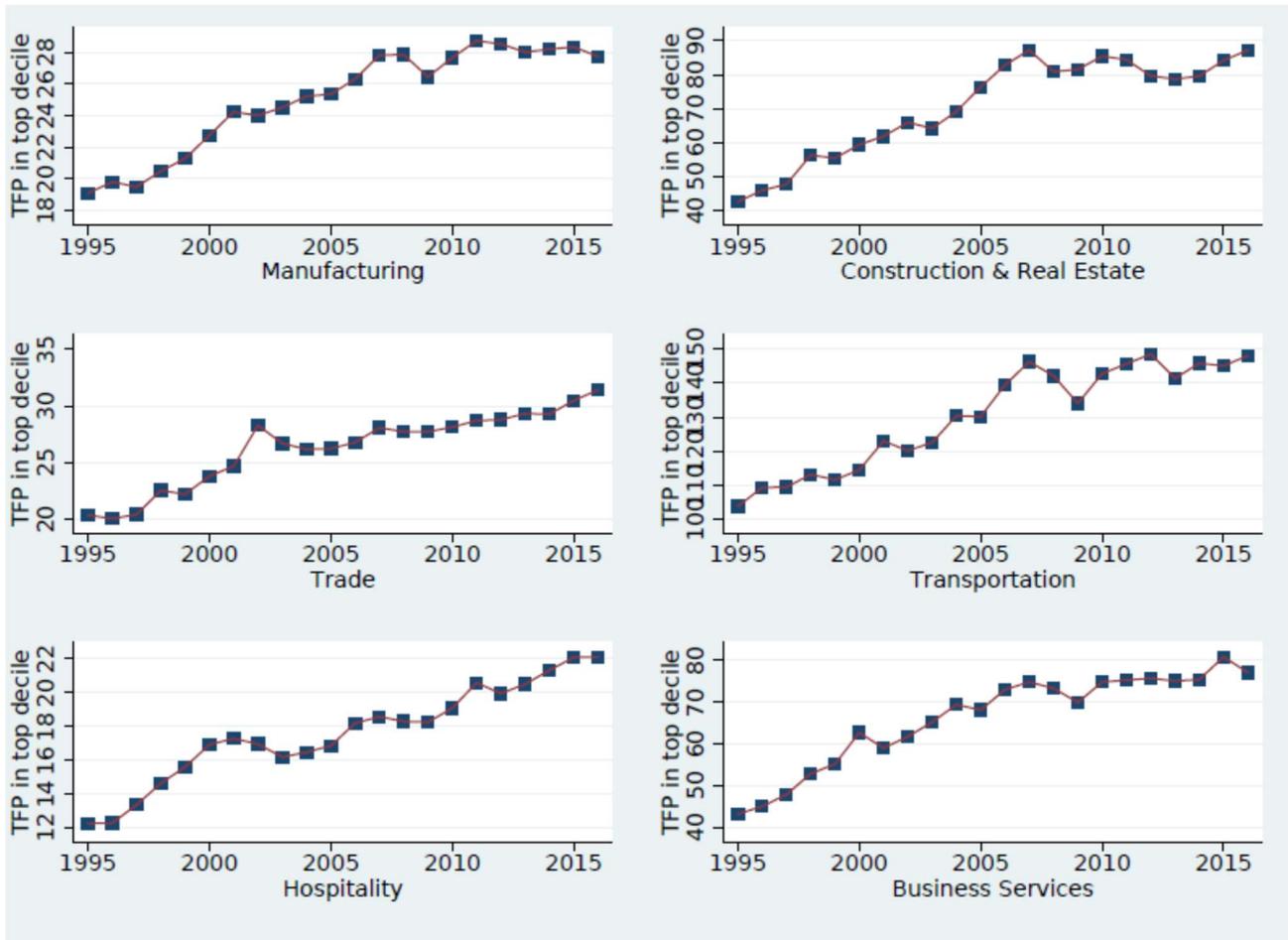


Figure 2: Time series plot of the TFP of frontier firms relative to median TFP in the sector.



Figure 3: Difference in average TFP between top and bottom quantiles (index: 1995=1)

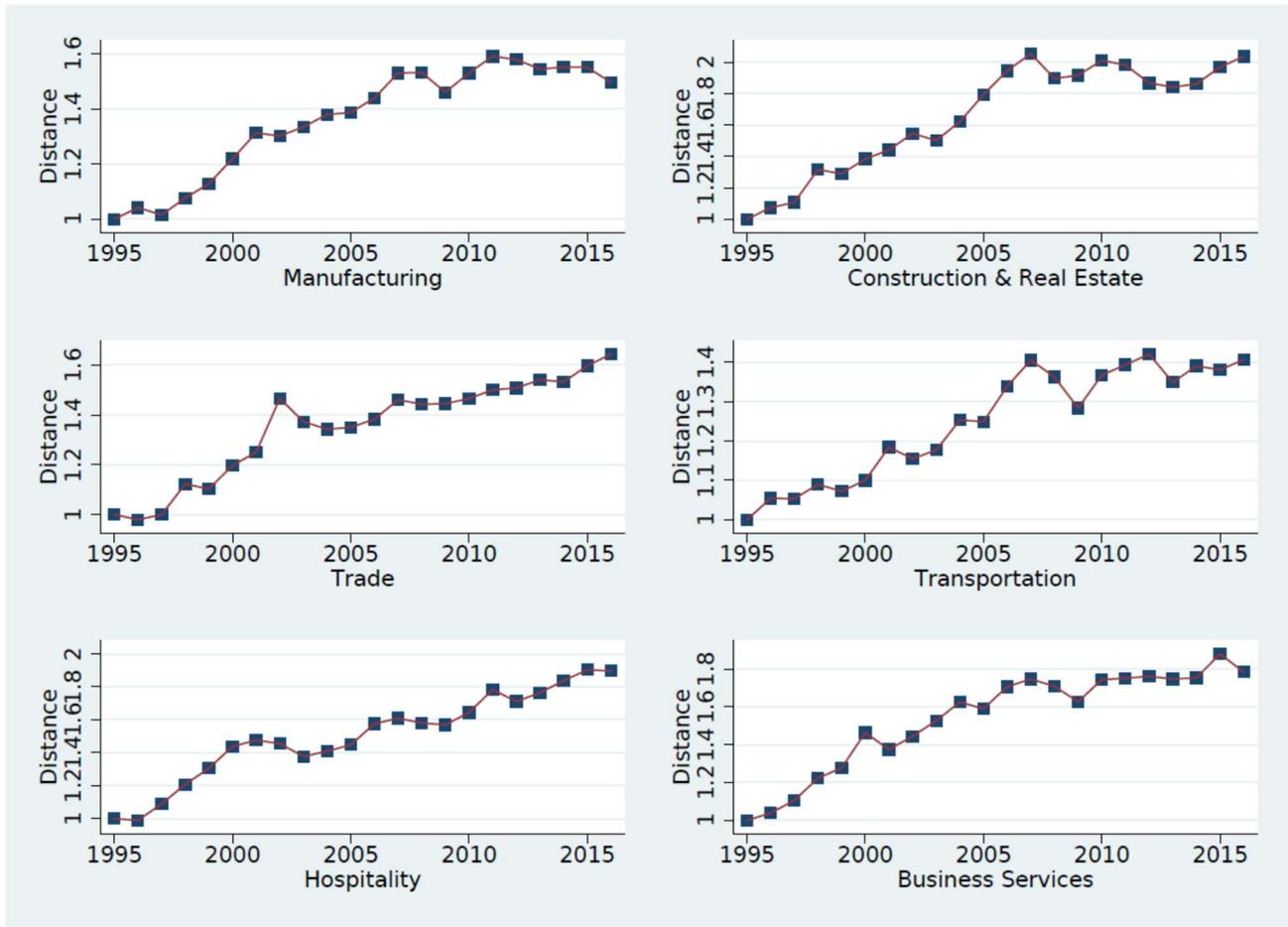


Figure 4: Market share of frontier firms, measured in terms of revenues and employment.

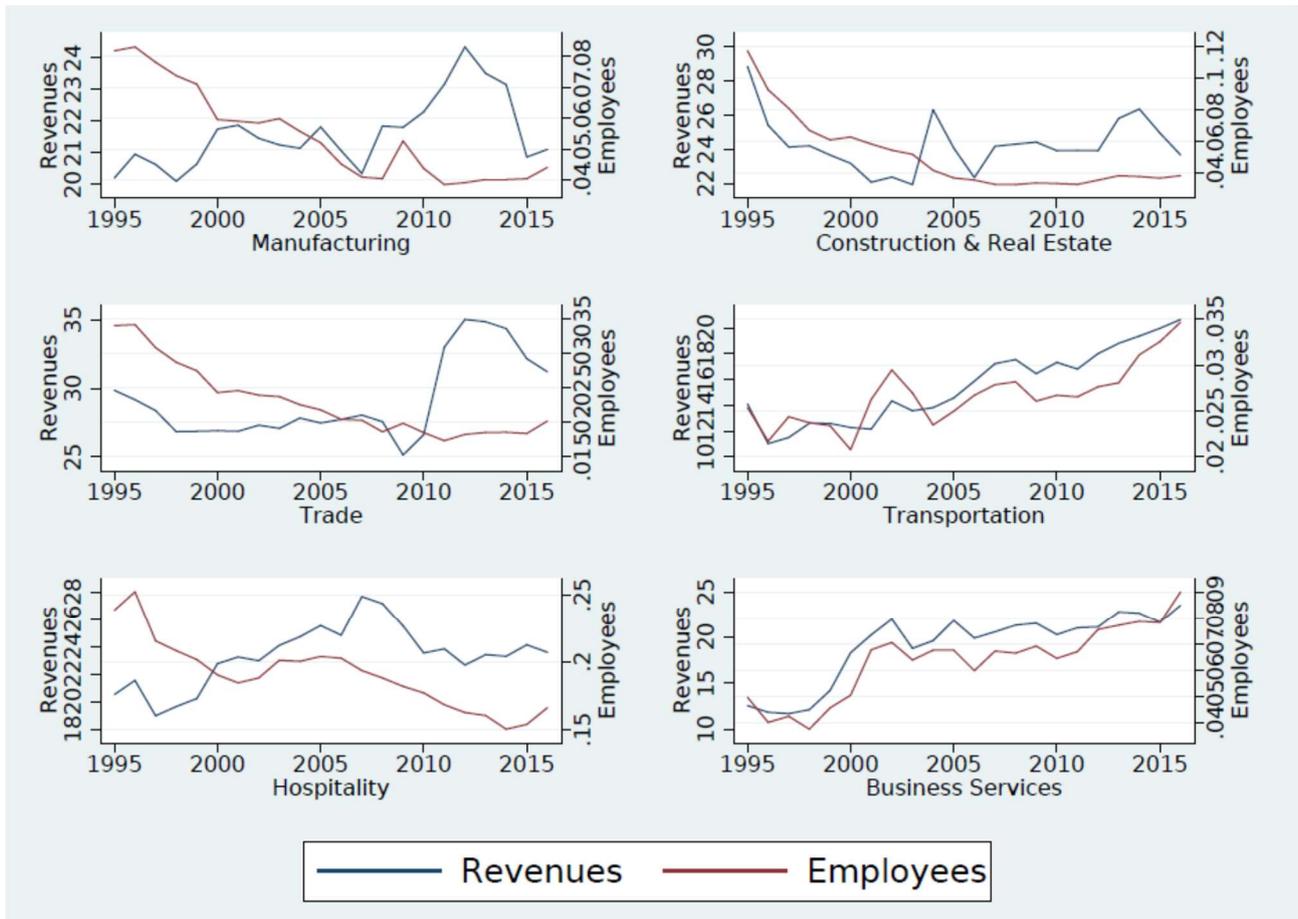


Figure 5: Top firms' contribution to yearly average TFP growth, 1996-2016.

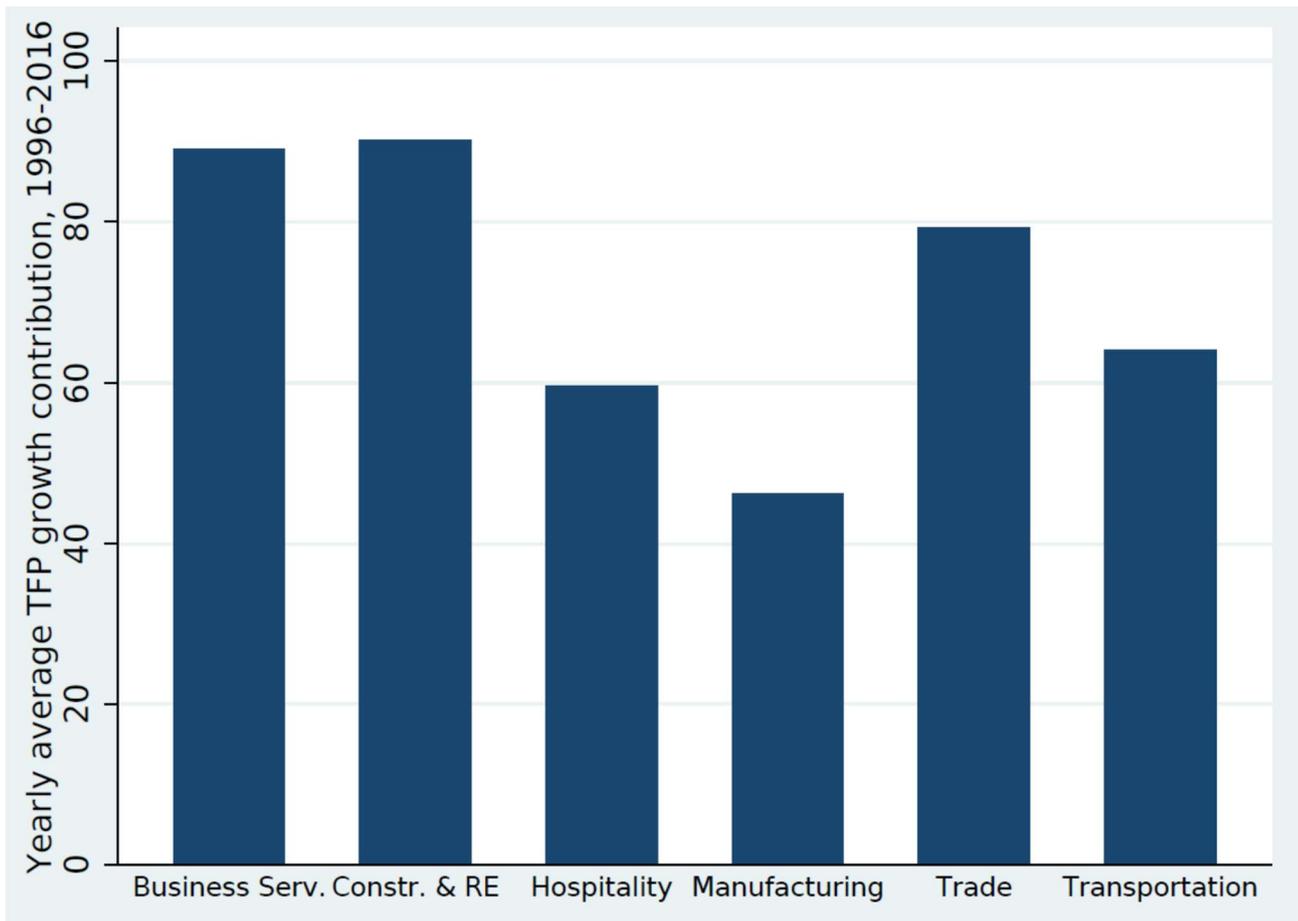


Figure 6: Contribution to yearly average TFP growth, top firms and other firms.

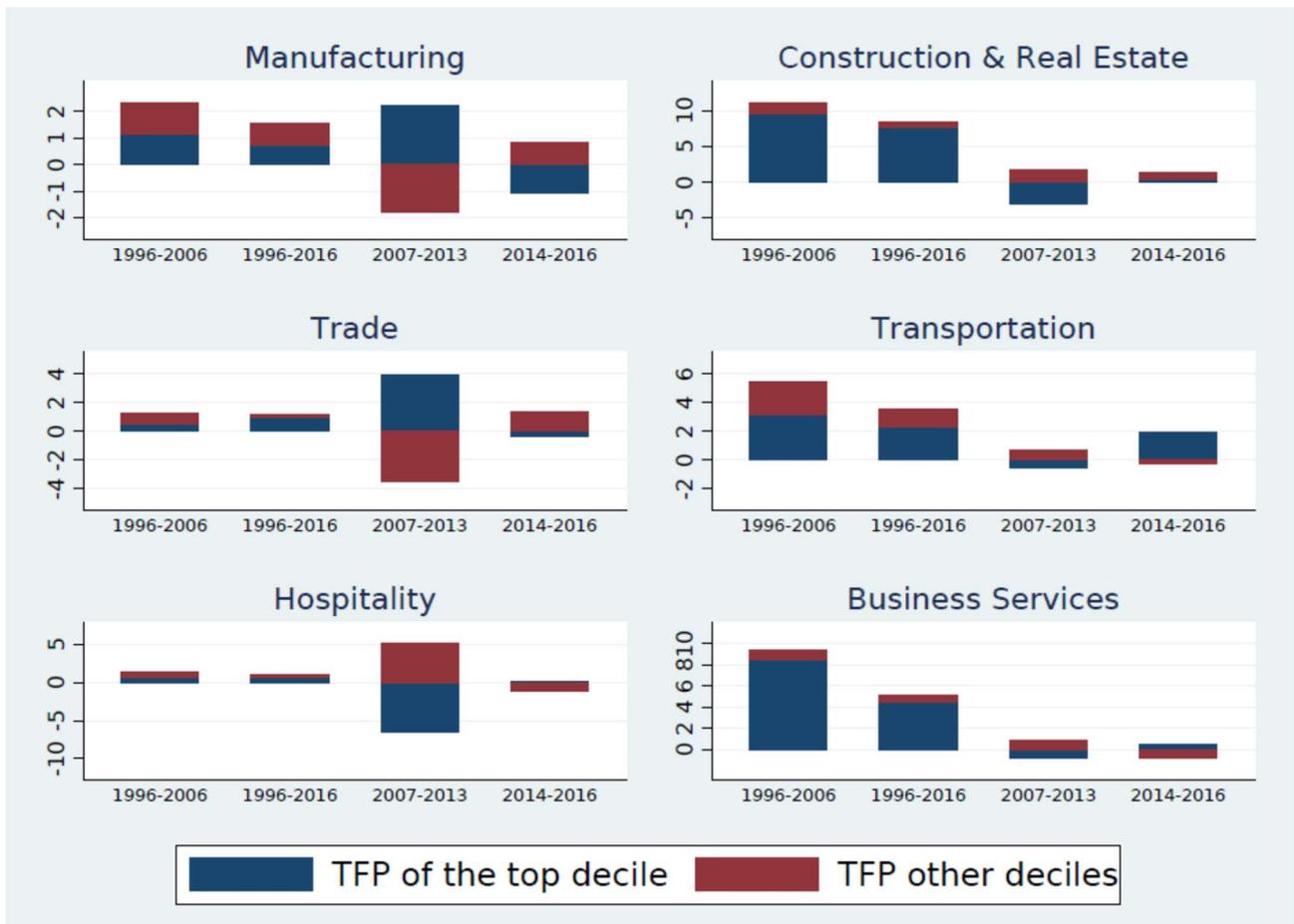
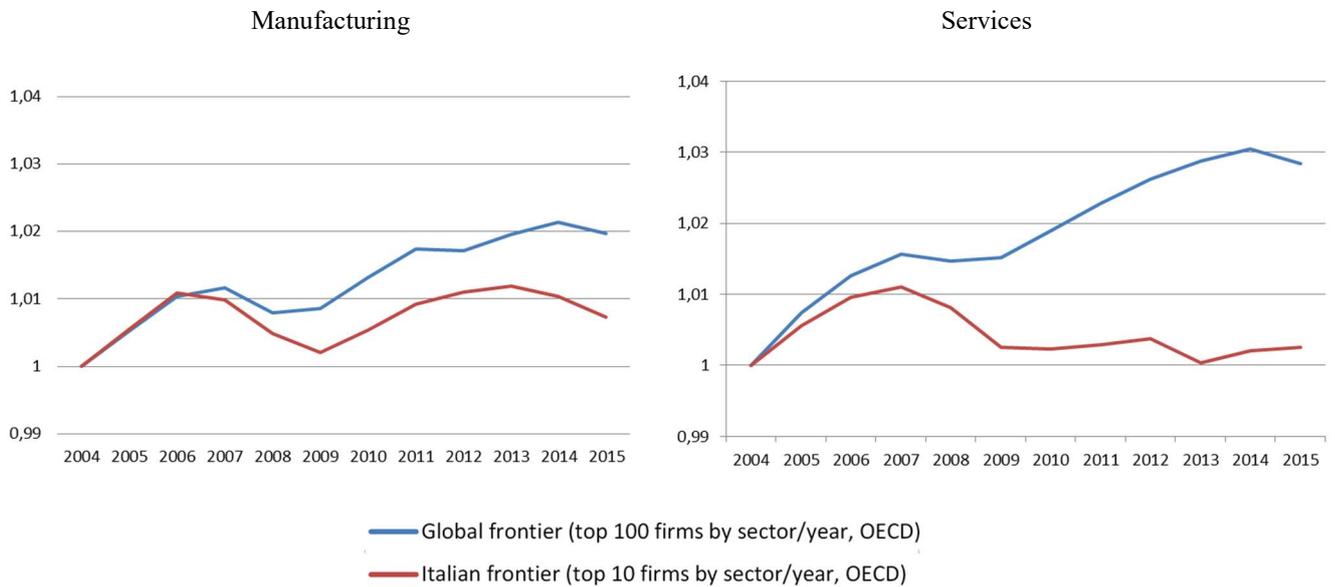
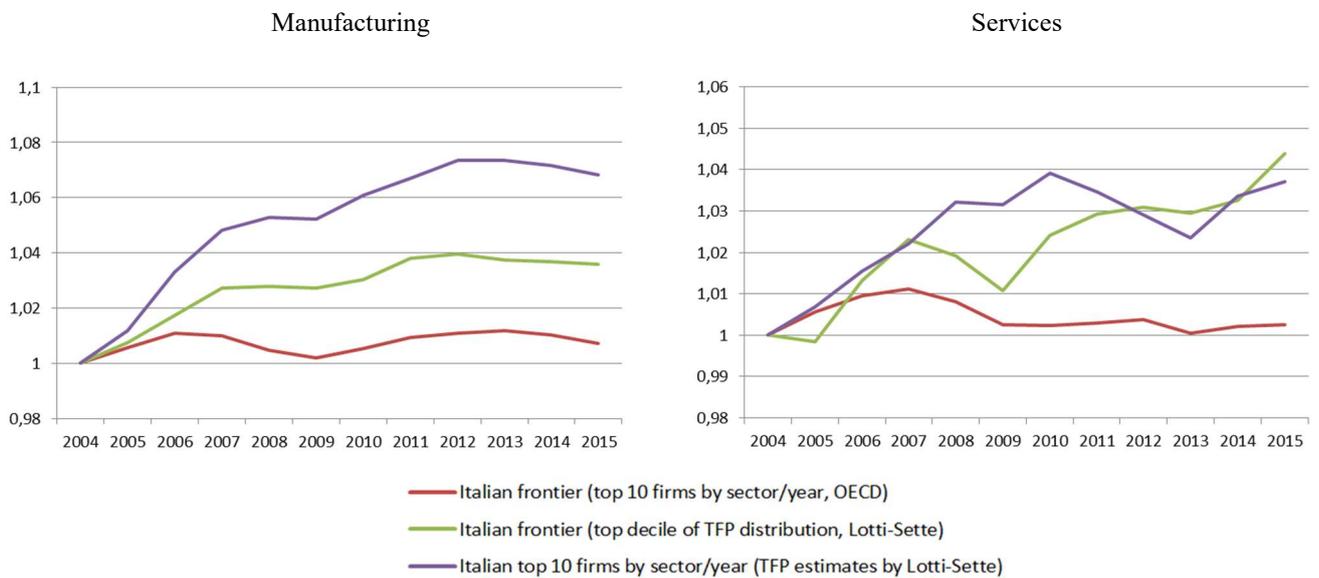


Figure 7: Italian firms and the global frontier (index: 2004=1).

Panel a



Panel b



Courtesy of Peter Gal and Chiara Criscuolo, based on the methodology employed in the paper “Frontier Firms, Technology Diffusion and Public Policy: Micro Evidence from OECD Countries”, by Dan Andrews, Chiara Criscuolo, Peter Gal (2015). In that paper, they estimate multi-factor productivity (MFP) using a simple Solow-residual based measure that applies the same industry-specific factor shares for each country and year. The “global frontier” is made by the top 100 globally most productive firms (within each industry and year), while the national frontier by the top 10 most productive firms (within each country, industry and year). The “Italian frontier” in the green line is made by the firms with TFP in the top decile of the TFP distribution according to our methodology; the “Italian top 10 firms” are the 10 most productive firms (in terms of TFP estimated with our methodology) by year and two-digit sector (purple line).

Table 1: Distribution of firms by year and sector.

	Manufacturing	Construction & Real Estate	Trade	Transportation	Hospitality	Business Services
1995	51,909	17,059	42,546	5,031	6,331	13,813
1996	55,741	18,111	46,458	5,638	7,140	15,595
1997	59,581	19,095	50,114	6,323	8,045	17,551
1998	63,092	19,983	53,786	6,998	8,822	19,498
1999	67,043	21,277	57,990	7,782	9,833	22,165
2000	71,572	22,926	63,191	8,728	11,124	25,599
2001	76,009	24,521	68,885	9,692	12,531	29,592
2002	81,174	27,151	75,515	10,672	14,520	33,950
2003	85,357	29,872	81,325	11,847	16,548	37,241
2004	89,636	32,811	88,310	12,980	18,993	41,350
2005	93,412	36,035	94,577	14,149	21,277	44,627
2006	96,898	39,853	100,705	15,375	23,478	47,952
2007	99,977	43,356	105,772	16,253	25,415	50,907
2008	100,102	44,569	107,207	16,849	26,497	52,956
2009	101,188	45,674	110,552	17,569	27,957	55,024
2010	101,320	45,656	112,458	18,129	29,145	56,759
2011	101,173	44,543	114,325	18,700	30,231	58,193
2012	100,044	42,995	115,507	18,963	31,079	58,930
2013	98,552	40,738	114,482	19,217	31,476	58,994
2014	97,813	39,080	113,269	19,447	32,544	58,706
2015	98,039	37,994	114,227	19,967	34,153	60,456
2016	90,206	30,734	101,727	17,680	29,217	51,574

Table 2: Main characteristics of firms by decile of TFP.

TFP decile	Employees	Capital	Revenues	Value added	Age	Investment	Investment/capital	TFP decile	Employees	Capital	Revenues	Value added	Age	Investment	Investment/capital
1	7.21	560.75	577.32	150.70	13.11	102.88	0.20	1	3.33	630.60	135.16	75.57	10.97	122.83	0.23
2	13.74	1275.02	3659.24	786.13	14.96	212.64	0.20	2	4.55	265.68	291.51	122.77	9.85	43.65	0.23
3	12.57	631.92	1657.91	466.88	15.75	116.17	0.20	3	6.14	382.77	475.66	187.57	10.23	72.04	0.24
4	14.77	719.20	2038.65	593.01	16.30	132.79	0.20	4	7.19	309.12	688.05	251.84	10.89	54.32	0.24
5	22.74	1653.46	6045.87	1373.60	17.05	301.28	0.21	5	8.29	338.56	934.65	311.96	11.26	62.77	0.25
6	23.65	1481.56	4999.09	1301.17	17.33	284.09	0.22	6	9.34	382.00	1223.49	374.02	11.66	72.87	0.25
7	31.29	2308.56	7991.02	1981.10	17.71	395.83	0.22	7	11.69	699.17	2423.23	639.86	12.15	122.68	0.39
8	41.20	2813.86	11213.02	2880.23	17.96	505.83	0.23	8	13.19	850.57	2937.68	707.15	12.51	138.95	0.26
9	43.30	2609.58	12512.78	3237.31	17.30	485.01	0.27	9	15.04	2325.46	5223.87	1116.03	13.31	193.43	0.27
10	32.93	2843.39	14432.03	3077.95	14.60	517.18	0.30	10	10.11	3563.18	5789.27	896.00	12.94	266.42	0.30
Test for equality across deciles	3178.79***	527.98***	1004.65***	1790.43***	2608.48***	431.95***	29.20***	Test for equality across deciles	1030.84***	12.01***	975.90***	516.27***	772.03***	13.95***	1.14
1	2.38	185.22	270.11	17.85	11.58	30.88	0.18	1	8.71	1209.01	299.85	291.12	13.44	212.13	0.20
2	3.58	183.42	586.54	97.09	11.93	31.73	0.18	2	12.35	738.16	597.06	411.09	13.05	101.74	0.22
3	4.91	223.24	973.36	157.93	12.27	40.17	0.19	3	15.98	2482.15	3709.93	2833.04	12.99	255.26	0.23
4	6.36	275.92	1490.36	228.61	12.48	51.80	0.21	4	21.37	2221.25	4715.87	3032.08	12.81	279.68	0.22
5	8.46	388.65	2365.76	353.04	12.99	79.05	0.22	5	21.28	1057.07	847.23	847.23	12.71	153.34	0.22
6	20.18	1261.80	6895.62	1027.66	13.60	248.06	0.22	6	24.80	14302.20	4407.36	3088.65	12.95	1569.57	0.23
7	12.64	768.85	6010.59	701.29	14.00	143.47	0.23	7	37.84	23904.28	8306.69	4039.36	13.43	2603.76	0.24
8	8.72	451.40	4325.15	501.57	14.46	90.91	0.24	8	39.28	8190.91	7745.11	3322.51	14.08	1016.36	0.24
9	16.17	1218.86	11707.77	1315.43	15.10	239.35	0.27	9	70.73	19632.32	15661.09	6711.81	14.60	2339.89	0.26
10	11.12	761.52	15687.33	1129.99	13.95	162.00	0.30	10	17.60	2332.67	10583.81	1374.35	14.40	427.44	0.25
Test for equality across deciles	609.32***	527.99***	764.56***	1224.76***	1822.07***	355.70***	16.74***	Test for equality across deciles	113.04***	24.27***	79.12***	23.48***	81.61***	21.88***	5.23***
1	3.31	390.74	124.51	30.20	7.21	76.06	0.21	1	5.16	465.21	184.46	119.87	9.98	98.59	0.24
2	5.34	271.33	244.18	78.72	7.79	42.18	0.17	2	7.86	263.86	345.39	194.04	10.43	54.49	0.23
3	6.21	277.83	345.70	118.15	8.08	39.83	0.16	3	12.02	1102.18	1112.61	562.88	10.99	183.84	0.22
4	7.35	290.12	435.80	151.41	8.49	40.49	0.16	4	13.82	476.49	1034.69	532.38	11.23	106.90	0.22
5	8.91	329.18	541.93	193.44	9.03	45.57	0.17	5	14.30	428.98	990.89	489.71	11.44	95.06	0.22
6	10.15	411.44	682.15	247.84	9.63	61.36	0.18	6	14.30	1188.23	1691.53	827.80	11.44	250.73	0.23
7	24.48	1252.66	2636.88	944.54	11.17	169.81	0.20	7	31.58	6983.06	8945.72	3846.17	11.36	1209.22	0.24
8	14.87	1357.66	1257.71	499.80	14.33	196.44	0.17	8	30.55	1220.29	4040.21	1452.67	11.07	304.44	0.25
9	14.67	1941.38	1218.19	563.76	15.67	216.03	0.17	9	31.78	1558.63	4563.80	1692.78	10.69	338.68	0.27
10	18.40	3661.86	2460.67	1021.09	14.67	433.31	0.21	10	23.49	2263.00	7028.43	1932.03	9.83	518.22	0.30
Test for equality across deciles	179.14***	1069.21***	359.25***	413.78***	3837.39***	111.80***	63.98***	Test for equality across deciles	92.44***	37.69***	104.72***	37.11***	388.46***	40.07***	37.00***

Table 3: Financial characteristics of firms by decile of TFP.

TFP decile	Liquidity/assets (short term)	Bank debt/assets (short term)	EBITDA	ROE MEDIAN	Score	TFP decile	Liquidity/assets (short term)	Bank debt/assets (short term)	EBITDA	ROE MEDIAN	Score
1	0.08	0.22	-50.77	-12.35	6.37	1	0.10	0.22	-49.61	-11.27	6.40
2	0.08	0.17	249.49	0.99	5.50	2	0.12	0.19	7.37	2.74	5.39
3	0.08	0.20	107.77	2.19	5.24	3	0.11	0.20	35.00	5.16	5.10
4	0.09	0.21	151.95	3.28	5.03	4	0.11	0.19	62.58	6.25	5.05
5	0.09	0.21	473.84	4.29	4.87	5	0.11	0.18	84.66	7.06	5.03
6	0.10	0.20	442.82	5.51	4.74	6	0.11	0.20	111.81	7.68	5.06
7	0.10	0.20	666.11	6.51	4.61	7	0.10	0.20	188.68	8.25	5.08
8	0.10	0.20	989.43	7.69	4.55	8	0.11	0.20	229.47	8.70	5.18
9	0.11	0.20	1150.44	9.19	4.52	9	0.11	0.20	405.00	9.42	5.27
10	0.13	0.20	1310.14	11.76	4.64	10	0.10	0.20	456.62	8.75	5.53
Test for equality across deciles	2269.54***	70.87***	1522.19***	4615.55***		Test for equality across deciles	60.84***	33.88***	628.39***	527.33***	783.66***
Manufacturing											
1	0.11	0.28	-63.55	-40.86	6.51	1	0.15	0.19	-73.99	-18.83	6.60
2	0.11	0.17	3.69	1.88	5.27	2	0.13	0.16	9.62	0.38	6.01
3	0.12	0.17	25.35	3.97	5.03	3	0.12	0.17	550.23	2.24	5.94
4	0.12	0.15	40.23	4.80	4.89	4	0.12	0.17	459.79	3.74	5.88
5	0.12	0.18	64.31	5.25	4.77	5	0.11	0.17	140.75	5.35	5.80
6	0.11	0.19	239.79	5.52	4.64	6	0.10	0.17	555.66	6.09	5.82
7	0.11	0.20	185.18	6.55	4.52	7	0.10	0.17	610.21	7.04	5.86
8	0.11	0.21	165.41	8.16	4.40	8	0.10	0.16	1216.57	8.05	5.93
9	0.11	0.22	476.44	10.10	4.31	9	0.10	0.16	2170.06	8.33	5.91
10	0.13	0.23	527.75	13.22	4.37	10	0.10	0.16	361.83	9.86	6.14
Test for equality across deciles	634.06***	251.98***	1511.88***	4094.23***		Test for equality across deciles	315.38 ***	12.03***	285.84 ***	20.78***	75.35***
Trade											
1	0.10	0.24	-49.00	-443.52	7.66	1	0.15	0.21	-73.27	-25.93	6.63
2	0.12	0.19	-8.04	-62.47	6.94	2	0.15	0.18	6.46	0.81	5.73
3	0.13	0.17	14.03	-13.70	6.53	3	0.14	0.18	166.99	3.46	5.42
4	0.14	0.17	29.43	-1.60	6.21	4	0.14	0.17	139.23	5.31	5.27
5	0.15	0.17	43.63	2.99	5.99	5	0.14	0.17	99.68	6.55	5.12
6	0.16	0.16	60.23	4.17	5.87	6	0.15	0.17	330.03	7.69	5.03
7	0.16	0.16	222.61	2.67	5.75	7	0.15	0.17	2160.35	9.01	4.98
8	0.12	0.15	142.59	0.29	5.79	8	0.16	0.16	369.72	10.53	4.96
9	0.11	0.15	203.04	1.41	5.72	9	0.17	0.16	465.63	12.50	4.93
10	0.13	0.14	425.96	5.01	5.51	10	0.19	0.15	741.47	16.00	4.98
Test for equality across deciles	635.31***	75.03***	1151.24***	851.86***		Test for equality across deciles	642.57***	65.87***	683.04***	27.74***	1152.60***
Hospitality											

Table 4: One-year transition matrix of firms across TFP deciles.

Panel A

		t										
		1	2	3	4	5	6	7	8	9	10	
Manufacturing												
	1	65.71	19.90	5.76	2.75	1.67	1.13	0.88	0.73	0.69	0.77	100
	2	19.78	46.48	20.07	6.50	2.86	1.61	1.01	0.69	0.55	0.46	100
	3	6.21	20.67	38.57	20.29	7.26	3.23	1.66	0.99	0.61	0.51	100
	4	3.11	6.98	20.74	35.18	20.28	7.67	3.12	1.52	0.85	0.56	100
	5	1.91	3.26	7.77	20.50	34.44	20.10	7.26	2.72	1.31	0.73	100
t-1	6	1.35	1.79	3.61	8.24	20.42	35.19	19.82	6.33	2.27	0.98	100
	7	1.01	1.12	1.96	3.57	7.85	20.34	38.10	19.47	5.07	1.50	100
	8	0.80	0.76	1.09	1.77	3.16	6.92	20.28	43.83	18.31	3.08	100
	9	0.70	0.57	0.71	1.01	1.54	2.65	5.80	19.73	53.29	14.00	100
	10	0.74	0.47	0.54	0.67	0.84	1.20	1.97	3.84	16.72	73.02	100
Construction & Real Estate												
	1	46.68	19.00	8.35	5.03	3.97	3.32	3.02	2.97	3.32	4.35	100
	2	19.26	35.56	19.46	9.33	5.30	3.74	2.53	1.85	1.60	1.39	100
	3	8.32	19.42	28.90	18.85	9.88	5.94	3.54	2.35	1.64	1.16	100
	4	5.31	9.18	18.89	25.84	18.45	9.89	5.61	3.43	2.08	1.31	100
	5	3.98	5.35	9.75	18.39	24.61	18.05	10.10	5.27	2.94	1.57	100
	6	3.31	3.68	5.94	10.22	17.76	24.37	18.23	9.37	4.78	2.34	100
t-1	7	2.85	2.66	3.67	5.93	10.01	18.20	26.21	18.65	8.45	3.37	100
	8	2.66	1.91	2.53	3.50	5.52	9.92	18.90	30.08	19.01	5.98	100
	9	2.56	1.59	1.77	2.33	3.26	5.04	9.29	19.79	37.63	16.74	100
	10	2.80	1.24	1.26	1.47	1.76	2.65	3.82	7.27	19.45	58.29	100
Trade												
	1	69.65	19.41	4.98	2.31	1.28	0.77	0.47	0.35	0.28	0.50	100
	2	19.77	53.43	18.93	4.51	1.64	0.76	0.39	0.22	0.15	0.20	100
	3	6.51	19.33	48.82	18.48	4.03	1.42	0.66	0.33	0.22	0.20	100
	4	3.45	5.54	18.86	47.28	18.22	3.96	1.40	0.63	0.36	0.30	100
	5	2.07	2.32	5.03	18.63	47.05	18.32	4.09	1.44	0.64	0.40	100
t-1	6	1.34	1.09	1.91	4.80	18.91	47.35	18.81	3.91	1.31	0.59	100
	7	0.83	0.56	0.87	1.89	4.99	19.73	49.00	18.06	3.10	0.96	100
	8	0.56	0.35	0.48	0.89	1.86	4.84	19.36	53.75	15.96	1.97	100
	9	0.46	0.21	0.29	0.43	0.83	1.68	4.16	17.85	62.77	11.32	100
	10	0.51	0.23	0.22	0.32	0.48	0.72	1.20	2.66	14.00	79.66	100

Panel B

		t										
		1	2	3	4	5	6	7	8	9	10	
Transportation	1	65.71	19.90	5.76	2.75	1.67	1.13	0.88	0.73	0.69	0.77	100
	2	19.78	46.48	20.07	6.50	2.86	1.61	1.01	0.69	0.55	0.46	100
	3	6.21	20.67	38.57	20.29	7.26	3.23	1.66	0.99	0.61	0.51	100
	4	3.11	6.98	20.74	35.18	20.28	7.67	3.12	1.52	0.85	0.56	100
	5	1.91	3.26	7.77	20.50	34.44	20.10	7.26	2.72	1.31	0.73	100
	6	1.35	1.79	3.61	8.24	20.42	35.19	19.82	6.33	2.27	0.98	100
	7	1.01	1.12	1.96	3.57	7.85	20.34	38.10	19.47	5.07	1.50	100
	8	0.80	0.76	1.09	1.77	3.16	6.92	20.28	43.83	18.31	3.08	100
	9	0.70	0.57	0.71	1.01	1.54	2.65	5.80	19.73	53.29	14.00	100
	10	0.74	0.47	0.54	0.67	0.84	1.20	1.97	3.84	16.72	73.02	100

		t										
		1	2	3	4	5	6	7	8	9	10	
Hospitality	1	52.09	22.24	8.95	5.00	3.55	2.77	2.28	1.58	0.84	0.71	100
	2	18.83	36.67	21.66	10.37	5.43	3.38	2.01	0.95	0.42	0.28	100
	3	7.45	20.65	31.98	21.21	9.97	4.84	2.35	0.91	0.40	0.23	100
	4	4.22	9.28	20.55	31.60	20.79	8.39	3.33	1.18	0.41	0.23	100
	5	2.91	4.95	9.79	19.83	33.16	20.25	6.48	1.77	0.60	0.25	100
	6	2.13	3.10	4.68	8.36	19.61	37.27	19.41	3.88	1.09	0.48	100
	7	1.68	1.81	2.41	3.36	6.38	17.80	44.18	18.11	3.19	1.08	100
	8	1.02	0.73	0.87	1.12	1.66	3.76	15.66	54.16	18.16	2.85	100
	9	0.59	0.28	0.24	0.33	0.52	0.92	2.96	17.26	62.82	14.08	100
	10	0.42	0.16	0.16	0.17	0.24	0.42	0.99	2.60	15.84	78.99	100

		t										
		1	2	3	4	5	6	7	8	9	10	
Business Services	1	65.46	19.64	5.89	3.02	1.83	1.32	0.88	0.76	0.66	0.55	100
	2	19.23	45.54	20.27	7.11	3.20	1.91	1.14	0.76	0.52	0.32	100
	3	6.30	21.28	37.90	19.72	7.32	3.45	1.87	1.17	0.70	0.29	100
	4	3.34	7.77	21.00	34.53	19.49	7.49	3.39	1.72	0.85	0.41	100
	5	2.16	3.92	8.61	20.48	33.69	19.02	7.15	3.01	1.39	0.57	100
	6	1.56	2.27	4.22	8.94	20.79	33.90	18.64	6.40	2.42	0.87	100
	7	1.14	1.48	2.42	4.33	8.74	20.75	35.99	18.48	5.22	1.44	100
	8	0.89	0.99	1.38	2.39	4.15	8.54	21.07	39.77	17.65	3.18	100
	9	0.78	0.72	0.94	1.31	2.10	3.57	7.65	21.24	47.42	14.26	100
	10	0.56	0.35	0.51	0.61	0.93	1.44	2.57	5.52	19.61	67.91	100

Table 5: Five-years transition matrix of firms across TFP deciles.

Panel A

		t										
		1	2	3	4	5	6	7	8	9	10	
Manufacturing												
	1	36.29	22.38	12.69	8.14	5.46	3.85	3.34	3.19	2.37	2.28	100
	2	18.6	24.13	18.44	12.88	8.13	5.91	4.23	2.95	2.61	2.12	100
	3	9.57	17.36	20.71	17.67	11.39	8.11	5.75	4.31	3.01	2.13	100
	4	6.65	11.32	16.3	18.48	15.55	11.55	7.97	5.8	3.62	2.75	100
	5	4.94	8.34	12.11	15.72	17.58	14.08	10.84	7.41	5.13	3.85	100
	6	4.2	5.42	9.24	12.56	14.79	16.81	14.95	10.15	6.93	4.94	100
	7	3.26	4.08	7.09	9.74	13.68	15.24	16.53	14.06	10.29	6.05	100
	8	3.47	3.55	5.37	6.72	8.54	12.92	14.85	20.5	15.73	8.32	100
	9	2.84	3.13	3.38	5.84	6.64	9.1	11.84	17.38	24.05	15.79	100
	10	2.35	2.1	2.9	3.3	4.13	5.61	7.45	10.13	19.04	42.98	100
Construction & Real Estate												
	1	24.46	20.32	12.66	11.12	9.03	6.04	5.21	4.46	3.35	3.35	100
	2	14.28	21.97	19.06	12.03	11.21	7.76	5.22	3.55	2.85	2.09	100
	3	8.53	13.93	19.36	16.01	14	10.05	8.18	4.23	3.49	2.22	100
	4	6.93	10.24	13.66	15.5	16.6	12.48	9.75	7.3	4.69	2.85	100
	5	5.27	7.29	11.46	13.44	15.59	14.62	13.23	9.4	6.41	3.29	100
	6	5.46	6.44	8.88	10.63	13.32	15.22	14.34	12.88	8.78	4.05	100
	7	4.28	4.87	7.39	10.12	11.09	13.28	16.39	14.35	12.05	6.16	100
	8	3.59	3.71	5.35	6.65	8.53	12.59	14.24	19.94	16.12	9.29	100
	9	3.7	3.64	5	5.59	6.82	9.68	13	17.54	20.4	14.62	100
	10	2.80	1.24	1.26	1.47	1.76	2.65	3.82	7.27	19.45	58.29	100
Trade												
	1	36.96	25.84	13.99	8.48	5.26	3.17	2.08	1.55	1.35	1.31	100
	2	18.6	28.8	23.57	13.49	7.21	3.32	2.31	1.31	0.85	0.52	100
	3	11.83	19.25	24.78	20.19	10.91	5.79	3.26	1.92	1.2	0.86	100
	4	7.31	11.16	17.28	22.29	18.33	10.31	5.95	3.46	2.34	1.56	100
	5	4.57	5.66	11.79	16.61	20.76	18.3	10.62	6.62	3.34	1.73	100
	6	3.78	3.85	5.78	10.94	17.29	20.86	18.3	10.77	5.81	2.62	100
	7	2.41	2.3	3.48	5.47	11.34	19.51	22.52	19.62	9.49	3.86	100
	8	1.95	1.38	2.11	3.52	7.74	11.96	19.05	25.36	19.7	7.22	100
	9	1.55	1.13	1.19	2.23	4.86	7.67	13.84	22.42	29.19	15.91	100
	10	1.81	0.85	0.87	1.53	2.56	3.59	5.78	10.62	21.66	50.73	100

Panel B

		t										
		1	2	3	4	5	6	7	8	9	10	
Transportation	1	36.82	21.94	12.13	10.03	6.62	3.53	3.2	2.65	1.76	1.32	100
	2	16.36	26.09	18.42	13.96	7.78	6.29	4.35	3.2	2.29	1.26	100
	3	8.57	17.26	21.87	17.52	12.53	9.21	6.14	3.71	1.92	1.28	100
	4	6.59	11.26	16.17	18.2	18.08	12.34	7.43	5.87	2.4	1.68	100
	5	3.07	6.27	12.67	16.53	20.67	17.2	13.47	6.27	3.2	0.67	100
	6	2.95	6.16	6.56	12.05	16.73	20.21	18.47	8.97	5.76	2.14	100
	7	2.26	4.21	6.17	10.98	13.68	16.99	19.1	14.44	9.77	2.41	100
	8	2.76	3.2	4.8	6.1	6.98	13.23	19.62	22.53	16.13	4.65	100
	9	1.68	2.9	1.98	3.81	8.08	6.71	11.28	16.62	34.3	12.65	100
	10	1.24	0.28	0.96	1.65	2.2	4.81	4.26	11.69	21.32	51.58	100
Hospitality		t										
		1	2	3	4	5	6	7	8	9	10	
Business Services	1	21.76	20.43	16	12.3	9.38	8.04	5.81	2.97	1.55	1.76	100
	2	14	18.4	18.1	16.99	13.04	8.95	5.01	3.03	1.37	1.11	100
	3	8.09	13.6	20.17	20.17	16.69	10.73	6.01	2.92	1.07	0.56	100
	4	6.02	10.34	17.98	19.17	19.49	14.47	8.15	2.32	1.07	1	100
	5	5.82	10.06	12.8	17.45	20.05	16.5	10.75	3.56	1.98	1.03	100
	6	4.61	7.51	9.1	12.52	18.13	18.46	17.93	7.05	3.23	1.45	100
	7	3.68	5.28	6.32	8.83	10.91	16.61	21.75	16.47	7.64	2.5	100
	8	2.56	2.56	4.43	3.44	5.02	9.06	15.85	26.18	21.26	9.65	100
	9	1.77	2.33	1.99	2.88	2.21	3.77	6.42	20.82	37.98	19.82	100
	10	0.95	0.43	0.78	0.61	1.65	1.82	3.47	8.76	26.45	55.07	100
Business Services		t										
		1	2	3	4	5	6	7	8	9	10	
Business Services	1	33.28	21.59	13.45	8.36	5.32	5.13	4.11	3.19	3.45	2.13	100
	2	15.62	27.18	18.87	12.73	8.56	6.01	3.63	3.3	2.3	1.8	100
	3	9.1	17.58	21.72	17.44	11.53	7.91	5.53	4.29	2.81	2.1	100
	4	6.73	12.4	16.47	17.83	16.13	11.09	7.9	5.91	3.68	1.84	100
	5	5.1	10.14	14.21	15.14	16.46	14.65	9.21	6.66	4.75	3.67	100
	6	4.26	6.73	10.89	13.56	15.79	15.94	13.37	10.59	5.54	3.32	100
	7	4.33	6.71	7.37	9.56	12.27	15.65	16.32	13.7	9.28	4.8	100
	8	2.75	4.93	6.67	7.94	9.86	11.99	18.36	18.01	13.56	5.93	100
	9	3.3	3.01	4.04	6.48	8.3	9.95	12.55	17.04	21.13	14.2	100
	10	2.2	2.27	3.04	3.53	5.21	6.75	9.02	13.98	20.73	33.28	100

Table 6: Distribution of TFP by firm age.

	TFP decile	Young firms	Incumbents		TFP decile	Young firms	Incumbents
Manufacturing	1	15.10	9.13	Construction & Real Estate	1	11.49	9.52
	2	11.43	9.76		2	12.48	9.20
	3	9.89	10.02		3	11.50	9.52
	4	9.05	10.16		4	10.39	9.87
	5	8.34	10.28		5	10.01	10.00
	6	8.09	10.33		6	9.39	10.20
	7	7.97	10.34		7	8.85	10.37
	8	8.02	10.34		8	8.59	10.45
	9	8.86	10.19		9	8.51	10.48
	10	13.24	9.45		10	8.79	10.39
Trade	1	14.18	8.98	Transportation	1	10.84	9.77
	2	11.86	9.55		2	10.76	9.78
	3	10.80	9.81		3	10.90	9.75
	4	10.39	9.90		4	10.64	9.82
	5	9.78	10.05		5	10.43	9.88
	6	8.98	10.25		6	10.14	9.96
	7	8.37	10.40		7	9.83	10.05
	8	8.01	10.48		8	9.41	10.17
	9	8.14	10.45		9	8.44	10.44
	10	9.48	10.12		10	8.61	10.39
Hospitality	1	15.76	7.57	Business Services	1	12.43	9.34
	2	13.22	8.64		2	10.59	9.84
	3	11.69	9.29		3	9.46	10.15
	4	10.72	9.69		4	9.02	10.26
	5	10.15	9.94		5	8.71	10.35
	6	10.06	9.98		6	8.67	10.36
	7	9.33	10.28		7	9.02	10.27
	8	6.55	11.45		8	9.62	10.10
	9	5.53	11.88		9	10.43	9.88
	10	6.98	11.27		10	12.05	9.44