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SOURCES AND IMPLICATIONS OF RESOURCE MISALLOCATION: NEW EVIDENCE FROM FIRM-LEVEL MARGINAL PRODUCTS AND USER COSTS

by Simone Lenzu* and Francesco Manaresi**

Abstract

Using micro-data on firm-specific borrowing costs and wages, we demonstrate that distortions in firms' policies can be empirically measured using firm-level gaps between marginal revenue products and user costs (MRP-cost gaps). We estimate MRP-cost gaps for 4.7 million firm-year observations in Italy between 1997 and 2013: their variation is closely related to the extent of credit and labor market frictions. Using the MRP-cost gaps, we assess the scope of input misallocation in Italy, and its impact on aggregate output and total factor productivity (TFP). The Italian corporate sector could produce 6% to 8% more output by reallocating resources toward higher-value users. Output losses from misallocation are larger (i) during episodes of financial instability, (ii) in non-manufacturing industries, (iii) in areas with less developed institutions and (iv) among high-risk firms. We highlight an important gain/risk tradeoff: gains from reallocation might come at the expense of increasing aggregate financial fragility, because maximizing reallocation gains requires a transfer of resource from large, old, and low-risk firms toward small, young, and high-risk firms.

JEL Classification: O16, O40, E24.
Keywords: total factor productivity, economic development, policy distortions.

Contents

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1 Introduction

Are resources allocated efficiently in the economy? And if they are not, how can we measure the extent of misallocation in the micro-data and gauge its implications for aggregate productivity and economic growth? These questions are of fundamental importance to both researchers and policymakers given the growing body of empirical evidence suggesting persistent differences in the efficiency of resource allocation could be a fundamental driver behind differences in income per capita across countries (Banerjee and Duflo 2005; Restuccia and Rogerson 2013; Hopenhayn 2014).

An intuitive way to conceptualize misallocation is to think of frictions and distortive regulations as implicit, heterogeneous taxes that generate wedges in the first-order conditions characterizing firms' investment and employment policies (Chari et al. 2007; Restuccia and Rogerson 2008). The implication of these taxes is that some producers are too large whereas others are too small relative to their "socially efficient" size, thereby squandering scarce resources and reducing aggregate productivity and economic growth. Relying on this powerful insight, previous research has developed indirect measures of the efficiency losses imputable to resource misallocation. Most notably, the seminal work of Chang-Tai Hsieh and Peter Klenow (2009) – hereafter HK – developed an appealing model-based measure that offers persuasive conclusions about the allocative efficiency losses in China and India relative to the US. Recent research, however, questioned the empirical validity of the aggregate assessments produced by the HK methodology, arguing the mapping from observed dispersion in revenue productivity (TFPR) to misallocative distortions rests on strict assumptions on both the demand and supply side of the firm, which are found to have limited support in the data (Haltiwanger et al. 2017). Lacking direct, micro-level measures of firm-specific deviations from "optimal" investment and employment policies, it is difficult to evaluate the extent to which wedges indirectly inferred from any given model can be attributed to specific market frictions (e.g., financial frictions, labor market rigidities, or frictions in the market of firm ownership and control), as opposed to heterogeneity in fundamentals, real adjustment costs (Asker et al. 2014; David and Venkateswaran 2017), uncertainty (Bloom 2009), risk (David et al. 2018), or measurement-related issues (Bils et al. 2017).

This paper tackles this question by shedding light on the distribution of the firm-level gap between marginal revenue products of capital and labor and their user costs (MRP-cost gaps), which characterize firms policies in an undistorted environment. We provide evidence linking variation in firm-level gaps to specific market frictions and regulations. Then we show how to use our micro-estimates to quantify the impact of resource misallocation on aggregate TPF and output, thereby studying how gains from reallocation vary over the business cycle and in different subsets of the economy.

Overcoming the data limitations of previous research, we assemble a comprehensive bank-firm-employee matched panel dataset that contains information on firm-level wages, borrowing costs, and production and financing decisions to estimate firm-level MRP-cost gaps for the non-financial corporate sector in Italy between 1997 and 2014. We link the census of corporations to the archives of the national Credit Register and to employer-employee records obtained from the social security administration. The coverage, granularity, and richness of our data allow us to structurally estimate the distribution of marginal revenue products of primary inputs, and puts us in the unique position of observing the user cost of both capital and labor at the firm-year level.

To develop intuition on the economics underlying the relation between MRP-cost gaps and market distortions, let us consider a neoclassical environment with homogeneous producers and no risk. When input policies are fully unconstrained, firms accumulate assets and hire labor up to the point where marginal revenue products are equal to the user costs they face. We show this intuition can be generalized to a more realistic framework with heterogeneous producers, where capital structure matters and default risk is endogenous. This approach captures the idea that producers may face differential relative costs when they try to acquire capital and labor inputs in the market, either because of implicit costs or because they face quantity constraints (shadow prices). In particular, when debt is the marginal source of financing, the gap between the marginal revenue product of capital and its user cost (the sum of the interest rate and the depreciation rate on the capital stock) is linearly related to the shadow cost of funds generated by binding credit constraints (Stiglitz and Weiss 1981, 1992). Similarly, the gap between the marginal revenue product of labor (MRPL) and the wage is proportional to the implicit cost of labor that firms face, such as the costs driven by regulatory interventions in labor markets (Petrin and Sivadasan 2013).

Our research has three primary empirical results. First, we characterize the distributions of MRP-cost gaps of capital and labor, which the literature has been unable to observe so far due to lack of information on firm-specific user costs. The distributions of MRP-cost gaps of both capital and labor are largely dispersed and right-skewed, with the median firm facing an implicit tax of 14% on capital and of 37% on labor. On average, these taxes are much larger: over 100% on capital and 60% on labor. In other words, the user cost that would rationalize the estimated marginal products are twice as large as the observed user costs of capital and 60% larger than the observed user costs of labor. Despite access to capital and labor markets is quite expensive for many firms in the economy, the investment and employment choices of other producers appears consistent with a subsidized access to factor markets (negative taxes). Taken together these findings suggest aggregate output gains might be achieved through a more efficient allocation of resources.

The second empirical result of the paper consists of providing empirical micro-economic evidence that links the sign, magnitude, and dispersion of MRP-cost gaps to specific market frictions faced by individual producers. We focus on the scope of asymmetric information in credit markets and on the impact of regulations that generate implicit costs of labor that vary as a function of firm size.

We use detailed information on the length of the lending relationships of a firm with its lenders to construct an empirical proxy of the degree of credit market frictions faced by individual firms. This proxy captures the idea that repeated interactions with financial intermediaries allow firms to overcome possible asymmetric information frictions, and gradually accumulate a capital endowment consistent with profit maximization (Diamond 1991; Petersen and Rajan, 1994). We find a monotonic negative relation between MRP-cost gaps for capital and the length of the lending relationships. This relationship is evident in the row data. It is remarkably robust after controlling for a rich set of covariates that capture differences in firms life cycle, risk, and fundamentals, and it holds if we focus only on within-firm variation controlling for firm fixed effects. We also show the benefits of repeated bank-firm interactions are entirely borne to borrowers that operate with an insufficient capital endowment and are stronger for highly productive firms. These findings are consistent with the predictions of economic theory: MRP-cost gaps capture heterogeneous shadow costs of capital, which, ceteris paribus, are higher for productive credit-constrained firms.

On the labor side, we study the relation between MRP-cost gaps and regulations that impose heterogeneous labor costs that vary as a function of firm-size. We show the interplay of the size-dependent provisions and wage rigidities differentially distort employment policies of firms of different sizes. Although labor gaps appear to be (nearly) monotone in firm size, we observe kinks around the regulatory thresholds, which suggests the heterogeneous implicit costs of labor due to government interventions discourage firms from scaling-up production despite the possible availability of growth opportunities.

Importantly, our analysis sheds light on the relative importance of the price channel versus the quantity channel in the transmission of frictions and regulations to the real economy, highlighting that market prices are not the instruments that allocate resources across credit and labor market participants. In fact, for both capital and labor, the cross-sectional dispersion of MRP-cost gaps and the relation between gaps and market frictions is almost entirely driven by variation in marginal revenue products. Borrowing costs and wages, by contrast, display a limited cross-sectional variation.

The third set of results in this paper casts light on the aggregate implications of resource misallocation. We use MRP-cost gaps to estimate how idiosyncratic distortions in input policies translate into aggregate output and total factor productivity (TFP) losses in Italy and to document how gains from reallocation evolved over time and how they differ across sectors and different geographical regions. We calculate that, over our sample period, aggregate TFP and output of the Italian corporate sector could be 6%–8% higher following a reallocation of production factors, by taking resources away from firms that over-utilize them, and redistributing those resources to more productive firms in the same industry that are lacking them. We find that gains from reallocation are higher during periods that are characterized by financial instability – the financial crises and following the burst of the sovereign debt crisis – compared to those estimated during the 1997-2004 period.

Examining where gains from reallocation originate, we find significant cross-sectoral heterogeneity, with the scope of misallocation being greater outside of manufacturing industries (i.e., services and construction). This finding is important because data constraints have forced most of the existing literature to focus on data from manufacturing industries.[1] Thus, researchers might

[1]Relatively few papers have addressed misallocation in the service sector. Those empirical studies that do, also find the scope of misallocation appears to be larger in services sectors than in manufacturing (Busso et al. 2013;

underestimate the extent of resource misallocation by generalizing evidence from manufacturing industries to the whole economy. In the cross-section, we document that the subset of firms with high ex-ante credit risk experience both larger losses due to misallocation and a greater exacerbation of these losses during financial crisis. Examining the spatial variation in misallocation in Italy, we document larger output and TFP losses directly imputable to misallocation in regions characterized by weaker financial markets and socioeconomic institutions (Shleifer, 1998; Wurgler, 2000; Guiso et al., 2006).

A key advantage of our bottom-up approach to measuring aggregate gains from reallocation is the ability to transparently investigate a possible trade-off that a reallocation of resources might pose. In fact, a concern is that part of the potential gains from reallocation might not be feasible or desirable. For example, an efficient reallocation might require machines and workers to be re-deployed across distant locations, or output gains might come at the expense of increasing the volatility of the economy and the fragility of the credit system. Constraining capital and labor flows to take place within the same industry-regions does not substantially reduces gains from reallocation. However, our analysis highlights an important gain/risk tradeoff. Holding risk constant reduces reallocation gains by two-thirds, which suggests closing MRP-cost gaps requires a reallocation of resource from large, old, and low-risk firms toward small, young, and high-risk firms in the economy.

This paper speaks to the literature that studies the impact of a suboptimal allocation of resources on aggregate TFP and output (Banerjee and Duflo 2005; Restuccia and Rogerson 2008; Hsieh and Klenow 2009; Petrin et al. 2011; Gilchrist et al. 2013; Bartelsman et al. 2013).[2] Our contribution is twofold. First, to the best of our knowledge, ours is the first paper characterizing the empirical distribution of firm-level deviations in first-order conditions using detailed micro-data on *both* borrowing costs and wages, and to use these micro-estimates to provide macro assessments. Our bottom-up approach to estimating gains from reallocation does not rely on the distinction between a firm's physical productivity and its revenue productivity, thereby not resting on strict assumptions on a firm's demand and production technologies (Haltiwanger et al. 2017). Secondly, substantial empirical evidence documents declines in aggregate TFP and output during economic downturns and, in particular, following episodes of financial instability (Calvo et al. 2006; Jermann and Quadrini 2012). An open question is whether a change in the scope of resource misallocation, on top of (or instead of) technology shocks, contributes to explaining the co-integration of business-cycle fluctuations and aggregate TFP.[3] Our results speak to this question by showing that episodes of financial markets disruptions are characterized by a reduction in aggregate TFP due to a deterioration of allocative efficiency (Herrera et al. 2011; Gopinath et al. 2017; Oberfield 2013;

De Vries 2014; Dias et al. 2016).

[2]A number of papers have explored the role played by different economic forces on resource misallocation in capital and labor markets. Among them Asker et al. (2014), Midrigan and Xu (2014), Moll (2014), Garicano et al. (2016), Peters (2016), David et al. (2016), David and Venkateswaran (2017), and David et al. (2018). See Restuccia and Rogerson (2013), Hopenhayn (2014), Eisfeldt and Yu (2018), and Restuccia and Rogerson (2017) for a review.

[3]Eisfeldt and Rampini (2006) and Kehrig (2015) study allocation gains and productivity dispersion over the busyness cycle, showing both of them display countercyclical dynamics.

Sandleris and Wright, 2014; Schivardi et al. 2017).[4]

More broadly, our research connects to the literature in corporate finance and labor economics interested in studying the impact of market frictions and regulations on firms' real activity. The empirical measures produced and analyzed in this paper (MRP-cost gaps) are tightly linked to theory and, because they vary both between and within firms, they allow us to produce empirical tests that shed light on the differential impact of specific market distortions across heterogeneous types of firms. On the investment side, we see MRP-cost gaps as a particularly appealing empirical tool for researchers seeking to identify firms that are more likely to be sensitive to changes in the availability of external financing and for those interested in measuring the real effects of financial frictions, both of which are key topics in corporate finance and applied macroeconomics.[5] The value added of our approach is particularly evident when studying investment policies of privately owned firms. For these firms, traditional measures such as Tobin's Q (Hayashi 1982; Abel and Eberly 1994) or popular indexes of financial constraints (Kaplan and Zingales 1997; Whited and Wu 2006) are not computable, because no information is available on the market value of their assets and liabilities. By contrast, the estimation of MRP-cost gaps requires standard product variables and information on user costs, both of which are observable for private firms, and are becoming accessible to researchers as more administrative databases are being disclosed. On the labor side, the analysis of the effects of size-dependent regulations connects this paper to a strand of empirical works in labor economics (Schivardi and Torrini 2008; Hijzen et al. 2013; Bertrand et al. 2015) and applied macroeconomics (Guner et al. 2008; Petrin and Sivadasan 2013; Garicano et al. 2016).[6] Given the widespread presence of size-dependent regulations across countries, and the evidence on the comparability of labor demand functions around the world (Hamermesh 1996; Heckman et al. 2006), the empirical findings in this paper are likely applicable to other countries and to similar types of labor market interventions.

The paper is organized as follows. Section 2 describes the data and the institutional features of the Italian credit and labor market that are relevant for our analysis. Section 3 presents the theory underpinning the MRP-cost gaps and illustrates their relationship to market frictions. Section 4 estimates the gaps and characterizes their empirical distribution. Section 5 explores the relationship between MRP-cost gaps and credit and labor market frictions. We examine the aggregate implications of resource misallocation in section 6. Section 7 concludes.

[4]Two recent papers examine the aggregate costs generated by financial frictions: Chaney et al. (2017) focus on firm-specific collateral constraints and Whited and Zhao (2017) on firms' capital structure.

[5]A companion paper (Lenzu and Manaresi 2018) uses MRP-cost gaps to study the heterogeneous sensitivity of investments to external financing and evaluates the efficiency of credit allocation and its implications for capital allocation.

[6]The analysis of the economic effects of firing costs in Hopenhayn and Rogerson (1993) is one of the earliest studies of misallocation due to regulation. See Cooper and Willis (2009) for a study of the aggregate implications of different forms of establishment-level labor adjustment costs.

2 Data and Institutional Context

We assemble a comprehensive employee-employer-bank matched database that contains micro-level information on firm-specific wages, borrowing costs, balance-sheet data, and bank credit for the lion's share of non-financial incorporated firms that were active in Italy between 1997 and 2013. We assemble our data by merging and harmonizing different administrative and proprietary sources.

We collected detailed information on yearly balance sheets, income statements, and registry variables from Cerved Group S.p.A. (Cerved database).[7] We merge the firm-level dataset with the archives of the national Credit Registry (CR) administered by the Bank of Italy, and to matched employer-employee records from the Italian National Social Security Institute (INPS). The CR provides us with information on firms' credit market participation, debt exposure, and corresponding borrowing cost (interest rates) for each bank-firm credit relationship. The Social Security records allow us to observe wages and a detailed snapshot of firms' workforce composition. We complement these data with information on industry-specific price deflators, industry-specific depreciation rates of fixed assets, and socioeconomic indicators measured at the province level, all of which are collected from the publicly available archives of the Italian National Statistical Institute (ISTAT).[8]

Our final dataset includes over 4.7 million firm-year observations, 7,300 thousand firms, and 13.3 million credit relationships. It amounts to approximately 90% of the value added produced by the corporate sector in the selected industries, and over 70% of the total value added produced by the whole Italian corporate sector.[9] To the best of our knowledge, ours is the first longitudinal dataset that provides information on both production and financing, as well as firm-specific wages and borrowing costs for the large majority of the corporate sector of a country. Table 1 reports the summary statistics of the main variables used in our analysis.

Appendix A provides a detailed description of each variable and of the steps followed to clean the database. Our sample is composed predominantly of small and medium enterprises, matching the size and industry distribution of Italian firms.[10] 224 companies in the Cerved sample are unlisted, makes our dataset particularly suited for the purpose of studying market failures. Frictions are expected to have a greater impact on small and young firms (Gertler and Gilchrist 1994; Petersen

[7]Our database includes only incorporated businesses (limited liability companies), but not sole proprietorship and other non-incorporated firms. The unit of observation is a firm-year. No plant-level information is available. Compared to other publicly available datasets (e.g., Orbis and Amadeus by Bureau van Dijk Electronic Publishing; see Kalemli-Ozcan et al. 2015), our database has the advantage of having no selection bias, no issues with merging different vintages, and a substantially richer set of balance sheet, income statement, and registry variables.

[8]Data available at https://www.istat.it/en/.

[9]We drop the following industries: Agriculture, Mining and quarrying, Utilities, Public administration and National defense, Education, Health services, Activities of membership organizations, Activities of households as employers, and Activities of extraterritorial organizations and bodies to avoid dealing with firms with complete or partial government ownership, or heavily subsidized by the government; Financial and insurance activities and Real estate activities because firms operating in these industries are themselves credit providers. See Appendix A for further details.

[10]The median firm in our dataset collects 825 thousand euros per year in revenues, has a book value of fixed assets worth 706 thousand euros, and only 6 employees (average number of employees through the year). The macro-industry composition mirrors the one of the Italian economy: 30% of the observations refer to firms operating in manufacturing (23% of the firms); 54% of firms operating in the service sector (61% of the firms); 16% of firms in construction industry (16% of the firms).

Table 1: **Summary statistics**

This table reports the summary statistics of the main variables used in the paper. A description of the variables is provided in Section 2 and Appendix A.

	Mean	Std	p10	p25	p50	p75	p90
Revenues	3245	9757	144	321	816	2232	6058
Total Assets	2996	9118	127	280	722	2010	5594
Age	14	12	3	5	11	19	29
Employees	16	35	1	3	6	14	32
Assets Turnover	1.43	1.03	0.44	0.78	1.23	1.78	2.53
ROA	0.03	0.17	-0.08	0.01	0.04	0.09	0.16
Cash Flows / Assets	0.05	0.16	-0.04	0.02	0.05	0.10	0.17
Bank Leverage	0.43	0.44	0.00	0.06	0.34	0.64	0.96
Length Relations^{mean}	3.7	2.7	0.9	1.8	3.1	5.1	7.5
Length Relations^{wmean}	4.0	3.0	1.0	1.8	3.3	5.5	8.2
Length Relations^{lead}	4.3	3.8	0.8	1.5	3.0	6.0	10.0
Number Relations	3.9	3.3	1.0	2.0	3.0	5.0	8.0
Credit Rating	5.4	5.8	2.0	4.0	5.0	7.0	8.0
Borrower	0.80						
Manufacturing	0.30						
Services	0.54						
Construction	0.16						
Observations	4735938						
Firms	735375						

and Rajan 1994; Chodorow-Reich 2014; Bottero et al. 2017).

About 80% of the firm-year observations report access to some form of bank credit (Borrower=1); only 9% of firms never engaged in any type of credit market transaction at some point between 1997 and 2013. Bank debt is worth, on average, 43% of firm total assets (54%, if we consider only firms with outstanding debt obligations).

Exploiting the panel dimension of the CR database, we gauge information on the number and length of active credit relationships between firms and individual credit institutions. On average, firms have four active credit relations with financial intermediaries (Number Relations$_{it}$).[11] The variable Length Relation$_{it}$ = $\sum_{b\in\mathcal{N}_{it}^B}\frac{\text{Credit}_{ibt}}{\text{Credit}_{it}}\cdot$ Length Relation$_{ibt}$ measures the (weighted) average length of active relations, where Length Relation$_{ibt}$ is the number of years of continuous relationship between firm i and its lender b, and $\mathcal{N}_{it}^B$ is the set of all its active lenders at time t, and $\frac{\text{Credit}_{ibt}}{\text{Credit}_{it}}$ is the share of total credit provided by each lender. By construction, our measure of relationship length is bounded between 0 (no credit relations) and 16 years (the span of our sample). The data highlight that credit relationships, once established, tend to be quite stable. The average relationship lasts over 3.9 years, which represents about one-third of the time span of our sample.

For each firm-year observation, we have information on their Credit Score measured by a discretization of the Altman Z-score (Altman 1968; Altman et al. 1994). This credit-rating metric is widely used by Italian financial intermediaries in their assessment of firms' creditworthiness (see

[11]Multi-bank relations are a wide-spread phenomenon in business lending, including the US (Detragiache et al. 2000).

Albareto et al. 2011). It ranges from 1 to 9, with lower numbers (1–4) indicating high solvency and low risk, and higher numbers (7–9) indicating troubled economic conditions and high default risk. Return on Assets (ROA), Assets Turnover (Revenues/Assets), and Cash Flows/Assets are measures of profitability, also commonly used in banks' credit assessments.

3 A Theory of Gaps

Let us consider a neoclassical environment with homogeneous producers and no risk. When input policies are fully unconstrained, firms accumulate assets and hire labor up to the point where their marginal revenue products are equal to their user costs. In this section, we show this intuition can be generalized to a more realistic framework with heterogeneous producers, where capital structure matters and default risk is endogenous. Appendix C provides a full description of the model.

Economic environment – Consider a firm run to maximize the present discounted value of cash flows to risk-neutral shareholders in an environment where firms are heterogeneous with respect to the realization of firm-specific revenue productivity (ω_{it}, TFPR). Every period, the manager observes the realization of productivity, and then he decides whether (i) to repay its outstanding debt or (ii) default and exit. From a firm's standpoint, a default on bank debt is the optimal decision when the realization of ω is below an endogenously determined threshold level $\bar{\omega}$ (Hennessy and Whited 2007).[12] If the firm is worth more as an ongoing concern, the manager repays its obligations and he chooses new factor demands (capital K_{it+1}, labor L_{it}, and intermediate inputs M_{it}) and how to finance these purchases (bank debt B_{it+1}, internally generated cash flows, or capital injection from shareholders). In case of default, creditors acquire ownership and control of the firm. They produce during the current period and liquidate the firm at the end of the period. We assume liquidation is costly, as a fraction $X \geq 0$ of firm assets are lost during the bankruptcy process.

Firm policies and MRP-cost gaps – We heuristically characterize firms' investment policies using the augmented Euler equation of capital and the first-order condition for labor.

We assume new capital injections from shareholders are costly and restrict our attention to cases in that debt is the marginal source of financing for incremental investment, an assumption which is largely consistent with the patterns in our data and in line with previous literature on equity financing (Greenwald et al., 1984; Myers and Majluf 1984; Stiglitz 1992).[13] We consider a credit market where lenders offer loan contracts that consist of a single interest rate for each

[12]Revenue productivity is a combination of technical Hicks neutral productivity and consumer demand (Foster et al., 2008). We assume TFPR evolves stochastically following a first-order Markov process. Because today's investment becomes productive tomorrow ($K_{it+1} = (1-\delta)K_{it} + I_{it}$), uncertainty about the realization of ω_{it+1} generates idiosyncratic investment risk, which makes capital and debt imperfect substitutes in the firm's problem and generates endogenous default risk.

[13]This assumption is largely consistent with what we find in our data, in which over 99% of firms are not listed in the stock market, and 80% of the firm-year observations borrow from financial institutions to finance their operations. Of the remaining 20% of the observations, 80% finances capital expenditure with some combination of self-financing and trade credit, and less than 5% uses only capital from shareholders, either in the form of debt from shareholders or in-kind contributions.

group of observationally similar firms ($r_{it+1} = \bar{r}_{t+1}$), and deal with diversity by rationing those firms within the group that have a loan demand exceeding the loan offer (Stiglitz and Weiss 1981), which is tied to firms' net worth $B_{it+1} \leq \lambda_{it} K_{it+1}$, $\lambda_{it} \geq 0$ (Kiyotaki and Moore 1997).[14] A lower λ reflects higher deadweight costs of bankruptcy and/or a higher perception of credit risk by banks. As a result, a firm might prefer to pay a higher interest rate in order to obtain a larger loan, but charging higher interest rates would conflict with the purpose of the bank and its classification scheme. We return to this point below.

In this environment, conditioning on non-zero investment, the investment optimality condition is characterized by the following equation:[15]

$$\begin{aligned}\rho \int_{\bar{\omega}}^{\infty} \left[MRP_{it+1}^{K} - (\bar{r}_{t+1} + \delta) \right] d\Phi(\omega_{it+1}|\omega_{it}) = \quad & \psi_2^K(K_{it}, K_{it+1}) + \rho \int_{\bar{\omega}}^{\infty} \psi_1^K(K_{it+1}, K_{it+2}) d\Phi(\omega_{it+1}|\omega_{it}) + \\ & \chi_{it}(1-\lambda_{it}) \\ & \equiv \tau_{it}^{K} \,. \end{aligned} \tag{1}$$

where $\Phi(\omega_{it+1}|\omega_{it})$ denotes the conditional density function of TFPR and ρ is a risk-neutral time discount rate.[16] The left-hand side represents the difference between the marginal revenue product of capital and the user cost of capital ($r_{it+1} + \delta$). On the right-hand side, the first line denotes real adjustment costs of capital (Cooper and Haltiwanger 2006). $\psi^K(K_{it}, K_{it+1})$ is an adjustment cost function of capital, and $\psi_j^K(\cdot)$ is the derivative with respect to its jth argument. The existence and impact of these costs on investment policies might be related to firms' life cycle (e.g., age and size) or product market conditions. The second term - $\chi_{it}(1 - \lambda_{it})$ - is the *shadow cost of funds* firms face. In the presence of binding credit constraints, the gap between the marginal revenue product and the user cost of capital is an increasing function of the multiplier attached to the borrowing constant ($\chi_{it} \geq 0$) and of the tightness of the constraint $(1 - \lambda)$. We group the terms on the right-hand side and denote them by τ_{it}^K. Abstracting from the impact of adjustment costs, MRP-cost gaps are positive for credit-constrained firms. Their magnitude is proportional to the degree of credit market frictions that individual producers face (e.g., asymmetric information frictions and bankruptcy costs).

Similarly, we express the first-order condition that characterizes optimal employment policies isolating the difference between the Marginal product of labor and its user cost (w_{it}) from a residual

[14] The interest rate $\bar{r}_{it+1}$ and the tightness of the borrowing constraint λ_{it} are set jointly to maximize bank profits when lending to firms similar to firm i. Pooling observationally similar borrowers, banks set the interest rate based on the expected probability of default for firms similar to firm i, and may cope with risk imposing a borrowing constraint that links credit supply to firms' net worth. For every group of similar borrowers, banks can choose multiple lending contracts, defined by the pair $(\bar{r}, \lambda)$. For example, a competitive lender might follow a two-step optimization process. As a first step, interest rates are chosen to maximize expected profits from borrowers similar to type i. Then λ_{it} is chosen to satisfy the zero-profit condition, irrespective of firm-specific productivity, which is unobservable to the bank. A similar two-step optimization can be followed by a monopolistic competitive lender that faces a downward-sloping residual demand for its financial services.

[15] Gopinath et al. (2017) derive a similar expression in a model with no default risk.

[16] The assumption of risk neutrality allows us to abstract from the impact of aggregate risk and the implications of dispersion in risk-premia in the cross-section of firms (see David et al. 2018). We return to this issue in section 4.

quantity τ^L_{it}

$$MRP^L_{it} - w_{it} = \psi^L_2(L_{it-1}, L_{it}) + \rho \int_{\omega}^{\infty} \psi^L_1(L_{it}, L_{it+1}) d\Phi(\omega_{it+1}|\omega_{it}) \equiv \tau^L_{it} \, . \tag{2}$$

Intuitively, when labor is flexibly hired on the spot market after the realization of productivity, firms choose labor demand equalizing the marginal revenue product of labor to the wage rate. The presence of labor adjustment costs ($\psi^L(L_{it-1}, L_{it})$) invalidates this neoclassical prediction (Cooper and Willis 2009).[17] As we will discuss in section 5.3, the incidence of adjustment costs that vary as a function of firm size is particularly relevant for the purpose of this paper. Consider the following adjustment cost function:

$$\psi^L(L_{it-1}, L_{it}) = \begin{cases} \frac{c^L}{2} \frac{(\Delta L_{it})^2}{L_{it-1}} & if \quad L_{it-1} < \bar{L} \\ \left(\mathbf{1}_{[\Delta L_{it}<0]} \, f^L\right) \Delta L_{it} + q^L L + \frac{c^L}{2} \frac{(\Delta L_{it})^2}{L_{it-1}} & \text{otherwise}\, , \end{cases}$$

where $f^L > 0$ is a cost that firms have to pay when they lay off workers. $q^L > 0$ is an additional cost per worker, besides the wage rate.[18] An example of such costs are government-mandated severance payments and expected costs associated with the government-mandated quotas for workers in protected categories. Only firms that employ more than $\bar{L}$ workers face the costs f^L and q^L. If not undone by wage bargaining (Lazear 1990), these size-dependent costs increase the implicit cost of labor and generate variation in marginal revenue products of labor across firms. Because both costs are borne by companies whose employment is above the size threshold $\bar{L}$, MRP-cost gaps for labor are expected to display a discontinuous behavior around the threshold.

Discussion – The characterization of firm policies in terms of MRP-cost gaps is convenient. From an empirical point of view, realized MRP-cost gaps are measurable quantities, once estimates of marginal revenue products and information of user costs are available. Thus, they can be used to cast light on the distribution of the unobservable residuals τ^K_{it} and τ^L_{it}, and to test the incidence of specific types of frictions and regulations that affect firm policies. On the capital side, the gap τ^K_{it} is a particularly valuable empirical tool for investigating the efficiency of investment policies for privately owned firms. For them, traditional measures, such as Tobin's Q or other indexes of financial constraints (e.g., Kaplan and Zingales 1997; Whited and Wu 2006), are not computable because, no information is available about the market value of a firm's assets and liabilities.[19]

The role played by price adjustments in credit and labor markets, or lack of adjustment thereof, is important in interpreting the sign and magnitude of MRP-cost gaps. As shown in equations (1) and (2), when borrowing costs and wages do not vary to accommodate factor demands of heterogeneous producers, MRP-cost gaps capture the pass-through of credit and labor market

[17] González and Miles-Touya (2012) and Petrin and Sivadasan (2013) construct similar value of the marginal product minus wage gaps to study the impact of changes in the employment protection regulation in Chile and Spain.

[18] Section 5.3 provides an example of labor market regulation that requires firms to employ a minimum share of their workers with disabilities, with this share changing as a function of firm size.

[19] In Appendix C, we show that MRP-cost gaps are positively related. Thus, high MRP-cost gaps are a reflection of both high financial constraints and high investment possibilities.

frictions to firm policies via distorted accumulation of capital and labor. The interpretation of τ^K and τ^L changes when prices are the instruments that allocate resources in capital and labor markets.

In Appendix C, we consider a credit contract by which banks do not constrain their credit supply but adjust the interest rate as a function of firm characteristics (bank leverage, capital endowment, productivity) and in response to credit market frictions (bankruptcy costs): $r_{it+1} = r(K_{it+1}, B_{it+1}, \omega_{it}, X)$. Under this credit contract, anything that affects the firm-specific likelihood of default, cost of credit provision, or loss given default affects individual firms' investment decisions and the allocation of credit through an adjustment of the cost of credit. In this case, the term $\chi_{it}(1 - \lambda_{it})$ is replaced by the term $\left(\frac{\partial r_{it+1}}{\partial K_{it+1}} + \frac{\partial r_{it+1}}{\partial B_{it+1}}\right)$, and positive gaps would no longer signal constrained access to credit.

Similarly, the characteristics of the wage contract affect the interpretation of the labor gap. Since the seminal work of Lazear (1990), it is well known that, in the absence of contractual and market frictions, the costs f^L and q^L can be neutralized by an appropriately designed wage contract: The firm reduces the entry wage of the worker by an amount equal to the expected present value of the future transfer, so as to leave the expected cumulative wage bill arising from the employment relationship unchanged. On the contrary, when wages are inflexible, firms resort to quantity adjustments that are then reflected in the distribution of τ^L.

The literature suggests several explanations for why the price terms in credit and employment contracts might be rigid. Prominent examples are asymmetric information frictions (Stiglitz and Weiss, 1981, 1992; Campbell III and Kamlani 1997), imperfect competition (Petersen and Rajan 1995; Ashenfelter et al. 2010), and government interventions that prevent or limit price discrimination, forcing sellers/buyers of credit or labor services to charge/demand the same price in types of transactions that are intrinsically different (Calmfors and Horn 1986; Benmelech and Moskowitz 2010; Banerjee and Duflo 2014; Hurst et al. 2016). In section 5, we document a relative stickiness of interest rates and wages, and provide evidence that is consistent with changes in credit limits and in employment as the primary margin of adjustment in response to credit and labor market frictions.

Finally, note that besides credit and labor markets frictions, other phenomena contribute to the size and dispersion of realized MRP-cost gaps. Equations (1) and (2) highlight that economic uncertainty and real adjustment costs naturally drive a wedge between realized marginal revenue products and user costs (Asker et al. 2014; David and Venkateswaran 2017). Also, market power and imperfect competition (Peters 2016), heavy taxation, corruption, the bureaucratic costs of doing business, tariffs and subsidies, and frictions in the market of corporate ownership and control also drive a wedge between user costs and marginal revenue products of production factors (see the review in Restuccia and Rogerson 2017). In section 5, we design empirical tests that allow us to disentangle the effect of these alternative phenomena from the extent of credit and labor market frictions that individual firms face.

4 The Distribution of MRP-Cost Gaps in the Micro Data

In this Section, we describe the empirical procedure that allows us to produce measurable counterparts of the MRP-cost gaps in equations (1) and (2). A unique feature of our database is the availability of information on *both* firm-specific wages and interest rates, collected from highly reliable administrative sources, for the lion's share of the corporate sector of a country. This feature gives us a significant edge in obtaining measurable proxies for distortions in firms' first-order conditions. In fact, unable to observe user costs of capital and/or labor, previous literature has frequently relied on both time-specific effects and firm-specific effects in the empirical specifications to control for the variation in these terms.

Empirical counterparts of MRP-cost gaps are estimated as follows:

$$\hat{\tau}_{it}^{K} \equiv \rho(1 - \hat{P}\{Exit_{it+1}|X_{it}\}) \cdot \left[\widehat{MRP}_{it+1}^{K} - (r_{it+1} + \delta_s)\right] \tag{3a}$$

$$\hat{\tau}_{it}^{L} \equiv \widehat{MRP}_{it}^{L} - w_{it} \,. \tag{3b}$$

The one-period (risk-neutral) discount factor ρ is set to 0.95, a standard assumption in the literature (Gopinath et al. 2017). To approximate the conditional expectation in equation (1), we evaluate the expectation of the marginal revenue product minus the user-costs gap at their realizations, adjusting the latter by multiplying them by the expected probability of exit ($P\{Exit_{it+1}\}$), which are estimated from the micro-data. This procedure naturally introduces an expectational error that is going to generate variation in our estimate of realized MRP-cost gaps (Asker et al. 2014). By adjusting the realized gap between marginal products and the user cost of capital by the probability of survival, we account for the fact that expected returns are lower for firms with higher exit probability. We estimate expected firm-specific probabilities of exit as a function of time, space, and firm characteristics.[20] Because we allow the estimated exit probability to vary both in the time-series and in the cross-section, they indirectly pick-up time-variation in aggregate risk and heterogeneous risk premia across firms. This is important because high MRPK firms tend to offer high expected returns and have a higher loading on the stochastic discount factor than low MRPK firms, as shown by David et al. (2018).

In the remainder of this section, we describe our proxies for the user costs of capital and labor, illustrate the estimation procedure of marginal revenue products, and finally present the estimates of the MRP-cost gaps and the distortions in investment and employment policies that they imply.

4.1 User costs of Capital and Labor

The User Cost of Capital – We construct firm-time-varying user costs of capital as the sum of borrowing costs and depreciation rates of fixed assets ($r_{it+1} + \delta$). Industry-specific depreciation

[20] Appendix G describes the estimation procedure of $P\{Exit_{it+1}\}$. Our estimate of the unconditional probability of exit is 6.5% on average, matching the unconditional exit rate in our sample. In line with the guidelines of economic theory, the estimated exit probability is decreasing in the firm's size, age, productivity, and credit rating. It is higher for more leveraged firms and for those producers that defaulted on their debt obligations.

rates (δ) are collected from the Italian Statistical Agency (National Accounting Tables). To measure the borrowing rate r_{it+1}, we use the average percentage rates (APR) on firm-bank matched loans from the credit registry (Taxia database). Although alternative credit products are available to firms, bank loans represent around three-quarter of total bank debt and they are the typical credit product used to finance expenditures in fixed assets.[21] We calculate the firm-year-level APR as follows. When multiple banks are lending to the firm, we compute the weighted average APR with weights equal to the fraction of total loans granted by each institution. When a firm has only one outstanding loan from a single bank, no aggregation is needed.[22]

Firms that do not actively engage in credit market transactions (20% of our sample) pose an empirical challenge because we have no information on borrowing rates for them. Yet, these observations are of interest because they allow us to investigate the relationship between credit market participation and firm investment policies. Thus, we would like to construct a plausible estimate of their user cost. Ample empirical evidence, corroborated by the analysis of section 5, suggests banks set their rates based on a limited number of observable characteristics (Jaffee and Modigliani 1969; Crawford et al., 2016). Moreover, it is well established that financing of small and medium firms - the lion share in our data - is tied to their local credit markets as proximity between borrowers and lenders facilitates information acquisition (Petersen and Rajan, 2002; Degryse and Ongena 2005). We use firm characteristics and geographical location to infer the interest rate that non-borrowers could have been plausibly charged had they engaged in credit market transactions. Within each year and local credit market - defined by the perimeter of Italian provinces -, we estimate loan-pricing regressions in the firm-bank-level database. The set of predictors includes industry, age, assets, credit score, assets turnover, ROA, and whether the firm has any credit in default during that year or the previous ones.[23] These variables are selected to meet two criteria. On the one end, they represent a parsimonious choice that ensures the existence of a common support between the group of borrowers and non-borrowers for every year-market combination. On the other hand, they are observable indicators commonly used by banks to assess firms' riskiness and creditworthiness. The Altman Z-score is a metric widely used by Italian banks to assess firms' credit risk (Albareto et al. 2011), and the Cerved database is the source of firms' balance sheet information used by banks to collect balance sheet data on current and perspective borrowers. Moreover, our data on firms' total debt exposure obtained from the CR are equivalent to the information that banks can obtain when they send a query to the CR.[24] The pricing regression is estimated on the

[21]Appendix B.1 shows that changes in bank loans can explain a larger share of the variation in investment rates and that the elasticity of investment with respect to changes in loans is three times as large as the elasticity with respect to changes in credit line draws.

[22]That is, we calculate the value-weighted average APR for each firm-year as $r_{it+1} = \sum_b w_{bit} r_{ibt+1}$, where $w_{ibt} = {}^{Loans_{ibt}}/\sum_b Loans_{ibt}$. When we observe multiple APRs for the same firm-bank pair, we calculate the weighted average using as weights the share of interest expense imputable to each loan. See Appendix A for details.

[23]Italian provinces are the natural candidates for the definition of local credit markets for small-business lending (see Guiso et al. 2012). They constitute administrative units comparable to US counties. The Bank of Italy uses the administrative boundaries of provinces as a proxy of local credit markets for regulatory and supervisory purposes.

[24]Through the CR financial companies supervised by the Bank of Italy exchange information about the global risk position (total outstanding bank credit and total credits in default) of their customers and of those of other institutions. After it receives information on the loans granted by the participating intermediaries to individual

subsample of newly established relations (LENGTH RELATION$_{it}\leq$ 1 year).[25] Appendix B.2 provides a detailed description of this procedure and provides a number of robustness tests of our estimates of the borrowing rates of non-borrowers.[26]

Firms that engage in credit market transactions, but for which we are unable to observe the interest rate, represent a second empirical challenge for the construction of the user cost of capital. These observations refer to firms that only use credit lines, to those firms borrowing from lenders that are not part of the group of banks in the Taxia database, or to firms that borrow small amounts that are not reported in the CR.[27] For these observations, the missing-price problem is less severe because, in addition to firm-specific characteristics and geographical location, we can augment the pricing regressions with information about total bank leverage, the length of each individual credit relation, the total number of lending relations, and dummies that identify lenders (see Appendix B.2).

Table 2 (panel a) presents summary statistics describing the distribution of user costs of capital and its components. We present them for the whole sample, and splitting observations into borrowers with outstanding loans (BORROWERS-LOANS), borrowers with no loans (BORROWERS-CREDLINES, i.e., firms with no outstanding loans but positive draws from credit lines), and non-borrowers (NON-BORROWERS). For observations belonging to the first subsample, the interest rate is observed; for the last two groups, we report the estimated interest rate. Consider first the subsample of borrowers with loans. Over our sample period, their user cost of capital was on average 16.4%. One-third of it is imputable to the borrowing cost (5.5%), and two thirds to depreciation rates (10.8%). On average, the borrowing costs inferred for credit lines-only borrowers and for non-borrowers are higher than the ones observed for borrowers, reflecting the compositional differences among the observations that form the three subsamples. In fact, Appendix A shows that, than firms with outstanding bank loans, producers that do not engage in credit market transactions and those that only used credit lines are younger and smaller; over-represented in Southern regions of Italy, and in industries with lower tangible-to-intangible assets ratio (e.g., services).[28] Credit lines-only firms also tend to have shorter lending relationships with their lenders when compared to companies that utilize bank loans. Not by chance, all these firm-specific variables are commonly regarded as proxies for credit constraints.[29] Consistent with this hypothesis, the empirical analysis of section

customers, the Bank of Italy aggregates the data for each borrower and calculates their total debt exposure vis-a-vis the financial system, and possible amounts past due or in default.

[25]The focus on new relationships is important because non-borrowers would be new customers for the bank in case they approach them. Moreover, for new relationships, we do not have to account for the dynamics of firm-bank relationships and the acquisition of soft information and lower monitoring costs that repeated interactions bring about.

[26]Matching-on-observables raises concerns related to unobserved heterogeneity - because soft information might be available to the bank but not to the econometrician -, and to possible selection issues, because only transactions for which borrowing/lending is economical for both firms and banks are observed. We discuss these issues in Appendix B.2.

[27]See Appendix A for details on reporting threshold in the CR and Taxia database.

[28]See Appendix A for a comparison of borrowers and non-borrowers based on observable characteristics.

[29]Because credit lines are a more expensive type of credit and they can be revoked at lenders' discretion, firms should rarely turn to credit lines to finance capital expenditures in fixed assets, unless bank loans are constrained or denied by credit institutions.

Table 2: **Marginal revenue products, user costs, MRP-cost gaps, implicit taxes, and percentage deviations**

Panel a reports summary statistics describing the distribution of the marginal revenue product of capital (MRP_{it}^K) and labor (MRP_{it}^L). MRP_{it}^K is expressed in percent; MRP_{it}^L is expressed in thousands of Euros. Panel b reports summary statistics describing the distribution of the annual percentage rate (APR) on bank loans (r_{it+1}), depreciation rate on capital (δ_s), the sum of the two (user cost of capital, $r_{it+1} + \delta_s$), and wage (user cost of labor, w_{it}). Interest rates, depreciation rates, and user costs of capital are expressed in percentages; wages are expressed in thousands of Euros. Panel c presents the descriptive statistics of the distribution of MRP-cost gaps τ_{it}^K and τ_{it}^L . Capital gaps are expressed in percentages; labor gaps are expressed in thousands of Euros. Panel d reports the summary statistics of the implicit taxes implied by the estimated capital and labor gaps ($\tilde{\tau}_{it}^K$ and $\tilde{\tau}_{it}^L$), both expressed in percentages. Panel e reports summary statistics of the distribution of percentage deviations from target input demands ($\frac{L_{it}^*-L_{it}}{L_{it}}$, $\frac{K_{it}^*-K_{it}}{K_{it}}$) and implied deviation from target output $\frac{Y_{it}^*-Y_{it}}{Y_{it}}$, which are expressed in percentages. Summary statistics are reported for the full sample and, for capital-related variables, also splitting the sample into borrowers with active loans (Borrower-Loans = 1) , borrowers with credit lines only (Borrower-CredLines = 1), and non-borrowers (Borrower = 0). Block-bootstrapped standard errors are in parentheses.

	Whole Sample				***Borrowers-Loans***				***Borrowers-CredLines***				***Non-Borrowers***			
	Mean	Median	10^{th}	90^{th}	Mean	Median	10^{th}	90^{th}	Mean	Median	10^{th}	90^{th}	Mean	Median	10^{th}	90^{th}
Panel a: User Costs																
$r+\delta$	16.3	16.5	11.8	19.9	16.3	16.3	12.4	19.9	15.9	16.2	11.1	19.4	16.6	17.0	11.7	19.4
r	5.9	5.7	3.4	8.4	5.5	5.3	2.9	8.3	5.9	5.7	4.0	8.1	6.6	6.4	4.5	8.8
δ	10.4	11.4	5.6	12.5	10.8	11.4	5.7	12.5	10.0	10.1	5.5	11.9	10.0	10.3	5.6	11.9
w	20.5	19.4	11.5	30.2												
Panel b: Marginal Revenue Products																
MRP^K	48.8	19.6	2.9	106.1	36.6	17.2	2.9	174.6	52.7	19.9	2.8	117.7	71.3	27.1	3.4	174.6
	(0.11)	(0.04)	(0.01)	(0.28)												
MRP^L	31.7	27.2	10.7	54.6												
	(0.02)	(0.02)	(0.01)	(0.05)												
Panel c: MRP-Cost Gaps																
τ^K	27.1	3.7	-10.9	73.9	19.2	1.8	-11.3	55.8	34.8	5.1	-10.7	94.1	46.6	10.4	-9.8	127.3
	(0.10)	(0.03)	(0.01)	(0.26)												
τ^L	11.2	7.0	-5.8	30.7												
	(0.02)	(0.01)	(0.01)	(0.04)												
Panel d: Implicit Taxes																
$\tilde{\tau}^K$	108.1	14.4	-65.5	343.7	66.3	0.5	-67.7	237.7	122.1	16.5	-64.6	386.6	193.2	55.2	-58.7	587.2
$\tilde{\tau}^L$	60.2	36.9	-30.0	159.8												
Panel e: Percentage Deviations																
$(K^*-K)/K$	26.1	9.9	-296.7	355.5	19.2	3.1	-279.7	315.7	30.4	15.4	-320.6	399.7	50.4	29.1	-280.7	420.7
$(L^*-L)/L$	14.7	4.7	-2.5	41.8												
$(Y^*-Y)/Y$	7.4	9.3	-81.2	77.3	4.8	6.7	-83.2	70.0	7.9	10.6	-83.0	85.5	14.3	15.7	-76.2	88.4

5.1 finds that firms that do not engage in credit market transactions and credit lines-only borrowers tend to have a higher marginal revenue product of capital than borrowers with outstanding term loans.

The User Cost of Labor – Employer-employee records from the Italian National Security Institute provide us with detailed information on workforce compensation. We use the average annual wage as a proxy for the user cost of labor w_{it}. We calculate it considering the annualized compensations of all fixed-term contract workers (white collar, blue collar, middle managers, and full-time interns) hired by the firm throughout the year.[30] Table 2, panel a, shows the average nominal wage is about 20 thousand euros per year, and the median is one thousand euros lower.

One may worry that the average wage may differ significantly from the wage paid to hire an extra worker. To address this concern, we construct an alternative proxy of the user cost of labor using individual workers' wage records from the matched employer-employee panel database. In particular, we calculate the average annualized wage paid by firms to *newly hired* workers in each industry-province-year triplet.[31] The advantage of this measure is that it can be thought of as the cost that a firm would incur when hiring an additional worker in the same industry and labor market. The drawback of this measure is that, by averaging across companies, it washes away any firm-level link between wages and the marginal product of labor. We find the average wage paid to new workers exceeds the average wages by approximately 4 thousand euros (18% of the average wage). As we discuss below, our main empirical findings are ultimately unaffected by using this alternative proxy of user costs of labor.

4.2 Identification and Estimation of Marginal Revenue Products

Without loss of generality, we can decompose the marginal revenue product of an input $X = \{K, L, M\}$ into the value of the marginal product (VMP_{it}^X) and the inverse-markup (μ_{it}^{-1})

$$MRP_{it}^X \equiv \frac{\partial \left(P_{it}(Q_{it})Q_{it}\right)}{\partial X_{it}} = \underbrace{P_{it}\frac{\partial Q_{it}}{\partial X_{it}}}_{VMP_{it}^X}\underbrace{\left(1 + \frac{Q_{it}}{P_{it}}\frac{\partial P_{it}}{\partial Q_{it}}\right)}_{\mu_{it}^{-1}} = \theta_{it}^X \frac{PQ_{it}}{X_{it}}\frac{1}{\mu_{it}}\,. \tag{4}$$

The last equation decomposes the physical value of the marginal product into output elasticity (θ^X) and average product ($\frac{PQ_{it}}{X_{it}}$) using the definition of output elasticity. We estimate marginal revenue products taking equation (4) to the data.

We measure average products of capital (PQ_{it}/K_{it}) and labor (PQ_{it}/L_{it}) directly in the data. PQ_{it} is total sales. The ideal empirical measures of capital (K_{it}) and labor (L_{it}) shall capture the

[30] The firm-level records are aggregated by the Italian National Security Institute and provided to us at a monthly frequency. For each firm-year observation, we first calculate the average monthly wage (simple average) and then we annualize it. Although not ideal, this procedure is better than using the annualized end-of-year wage (month of December), because end-of-year compensations are more likely to be susceptible to *una tantum* adjustments.

[31] The employer-employee matched database follows the employment history of a random sample of 20% of every cohort of workers. In our dataset, the subsample of firm-year observations that (i) hires new workers and (ii) for which we have information on at least one wage rate of the newly hired workers from the employer-employee database is 48%.

flow of services provided by these inputs. Toward this end, we re-construct the sequence of capital from investments in fixed assets (both tangibles and intangibles) following the perpetual inventory method (PIM) (Becker and Haltiwanger 2006) and measure labor services in units of effective labor (annual wage bill over average annual wage). The Perpetual Inventory Method provides us with a better proxy for capital services than the book value of fixed assets.[32] With respect to other measures - such as the number of workers -, by measuring labor services in effective labor units we can better account for differences in the quality of firms' workforce (Fox and Smeets 2011).[33]

Output elasticities and TFPR – We estimate output elasticities via production function estimation. Consider the following log-production function:

$$q_{it} = \omega_{it} + \epsilon_{it} + f(k_{it}, l_{it}, m_{it}, \gamma),$$

where γ is a vector of structural parameters to be estimated. ω_{it} is firm-level productivity, observed by the firm at the moment of its production decisions, and ϵ_{it} is a production shock taking place after input decisions have been made. Once estimates of the structural parameters γ are available, we infer the realization of firm-level revenue productivity (TFPR, Foster et al. 2008) as $\omega_{it} = q_{it} - f(k_{it}, l_{it}, m_{it}; \gamma)$.

We specify a translog functional form for production technologies f. For the purpose of approximating the full distribution of marginal revenue products, the flexibility of translog represents a significant advantage over more standard (but less flexible) functional forms such as Cobb-Douglas or CES. Translog does not impose any restriction on the elasticity of substitution of different inputs. Moreover, it allows us to recover a distributions of firm-time-specific elasticities that are a function of industry-specific structural parameters γs and of the input-mix utilized by each firm: $\theta_{it}^X = \theta^X(k_{it}, l_{it}, m_{it}; \gamma) \quad X = \{K, L, M\}$.[34]

We estimate production function parameters γ following the structural approach proposed in Gandhi et al. (2017b).[35] This approach identifies the parameters of the production function addressing the simultaneity bias that derives from the correlation between input choices and unobserved (to the econometrician) productivity (Marschak and Andrews 1944), and it solves the non-identification problem that affects the estimates of output elasticity with respect to flexible inputs.[36]

[32]See Appendix A.6 for details on the construction of the capital sequence using the Perpetual Inventory Method (PIM).

[33]Using total wage bill as a measure of labor inputs delivers estimates very similar to the ones obtained using effective labor. Results are available upon request.

[34]Consider the following log-version of production functions: $q_{it} = f(k_{it}, l_{it}, m_{it}; \gamma) + \omega_{it} + \epsilon_{it}$. Under Translog, the expression for output elasticities of any input $X = \{K, L, M\}$ is $\theta_{it}^X = \gamma_X + 2\gamma_{XX} x_{it} + \sum_{x' \neq x} \gamma_{xx'} x'_{it}$. See Appendix D for details.

[35]We provide the details of the estimation routine in Appendix D and refer to Gandhi et al. (2017b) for a more detailed exposition and its underlying assumptions. We thank the authors for sharing their code, and David Rives in particular for his advice.

[36]Gandhi et al. (2017b) show that the standard proxy-variable approach applied to gross output production functions - such as the one in Olley and Pakes (1996) and Levinsohn and Petrin (2003) - does not identify the elasticities of flexible inputs, unless the production function takes specific functional forms (e.g., the Leontief case discussed in Ackerberg et al. 2015) or external sources of variation in firms' demand for flexible inputs (e.g., Doraszelski and Jaumandreu (2013)).

The production function estimation is performed separately for every 4 digit industry (NACE, rev.2 industry classification system). This approach allows the structural technology parameters γs to vary by narrowly defined industries (467 in total) that encompass both the manufacturing and non-manufacturing sectors of the economy. We use deflated revenues in place of physical output, and deflate capital and intermediate inputs (measured as total expenditures in raw materials, services, and energy consumption) by the corresponding industry-year price deflators.[37] Finally, we need to take a stand on the vector of instruments that identify θ^K and θ^L in the estimation routine. We assume capital is quasi-fixed and predetermined. Thus, in principle, k_{it} does not require an instrument. Nevertheless, we use (lagged) firm-specific borrowing costs to construct an additional moment condition that strengthens the identification of the elasticity θ^K, which typically suffers from attenuation bias due to the difficulty in measuring capital services (Collard-Wexler and De Loecker 2016).[38] Given the institutional features of the Italian labor market, we consider labor a flexible input (chosen in period t after observing ω_{it}) but dynamic (subject to adjustment costs). Thus, we rely on l_{it-1} as an instrument for l_{it} and address the endogeneity problem due to correlation with unobserved productivity.

Finally, two remarks are in order. First, we treated deflated sales as a measure of physical quantity when estimating output elasticities. Therefore, our estimates are potentially subject to the omitted-price bias discussed in Klette et al. (1996), and our estimates of productivity are a proxy for revenue productivity (TFPR). Not controlling for firm-specific output prices would be particularly problematic if estimating physical productivity (TFPQ) were the ultimate goal of this paper (Foster et al. 2008). It is less of a concern for our analysis because TFPR is the relevant productivity measure to test the theory underlying the MRP-cost gaps and evaluate the aggregate implications of resource misallocation (Hopenhayn, 2014).[39] Second, we must also recognize that our data do not allow us to distinguish between single and multi-product firms. If firms operate across multiple industries or produce differentiated goods, our estimates might be biased because the estimation routine implicitly assumes a single production function and a single consumer's demand curve faced by each firm (see Bernard et al. 2010 and De Loecker 2011). We cannot identify which companies operate across industries, because our data report only the primary industry code of each observation. However, because large firms are more likely to expand their activity across industries, the small size of the producers in our data suggests multi-product firms are unlikely to make up the majority of our sample.

Markups – To estimate markups, we follow the production-side approach pioneered by the

[37]Although unsatisfactory, this approach is the predominant approach in the Industrial Organization literature because most of the available firm- and plant-level databases - including ours - do not separately report prices and physical quantities of inputs (with the exception or labor, in our case) and/or output. We use industry-specific investment deflators for capital, and industry-specific value-added deflators for intermediate inputs. These data are freely available on the website of the Italian National Statistical Agency (http://dati.istat.it/?lang=en).

[38]See Appendix Appendix D for more details, and Doraszelski and Jaumandreu (2013) for a discussion of how information on factor prices can be used to identify production functions.

[39]Note, however, that the inability to control for heterogeneous prices may also generate a downward bias in the estimates of output elasticities (De Loecker 2011) and thus of our estimates of marginal revenue products.

Table 3: **Revenue elasticities, returns to scale, markups, and elasticities**

This table displays the estimates of firm-level production function parameters, returns to scale, markups, and revenue productivity. We report average, interquartile range, and block-bootstrapped standard errors of the mean (in parentheses). The first block reports the statistics across all firm-years. The second and third block split the sample into manufacturing and non-manufacturing firms, respectively. In each block, the first four rows of the table show the estimates of output elasticities with respect to capital (θ_{it}^K), labor (θ_{it}^L), and intermediate inputs (θ_{it}^M). The fourth row reports the estimated returns to scale ($RS_{it} = \sum_X \theta_{it}^x$, $X = \{K, L, M\}$). The fifth and sixth rows report the summary statistics of the estimated markups (μ_{it}) and revenue productivity (TFPR, ω_{it}), respectively.

	All Industries		Manufacturing		Non Manufacturing	
	Mean	75-25	Mean	75-25	Mean	75-25
θ^K	0.05	0.04	0.05	0.04	0.05	0.04
	($0.6{\cdot}10^{-4}$)		($0.6{\cdot}10^{-4}$)		($0.6{\cdot}10^{-4}$)	
θ^L	0.29	0.21	0.30	0.16	0.29	0.23
	($2.2{\cdot}10^{-4}$)		($2.2{\cdot}10^{-4}$)		($2.2{\cdot}10^{-4}$)	
θ^M	0.67	0.22	0.67	0.16	0.67	0.25
	($1.9{\cdot}10^{-4}$)		($1.9{\cdot}10^{-4}$)		($1.9{\cdot}10^{-4}$)	
RS	1.02	0.05	1.02	0.04	1.02	0.06
	($2.2{\cdot}10^{-4}$)		($2.2{\cdot}10^{-4}$)		($2.2{\cdot}10^{-4}$)	
μ	1.02	0.16	1.01	0.15	1.03	0.16
	($0.6{\cdot}10^{-4}$)		($0.6{\cdot}10^{-4}$)		($0.6{\cdot}10^{-4}$)	
ω	2.48	0.71	2.61	0.34	2.43	0.83
	($14.5{\cdot}10^{-4}$)		($14.5{\cdot}10^{-4}$)		($14.5{\cdot}10^{-4}$)	

seminal work of Hall (1988) and recently revisited by De Loecker and Warzynski (2012). The identification rests on the theoretical intuition that, conditional on the state variables of the problem, the first-order conditions of the cost-minimization problem for inputs that are flexible and static provides an expression relating revenue cost shares and output elasticities to markups:

$$\hat{\mu}_{it} = \hat{\theta}_{it}^M \left(\frac{\frac{P_{it}Q_{it}}{exp(\hat{\epsilon}_{it})}}{P_{it}^M M_{it}} \right),$$

where $P_{it}Q_{it}/P_{it}^M M_{it}$ is the inverse of the expenditure share on intermediate inputs in revenues (directly observed in the data) and $\hat{\theta}_{it}^M$ is the output elasticity with respect to intermediate inputs (obtained via production function estimation). We follow De Loecker and Warzynski (2012) and correct expenditure shares using the residuals of a regression of a polynomial function of deflated inputs on deflated revenues. This adjustment helps to net out variation in output not correlated with changes in input utilization (such as the one due to demand, inputs prices, or productivity).[40] The flexibility of the translog functional form adopted in the production function estimation also helps address this issue.

Table 3 displays our estimates of elasticities, returns to scale, markups, and productivity. Block-bootstrapped standard errors are reported in parentheses (Horowitz 2001). The deflated revenues of the average firm responds by 5%, 29%, and 67% to a 1% increase in capital, labor, and intermediate inputs, respectively, which implies average local returns to scale close to unity. These parameters are precisely estimated and in line with the ones found in the literature.[41] Importantly, our estimates

[40] See Appendix E for more details and De Loecker et al. (2016) for a discussion and application of this methodology.

[41] See, for example, De Loecker (2011), Ackerberg et al. (2007), Petrin and Sivadasan (2013), and Gandhi et al. (2017b) for estimates referring to manufacturing industries.

highlight substantial heterogeneity in the parameters characterizing production technologies, both within and across industries.[42] The interquartile range spans between 57% and 79% for intermediate inputs, and 2%–6% and 18%–38% for capital and labor, respectively. In terms of markups, our estimates suggest that, on average, firms price 2% above their marginal cost of production. The right skewness of the distribution drives the dispersion of markups. Firms located at the 75th and 90th percentiles of the distribution price 5% and 15% above marginal cost, respectively.

In the Appendix of the paper, we present a number of sanity and robustness checks on our estimates. Appendix D shows the estimates of output elasticities are consistent with the ones obtained using a cost-share approach (Hall et al., 1986). We also discuss the robustness of our estimates with respect to alternative functional forms of production technologies and estimation routines. In Appendix E, we produce robustness checks of our estimates of markups. We find a strong positive correlation between markups and the firm's profitability (either EBITDA over total assets or ROA), and with product market concentration measured by the Herfindahl concentration index. Our estimates of firm-level markups also display a strong and positive correlation with productivity (in both levels and changes), which is an empirical relationship documented by previous literature (see De Loecker and Warzynski 2012).

Marginal revenue products – Combining average products, output elasticities, and markups, we construct estimates of realized marginal revenue products of K and L (equation 4). Table 2 (Panel b) reports descriptive statistics of their distribution. Over the 1997-2013 period, the median firm in our dataset has a marginal product of capital of 20%, while that of labor is slightly lower than 27 thousand euros.[43] We point out that the estimated marginal revenue product of capital is 2 times higher for non-borrowers and 1.5 times higher for those borrowers that have access only to credit lines, which suggests constrained access to credit markets might prevent some firms from harvesting profitable investment opportunities. We will return to the distinction between the three groups of firms in section 5.

4.3 The Variability of User Costs and Marginal Returns, and the Empirical Distribution of MRP-Cost Gaps

Dispersion in MRP and User Costs – Before presenting the empirical distribution of the MRP-cost gaps, it is instructive to analyze the joint distribution of user costs and marginal revenue products of capital and labor. In Figure 1, we parse the data according to the percentile of the distribution of user costs of capital (Panel a) and labor (Panel b). For each percentile, the x-axis reports the median value of the user cost. The y-axis reports the median value and interquartile

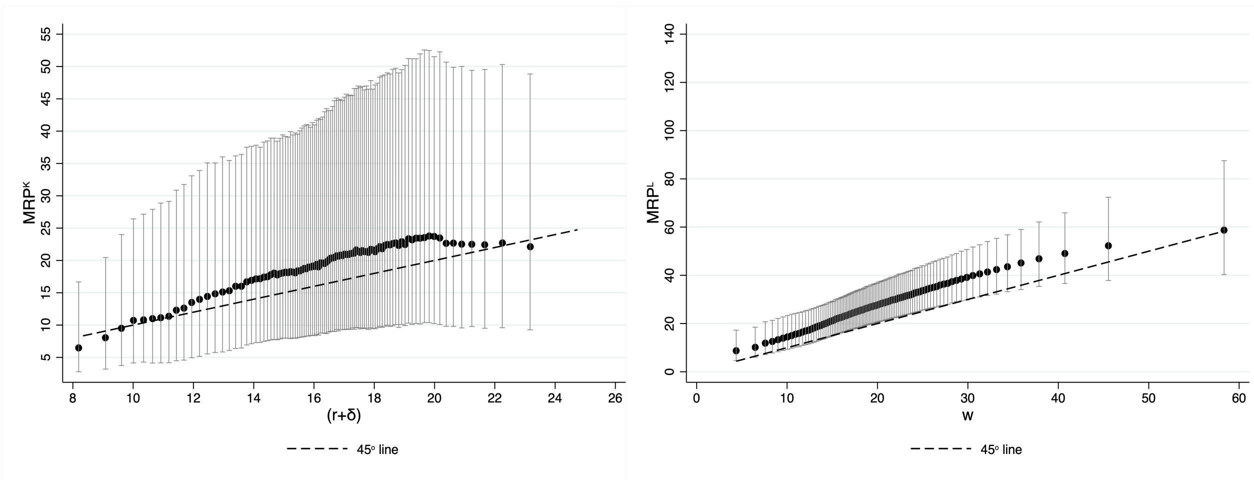
[42] Appendix D provides a graphical comparison of output elasticities across firms of different ages and sizes. We find a significant decline of θ^K with firm size and age, whereas θ^L increases as firms grow older but decreases with firm size.

[43] In Appendix F, we also investigate the sources of dispersion of MRPs. Two findings are worth mentioning. First, marginal revenue products are more dispersed outside manufacturing. Second, the bulk of the dispersion in MRPs is found within industries rather than between industries. The within-industry dispersion exceeds the between-industry dispersion by a factor of 2 for MRP^K and a factor of 1.4 for MRP^L.

Figure 1: **Joint distribution and dispersion of MRP and user costs**

This figure investigates the joint distribution of marginal revenue products and user costs, and their dispersion. We parse the data according to the percentile of the distribution of user costs of capital (Panel a) and labor (Panel b). The x-axis reports the median value of the user cost, and the y-axis reports the median value and interquartile range of the MRP for the group of observations belonging to the same percentile of the distribution of user costs.

Panel a: Capital **Panel b: Labor**



range of the MRP for the group of firm-year observations belonging to each percentile of the distributions of user costs. Two observations are in order.

First, the central percentiles of the distribution of MRPs map onto the corresponding moments of the distributions of the user costs. The correlation between the median (mean) value of MRP and the median (mean) value of user costs within each percentile of the distribution of user costs is 98% (95%) percent for capital and 98% (96%) for labor, with p-values lower than 1%.[44] This finding suggests user costs are an economically meaningful benchmark for the realized marginal revenue products of capital and labor of individual producers, as profit maximization predicts.

Second, the large dispersion of marginal revenue products is in stark contrast to the compact distribution of user costs. This finding is particularly evident in the case of capital for which the variation in realized MRP^K within each percentile of the distribution of the $r+\delta$ is greater than the variation in $r+\delta$ across percentiles the distribution of $r+\delta$. To a smaller extent, this conclusion emerges from the comparison of the dispersion in MRP^L and wages.

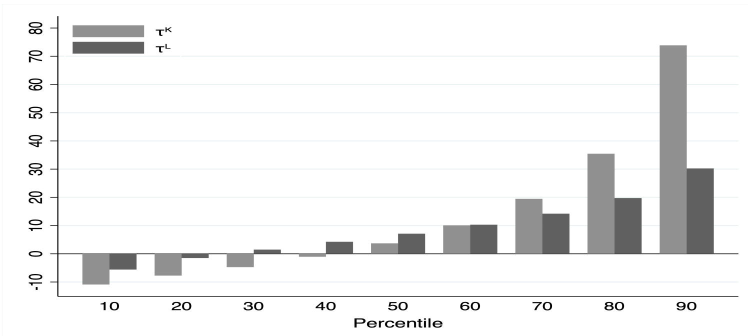
Distribution of MRP-cost Gaps and Implicit Taxes – We combine the estimates of MRP with the observed user costs to produce empirical counterparts of MRP-cost gaps (equations (3a) and (3b)). To limit the impact of outliers, we winsorize the 1% tails of the distribution of τ^K_{it} and τ^L_{it}. Table 2, panel c reports summary statistics of our estimates. Figure 2 (Panel a) displays their full distribution.

[44]The correlation between marginal revenue products and user costs is economically and statistically significant also at the firm-level (6% capital and 37% for labor, p-values lower than 1%).

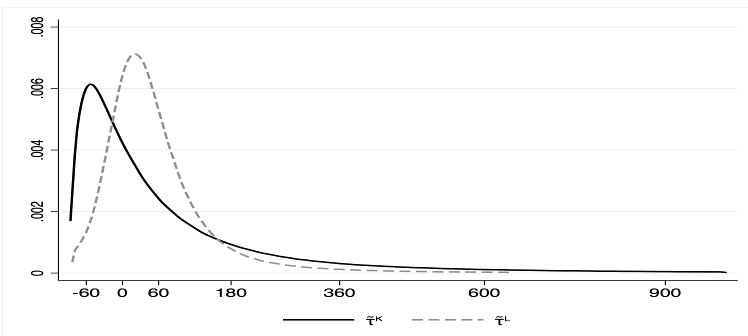
Figure 2: **Distribution of MRP-cost gaps, implicit taxes, and effective user costs of capital and labor**

Panel a presents the distribution of MRP-cost gaps of labor τ_{it}^{L} and capital τ_{it}^{K}. Labor gaps are expressed in thousands of euros; capital gaps are in percentages. Panel b presents the distribution of the implicit taxes and subsidies faced by individual producers ($\tilde{\tau}_{it}^{L}$ and $\tilde{\tau}_{it}^{K}$, both expressed in percentages). Panels c and d show the distribution of the effective user costs of capital ($\tilde{R}_{it}$, expressed in percentages) and labor ($\tilde{w}_{it}$, expressed in thousands of euros), respectively. In Panel a, the distribution of asset-weighted. In both Panels b, c, and d, the x-axis is in log-scale.

Panel a: MRP-cost gaps



Panel b: Implicit taxes



Panel c: User costs and effective user costs of capital

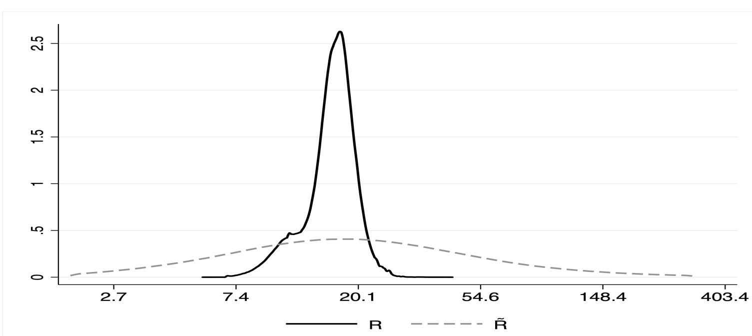
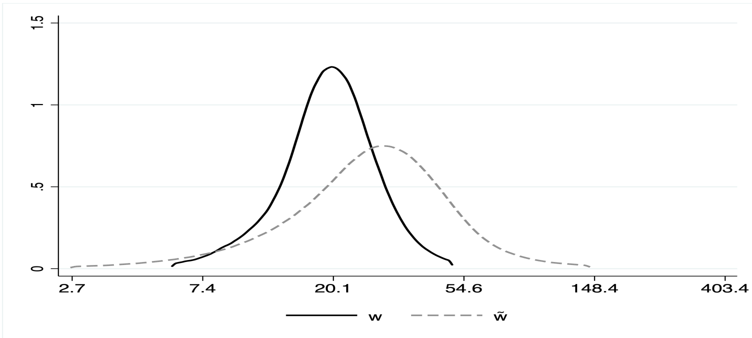


Figure 2 (cont'ed): **Distribution of MRP-cost gaps, implicit taxes and effective user costs of capital and labor**

Panel d: User cost and effective user costs of labor



According to our metric, the central percentiles of the distributions are occupied by firms whose capital and labor endowment appears to be relatively undistorted. The median gaps of capital and labor are 3.7% and 7 thousand euros for capital and labor, respectively.

Yet the distributions of MRP-cost gaps are dispersed and highly right-skewed, reflecting the right-skewness of the corresponding distributions of marginal revenue products. In fact, the average capital and labor gaps are 27% and 11 thousand euros, respectively; the 90-10 percentile differences are almost 3 times larger.

To put these numbers in perspective, we use the estimated MRP-cost gaps to infer the *implicit taxes or subsidies* on the user of capital and labor faced by individual firms. In the spirit of the seminal work of Restuccia and Rogerson (2008) and Chari et al. (2007), we can calculate the implicit taxes $\tilde{\tau}^K_{it}, \tilde{\tau}^L_{it} \lesseqgtr 0$, such that

$$\begin{array}{c} MRP^K_{it} = (1+\tilde{\tau}^K_{it-1})R_{it} = \tilde{R}_{it} \\ MRP^L_{it} = (1+\tilde{\tau}^L_{it})w_{it} = \tilde{w}_{it} \end{array},$$

where $\tilde{R}_{it}$ and $\tilde{w}_{it}$ are the *effective user costs of capital and labor* (i.e., after tax/subsidy).[45] Table 2, Panel d, reports the summary statistics of the implicit taxes $\tilde{\tau}^K_{it}$ and $\tilde{\tau}^L_{it}$. Figure 2 displays the distribution of the implicit taxes and subsidies (panel a) and a density plot overlapping the distribution of observed user costs and effective user costs (Panels b and c).

Our estimates suggest the median firm faces an implicit tax of 14% on capital and of 37% on labor. On average, these taxes are much larger: Over 100% on capital and 60% on labor. In other words, the user cost that would rationalize the estimated marginal products is twice as large as the observed user costs of capital and the 60% larger than the observed user cost of labor. Although access to capital and labor markets is quite expensive for many firms in the economy, the investment and employment choices of other producers appears consistent with a subsidized access to factor markets (negative taxes). In fact, we estimate a subsidy on capital of 40% or higher for a quarter

[45] $\tilde{\tau}^K_{it} = \left(\frac{\tau^K_{it}}{\rho(1-P\{Exit_{it+1}\})R_{it}}\right)$ and $\tilde{\tau}^L_{it} = \left(\frac{\tau^L_{it}}{w_{it}}\right)$, with $R_{it} = (r_{it} + \delta_s)$.

of the firm-year observations in our data, and a labor subsidy of 12% or higher for a third of them.

4.4 Firm-level Counterfactuals

Do the estimated MRP-cost gaps imply economically relevant investment and employment distortions? How much labor and capital do firms need to acquire/dismiss in order to close them? How would firm-level output change if firms were able to adjust their input-demand mix to the one that closes the MRP-cost gaps at the observed market prices? One way to answer these questions is to back-out the capital and labor endowments that, given the observed user costs, would equalize gaps to zero:

$$\begin{aligned} K^*_{it} &:= MRP^K(K^*_{it}) = r_{t+1} + \delta \\ L^*_{it} &:= MRP^L(L^*_{it}) = w_{it}\,. \end{aligned} \tag{5}$$

We refer to these counterfactual quantities as *target labor force* and *target capital endowment* (L^*_{it} and K^*_{it}). Figure 3 provides a graphical representation of the relationship between gaps and target endowments. Under the assumption that the user costs each firm faces do not change for moderate adjustments of their input demands, we calculate the *(percentage) deviations from target policies* as

$$\frac{L^*_{it} - L_{it}}{L_{it}} = -\frac{\tau^L_{it}}{L_{it}} \cdot \left(\frac{\partial MRP^L}{\partial L}\bigg|_{L \approxeq L_{it}\,;\, MRP^L \approxeq MRP^L_{it}} \right)^{-1} \tag{6a}$$

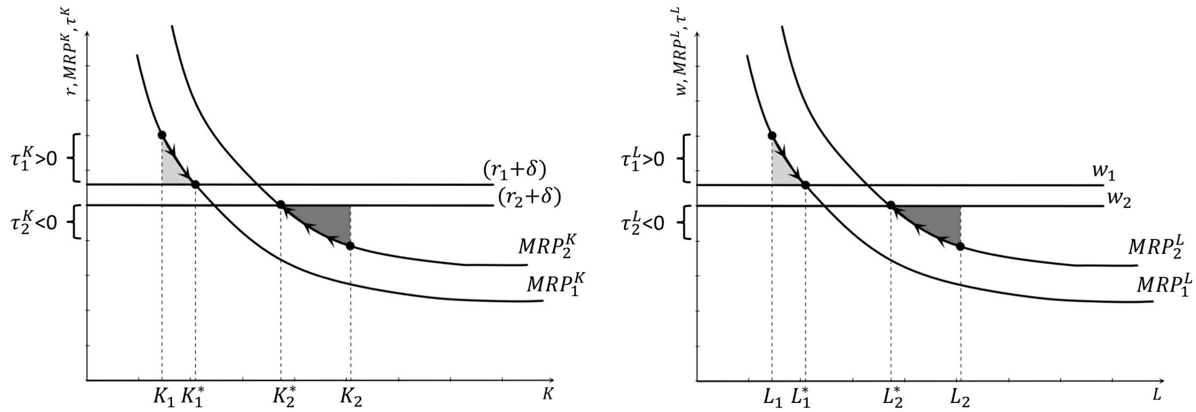
$$\frac{K^*_{it} - K_{it}}{K_{it}} = -\frac{\tau^K_{it-1}}{\rho(1 - Pr\{Exit_{it-1}\})K_{it}} \cdot \left(\frac{\partial MRP^K}{\partial K}\bigg|_{K \approxeq K_{it}\,;\, MRP^K \approxeq MRP^K_{it}} \right)^{-1}, \tag{6b}$$

where the terms in parentheses are the inverse of the slope of marginal revenue product schedules evaluated in a neighborhood of the observed input demands and realized MRPs. ${(L^*_{it} - L_{it})}/{L_{it}}$ and ${(K^*_{it} - K_{it})}/{K_{it}}$ have an intuitive interpretation. They help us read MRP-cost gaps in terms of how many extra workers a firm should hire (or fire), and how much capital expenditures should change, in order to close the gap between realized marginal revenue products and observed user costs. Thinking about policy distortions in terms of percentage deviations is also useful if one wants to compare the magnitude of the capital and labor adjustments needed to close firm-specific gaps. To clarify this point, consider a case where $\tau^K_{1t} > \tau^K_{2t} > 0$. Based on the ordinality of MRP-cost gaps, one might be tempted to conclude firm 1 investment policies are more distorted than firm 2 policies, because the distance between firm 1 capital stock from its optimal endowment is larger than the distance of firm 2. This logic has a caveat. What matters is not only the size of the gap but also the rate at which one additional unit of capital closes the gap. For example, consider small- and large-size firms with a similar $\tau^K > 0$. Despite the similar gaps, the implied investment policy distortion is expected to be larger for the latter because, as the data suggest, the slope of the MRP^K schedule in the $K - MRP^K$ plane is much steeper for small firms than for large firms.

Similar considerations apply to labor gaps.[46]

Figure 3: **MRP-cost gaps and firm policies**

This figure provides a graphical representation of gaps (τ_{it}^K and τ_{it}^L) and their relation to target input demands (K_{it}^* and L_{it}^*).



To construct empirical counterparts of the percentage deviations in (6a) and (6b), we use our estimates of $\hat{\tau}_{it}^K$ and $\hat{\tau}_{it}^L$, and we estimate slopes of marginal revenue products via local linear regressions. For each input and each macro-industry (1-digit code), we sort observations into 100 cells defined by deciles of the distribution of L and MRP^L (K and MRP^K). Within each cell, we run a linear model in first difference: $\Delta MRP_{it}^L = \beta^L \Delta L_{it}$ and $\Delta MRP_{it}^K = \beta^L \Delta K_{it}$.[47] Regressions are run separately for each macro-industry (1-digit code) to account for heterogeneous adjustments due to different technologies of production.[48]

Table 2 (panel e) reports the summary statistics of the estimated deviations from targets ${(L_{it}^*-L_{it})}/{L_{it}}$, ${(K_{it}^*-K_{it})}/{K_{it}}$. We multiply them by 100 to express them as percentages. Figure 4 (Panel a and b) provides a graphical representation of the distribution of percentage deviation from target inputs.

On average, to close their gaps, firms should increase capital expenditure by an amount worth 26% of their assets in place, and they should expand their (effective) labor force by 15% more. Mirroring the distribution of MRP-cost gaps, these numbers are driven by the right-tail of the distributions. In fact, according to our metric, central percentiles are occupied by firms whose capital and labor endowment appears to be relatively undistorted: For the median firm, investing an amount of capital worth 10% of firm assets and hiring 5% more units of effective labor would

[46]The estimated slopes confirm this intuition. Small firms tend to have higher marginal revenue products, but significantly steeper slopes than larger firms: large (small) MRP-cost gaps might translate to relatively small (large) distortions depending on the slope of the MRP-cost schedule.

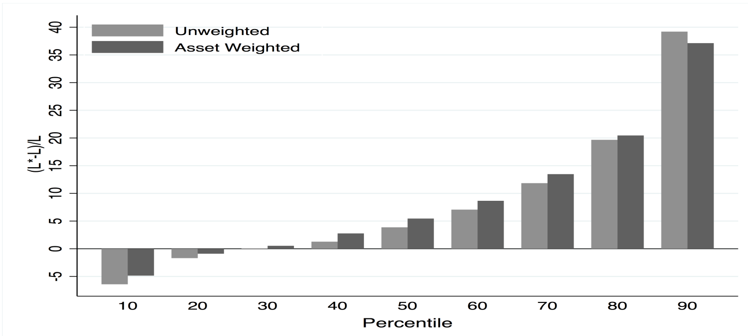
[47]We recover an estimate of the inverse of the slope of the MRP^K schedule by multiplying the $\hat{\beta}^K$ by $\frac{Var(\Delta K_{it})}{Var(\Delta MRP_{it}^K)}$ and an estimate of the inverse of the slope of the MRP^L schedule by multiplying the $\hat{\beta}^L$ by $\frac{Var(\Delta L_{it})}{Var(\Delta MRP_{it}^L)}$. First differencing allows us to exploit only within-firm variation, and smooth out the impact of outliers. We also experimented with other specifications in levels with fixed effects. This specification produces estimates of $\hat{\beta}$s in the same ballpark of the first-difference estimator, with some more extreme values.

[48]Table A.14 in Appendix F reports the summary statistics of the distribution of the estimated slopes. On average, a change in capital of 1,000 euros reduces the marginal revenue product of capital by 0.13%. A positive one-unit-change in effective labor reduces the marginal revenue product of labor by 8,000 euros.

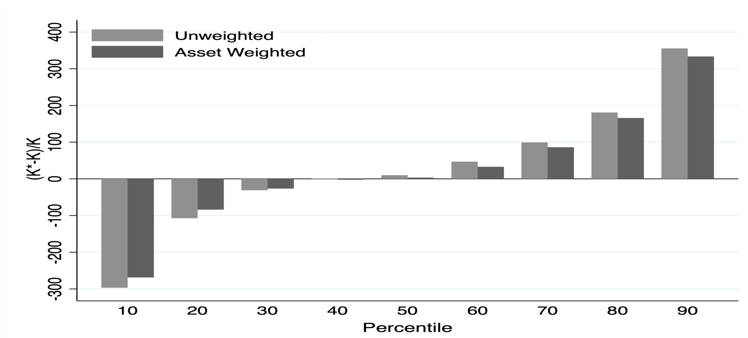
Figure 4: **Distribution of percentage deviations from target capital, labor, and output**

This graph presents the distribution of percentage deviations from targets input demands ($(K^*_{it} - K_{it})/K_{it}$ and $(L^*_{it} - L_{it})/L_{it}$, panel a and panel b) and percentage deviations from output ($(Y^*_{it} - Y_{it})/Y_{it}$, panel c). All deviations are expressed in percentages. The light bars refer the unweighted distributions, the darker bars refer to the asset-weighted distribution.

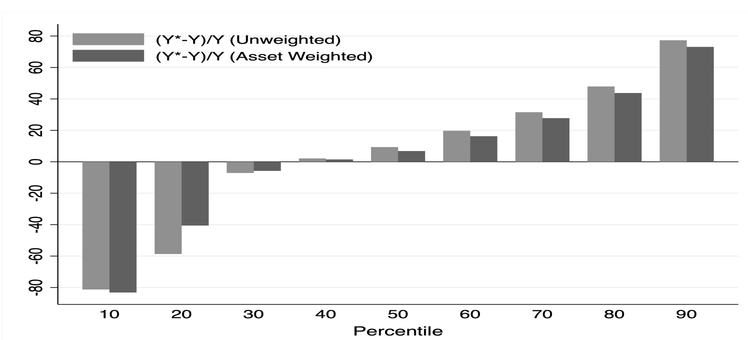
Panel a: Percentage deviations from target labor



Panel b: Percentage deviations from target capital



Panel c: Percentage deviations from target output



be sufficient to fully close the gaps. Importantly, we observe both positive and negative deviations at the tails or the distributions of ${(L^*_{it}-L_{it})}/{L_{it}}$ and ${(K^*_{it}-K_{it})}/{K_{it}}$. For example, a quarter of the firm-year observations should have invested to acquire over twice as many fixed assets and expand their labor force by 30% or more. On the contrary, another quarter of firm-year observations should scale down their assets by a factor of 3 and should reduce their quality-adjusted labor demand by 3% or more.

We take our analysis one step further and compute, for every firm-year observation, a counterfactual level of output (Y^*_{it}) that it could have produced employing K^*_{it} and L^*_{it}:

$$Y^*_{it} = e^{a_{it}} \cdot (K^*_{it})^{\gamma_s} (L^*_{it})^{1-\gamma_s} , \tag{7}$$

where $a_{it} = va_{it} - \gamma_s k_{it} - (1-\gamma_s) l_{it}$ is an estimate of firm-level valued-added productivity calculated using value-added cost shares of each 4-digit industry (γ_s; $1-\gamma_s$). The value-added production function above is obviously an over-simplification of firms' production function. However, it serves our purpose, which is to contrast Y^*_{it} with a comparable measure of output (Y_{it}) that uses the observed input demands K_{it} and L_{it}:

$$Y_{it} = e^{a_{it}} \cdot (K_{it})^{\gamma_s} (L_{it})^{1-\gamma_s} , \tag{8}$$

This approach has a number of advantages. First, any misspecification of firms' production process is held constant in (7) and (8).[49] Second, productivity and factor elasticities are held constant. Thus, the difference between Y^*_{it} and Y_{it} only arises from a different input mix. Third, as we discuss in section 6, these micro-level objects are going to prove useful for macro-assessments, because some notion of counterfactuals is necessary if one wants to evaluate the extent and aggregate implications of resource misallocation.

Figure 4 (Panel c) provides a graphical representation of the distribution of percentage deviation from target output. On average, output could be 9.4% higher if inputs were chosen to equalize marginal revenue products to the observed user costs. One might expect $Y_{it} < Y^*_{it}$ for the majority of the observations if firm policies were somehow constrained, and if the adjustments $K_{it} \to K^*_{it}$ and $L_{it} \to L^*_{it}$ move firms close to their production possibility frontier. Consistent with this prediction, we find $Y_{it} < Y^*_{it}$ in 62% of the cases. Importantly, this positive output gap does not simply result from more input utilization. In fact, target inputs demands (either K^*_{it}, L^*_{it}, or both) are lower than firms' actual input demands for 92% of the observations for which $Y_{it} < Y^*_{it}$. That is, a significant fraction of firms in the economy could produce *more output employing fewer resources* by simply utilizing a more efficient input-mix. As we document in section 6, if a reallocation of resources across producers were possible, it would generate significant aggregate output gains and growth in

[49]Value-added specifications, and the corresponding estimates of productivity and elasticities, are problematic from both a theoretical and an empirical point of view (see Gandhi et al. 2017a). In this context, however, we are interested in reconstructing counterfactual output levels obtained using the target labor and capital (K^*_{it} and L^*_{it}), and to contrast this quantity to a comparable output level obtained using the actual input demands observed in the data (K_{it} and L_{it}).

aggregate productivity.

5 MRP-Cost Gaps and Market Frictions

Up to this point, we have referred to MRP-cost gaps as distortions generated by some frictions in the allocation process, but did not take a stand on whether they stem from market failures or not. Before turning to the aggregate implications of micro-level distortions, we present empirical evidence that links the sign, magnitude, and dispersion of of MRP-cost gaps to specific frictions individual firms face when they access factor markets.

5.1 Correlation with Observable Characteristics

The correlation between MRP-cost gaps with firms' observable characteristics is a first step toward understanding the information content of gaps. We regress gaps on life cycle variables (firm age and size), credit score, measures of productivity and profitability (TFPR and ROA), and proxies of internal and external financing (cash-over-assets and bank leverage, respectively).[50] We focus on within-year and within-industry variation by controlling for year and industry fixed effects. Table 4 reports the regression results: Panel a for capital and Panel b for labor. Because τ^K and τ^L have different variability, coefficients are standardized (z-scores) to facilitate their comparison across the two panels.

The relation between both capital and labor gaps and productivity and ROA is positive and economically relevant, suggesting higher MRP-cost gaps capture unexpressed growth potentials, corroborating the theoretical prediction that gaps (of capital) are positively related to marginal q. The positive correlation with productivity is important in light of the message emerging from the recent literature on the aggregate implications of misallocation (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009; Bartelsman et al., 2013), according to which implicitly correlated distortions - that is, taxing more productive firms and subsidizing less productive ones—are the most damaging to aggregate TFP. We return to this point in section 6.

MRP-cost gaps of capital monotonically decrease with firm age and size. By contrast, labor gaps are higher for larger and older firms. The availability of financing, either internally generated liquidity or bank debt, is negatively correlated with τ^K. Unlike capital gaps, labor gaps are higher for firms with high cash and increase with bank leverage. MRP-cost gaps are low for firms with poor credit scores. For capital, this relation is driven by a combination of lower marginal revenue products and higher interest rates charged by banks. For labor, the negative correlation is entirely driven by the variation in marginal products of labor, whereas wages display little sensibility and,

[50] Age groups are defined as follows: young if age$\leq$ 5, medium if age$\in$ (10], old if age>10. Asset groups are defined based on the terciles of the distribution of assets (average assets across firms in each tercile are 190 thousand, 760 thousand, and 8.8 million Euros, respectively). Credit score groups are defined as follows: Safe firms are those with a credit score ranging from "Excellent" to "Solvent" (credit score from 1 to 4); a second group includes firms classified as "Vulnerable" and "Very vulnerable" (credit score from 5 to 6); Risky firms are with credit scores ranging from "Risky" to "Very very risky" (credit score from 7 to 9).

Table 4: **MRP-Cost gaps and firm's characteristics**

This table reports the correlation between MRP-cost gaps and firm characteristics. Panel a focuses on the MRP-cost gap of capital (τ^K) and Panel b on the MRP-cost gap of labor (τ^L). We regress gaps on life-cycle variables (firm age and size), credit score, measures of productivity and profitability (TFPR and ROA), and proxies of internal and external financing (cash-over-assets and bank leverage, respectively). Age groups are defined as follows: young if age$\leq$ 5, medium if age$\in$ (10], old if age>10. Assets groups are defined based on the terciles of the distribution of assets (average assets across firms in each tercile are 190 thousand, 760 thousand, and 8.8 million euros). Credit score groups are defined as follows: Safe firms are those with a credit score ranging from "Excellent" to "Solvent" (credit score from 1 to 4); a second group includes firms classified as "Vulnerable" and "Very vulnerable" (credit score from 5 to 6); risky firms are with credit scores ranging from "Risky" to "Very very risky" (credit score from 7 to 9). We focus on within-year and within-industry variation by controlling for year and industry fixed effects. All variables in the regressions are standardized so that coefficients are comparable across the two panels. The estimation sample includes firms for which we can calculate both τ_{it}^K and τ_{it}^L in a given year. Standard errors (in parentheses) are clustered at the firm level.

Panel a: MRP-Cost gap of capital (τ_{it}^K)

Age		Credit Score		TFPR
Young	Omitted Category	Safe	Omitted Category	0.366 (0.003)***
Medium	-0.253 (0.002)***	Vulnerable	0.002 (0.002)	
Old	-0.298 (0.002)***	Risky	-0.050 (0.002)***	**ROA**
				0.123 (0.003)***
Assets		**Leverage**		
Small	Omitted Category	-0.068 (0.001)***		
Medium	-0.091 (0.002)***			
Large	-0.146 (0.003)***	**Cash / Assets**		
		-0.112 (0.004)***		
Year Fixed Effects		Y		
Industry Fixed Effects		Y		
R^2		0.120		
R^2 Year and Industry FE only		0.070		
Observations		4,194,518		

Panel b: MRP-Cost gap of labor (τ_{it}^L)

Age		Credit Score		TFPR
Young	Omitted Category	Safe	Omitted Category	0.908 (0.003)***
Medium	0.031 (0.001)***	Vulnerable	0.000 (0.002)	
Old	0.009 (0.002)***	Risky	-0.038 (0.002)***	**ROA**
				0.119 (0.001)***
Assets		**Leverage**		
Small	Omitted Category	0.035 (0.001)***		
Medium	0.039 (0.002)***			
Large	0.338 (0.003)***	**Cash / Assets**		
		0.012 (0.001)***		
Year Fixed Effects		Y		
Industry Fixed Effects		Y		
R^2		0.337		
R^2 Year and Industry FE only		0.168		
Observations		4,194,518		

if anything, they tend to be lower for firms with poor credit scores. Importantly, these statistical relationships hold if we restrict attention to within-firm variation by controlling for firm fixed effects.

Prima facie, these patterns seem to suggest firms tend to have easier access to capital as they grow older and bigger, whereas the effective cost of labor that larger employers face seems to be greater than effective cost that smaller firms face. Next, we provide evidence connecting these patterns to access to finance and to the presence of regulatory costs that generate heterogeneous costs of labor that vary as a function of firm size.

5.2 Credit Market Distortions

5.2.1 Information Frictions and Relationship Lending

An extensive body of research in corporate finance has highlighted the importance of "relationship lending" for borrowers' access to credit, with banks gradually expanding their credit supply as they develop a tighter relationship with their borrowers (Petersen and Rajan 1994; Berger and Udell 1995). Repeated interactions with financial intermediaries allow firms to overcome possible asymmetric-information frictions, and gradually accumulate a capital endowment more consistent with profit maximization (Botsch and Vanasco, 2015). In line with these findings, our data shows that credit relationships, once established, tend to be quite stable and that the most important lender for a firm tends to the one with which the firm has the longest relationship.[51]

Enduring bank-firm relations typically translate into a reduction in the expected costs of credit provision for lenders, because, conditional on past experience with a borrower, the lender now expects loans to be less risky (Diamond 1991). Moreover, monitoring and screening costs related to information acquisition are generally lower for existing customers, because information obtained at one date may also be used to assess risk at a later date. Lenders could respond to a decline in the expected cost of credit provision by adjusting the price term of the loan contract or by relaxing credit limits that might be in place. Consistent with the theoretical discussion in section 3, we provide empirical evidence in favor of quantities rather than price adjustments and show that firm-level MRP-cost gaps for capital can measure the extent of asymmetric information in credit markets on capital accumulation by firms.

Price versus quantity adjustments – We begin by analyzing the relationship between the probability of default and the duration of lending relationships. We focus on the subsample of observations that engage in credit markets transactions and for which we have information on borrowing rates (see section 4.1).

We define the dummy variable $\textsc{Default}_{it+1}$ that takes the value of 1 in year t when we observe

[51] We construct two alternative proxies that measures the length of the relationship. One is the unweighted average length of relations ($\textsc{Length Relation}_{it}^{mean}$); the other is the length of the lending relationship with the most important lender in terms of outstanding credit ($\textsc{Length Relation}_{it}^{lead}$) and, for completeness. A comparison of the three measures offers important insights into the nature of firm-bank interactions. Table 1 shows that $\textsc{Length Relation}_{it}^{mean}$<$\textsc{Length Relation}_{it}$<$\textsc{Length Relation}_{it}^{lead}$. This finding indicates that, although they engage in multiple relations, not all of the relationships are equally important or equally long-lasting. This evidence is in line with the empirical findings reported in Petersen and Rajan (1994) for small firms in the US.

in year $t+1$ any credit in default, or any debt restructured, or in the process of being restructured.[52] Then, we estimate the following linear model:

$$\text{Default}_{it+1} = \beta_1 \cdot \text{Length Relation}_{it} + \Gamma X_{it} + \iota_{spt} + \epsilon_{it}\,. \tag{9}$$

To claim that longer lending relationships are less likely to culminate in default events, we must control for the underlying local credit market conditions, as well as loan- and firm-specific characteristics that are related to the strength of consumers' demand and might affect firm profitability and credit risk. Thus, the empirical model includes year-by-province-by-industry dummies, and a vector of firm-specific characteristics (X_{it}) that includes firm-level productivity (ω_{it}), assets turnover, ROA, cash flows over assets, current bank leverage (bank debt/assets), and a second-order polynomial in the firm's credit score (Altman Z-score), a second-order polynomial of firm age and size (log of firm' total assets).[53] As discussed in section 4.1, these variables are a set of observable indicators commonly used by banks to assess firms' riskiness and creditworthiness. We also control for the number of active credit relations to account for heterogeneity in the intensity of credit market participation. For expositional purposes, we multiply the estimated coefficients by 100. Conforming with the prediction of economic theory, we find a negative correlation between default and length of lending relationships (Table 5, column (1)). Ceteris paribus, the one-year probability of default of a loan granted to a long-term relationship borrower (Length Relation$_{it}$=10 years) is 1% lower than the probability of a loan granted to a new borrower. This effect is economically significant, considering that the unconditional probability of default is 1.5% among firms in the regression sample.

Next, we investigate if, and to what extent, the reduction in credit is passed through a reduction of the interest rates or, rather, through a relaxation of existing credit constraints. We estimate the regression model in equation (9) using borrowing rates and MRP^K as a left-hand-side variable. Despite the incidence on default rates, the data show a relative insensitivity of borrowing rates to the duration of lending relationships. Conditional on bank leverage and other observable characteristics, one extra year of lending relationships reduces interest rates by 1.5 basis points (Table 5, column (2)). Instead, the length of lending relationships is strongly and negatively associated with MRP^K (column (3)). Comparing two observationally similar firms that differ by one year in terms of length of lending relationships, we find the firm with the shorter relationship displays a marginal revenue product of capital 130 basis points higher.

The relative impact of the length of lending relationships on interest rates and MRP^K is consistent with the predictions of theories of credit rationing (Stiglitz and Weiss 1981; Stiglitz and Weiss 1992). Lacking complete information about their clients, lenders are reluctant to adjust the

[52] This definition is similar to the one adopted by Panetta et al. (2009) and Crawford et al. (2016).

[53] In the baseline regressions, we use 2-digits industries for the construction of year-by-province-by-industry dummies. This choice allows us to control for fairly granular industry heterogeneity while avoiding a reduction in the sample size due to singleton observations once we interact industry, year, and provinces. This choice does not affect our results. In fact, using a more (4-digits industries) or less restrictive (macro industries) definition of industries, coefficients remain remarkably stable.

Table 5: **Information frictions and relationship lending**

This table explores the relationship between length of lending relationships (Length Relation$_{it}$) and borrowing rates (r_{t+1}), marginal revenue products of Capital (MRP^K_{it+1}), and MRP-cost gaps of capital (τ^K_{it}). In Panel a, firm-level controls include: firm's age, size, credit score, assets turnover, ROA, cash flows over assets, leverage, and the number of active credit relationships. These regressions include year-by-province-by-industry (2-digit industry codes) fixed effects. In Panel b, we augment the specification with firm fixed effects. In Panel a, column (1), we report the estimated coefficients multiplied by 100. In columns (5)–(7) in Panel a and columns (2)–(4) in Panel b, we augment the regression with the interaction of the variable Length Relation$_{it}$ with the dummy Undercapitalized$_{it-1}$ (=1 if $\tau^K_{it-1} > 0$) and with TFPR$_{it}$ (ω_{it}). Regressions are run on the sub-sample of borrowers with outstanding loans for which we observe the APR on loans. Standard errors (in parentheses) are clustered at the firm level.

Panel a: Between-Firm Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	$Default_{it+1}$	r_{it+1}	MRP^K_{it+1}	$\lvert\tau^K_{it}\rvert$		τ^K_{it}	
Length Relation$_{it}$	-0.012	-0.015	-1.305	-2.160	-0.053	-2.268	-0.035
	(0.005)***	(0.001)***	(0.040)***	(0.376)***	(0.180)	(0.373)***	(0.146)
Length Relation$_{it}$					-1.440		-1.309
x Undercapitalized$_{it-1}$					(0.553)***		(0.566)***
Length Relation$_{it}$						-3.978	0.247
x TFPR$_{it}$						(0.584)***	(0.429)
Length Relation$_{it}$							-3.149
x Undercapitalized$_{it-1}$x TFPR$_{it}$							(1.445)**
TFPR$_{it}$	-0.542	0.007	23.552	34.925	44.523	54.492	44.052
	(0.048)***	(0.008)	(0.539)***	(4.899)***	(2.867)***	(6.454)***	(2.921)***
Undercapitalized$_{it-1}$					18.075		9.976
					(2.964)***		(2.749)***
Undercapitalized$_{it-1}$x TFPR$_{it}$							26.172
							(7.471)***
Firm Controls	Y	Y	Y	Y	Y	Y	Y
Industry x Year x Province FE	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	N	N	N	Y	N
Firm FE	N	N	N	N	N	N	N
R2	0.078	0.537	0.149	0.148	0.443	0.147	0.443
Obs.	2,219,552	2,219,552	2,219,552	2,219,552	1,929,974	2,219,552	1,929,974

Panel b: Within-Firm Regressions

	(1)	(2)	(3)	(4)
	$\lvert\tau^K_{it}\rvert$		τ^K_{it}	
Length Relation$_{it}$	-2.008	-0.114	-2.100	-0.017
	(0.867)**	(0.513)	(0.867)***	(0.468)
Length Relation$_{it}$		-0.674		-0.626
x Undercapitalized$_{it-1}$		(0.899)		(0.958)
Length Relation$_{it}$			-2.248	1.150
x TFPR$_{it-1}$			(0.959)**	(0.706)
Length Relation$_{it}$				-3.352
x Undercapitalized$_{it-1}$x TFPR$_{it}$				(2.834)
TFPR$_{it}$	61.341	28.212	71.722	20.304
	(13.239)***	(7.422)***	(15.462)***	(7.125)***
Undercapitalized$_{it-1}$		15.756		15.455
		(2.223)***		(2.351)***
Undercapitalized$_{it-1}$x TFPR$_{it}$				20.775
				(6.003)***
Firm Controls	Y	Y	Y	Y
Industry x Year x Province FE	N	N	N	N
Year FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
R2	0.170	0.173	0.171	0.173
Obs.	2,172,540	1,889,060	2,172,540	1,889,060

price of credit, because such adjustment affects both the composition of the borrowing pool and their borrowing behavior. Credit limits - rather than credit prices - adjust as bank-firm relations unfold and more information is acquired (Hoshi et al. 1990a 1990b, 1991; Petersen and Rajan 1994; Schenone 2009), and the MRP^K drops as profitable investments are undertaken.[54]

An alternative explanation for the sluggish response of interest rates is the lack of competition in credit markets. If information about a firm's creditworthiness is difficult to acquire and not easily transferable, relationship lending gives current lenders monopoly power over other intermediaries, which allows them to extract rents from highly productive firms that they manage to "lock-in" (Berger and Hannan 1989; Petersen and Rajan 1995).[55] In Appendix H.1, we test to what extent the relationship between the length of lending relationships, interest rates, and marginal revenue products is a function of the degree of competition of credit markets (Berger and Hannan 1989; Petersen and Rajan 1995). In line with the imperfect competition hypothesis, interest rates tend to be higher and the correlation between interest rates and the length of lending relations is less negative in more concentrated markets. Interestingly, the correlation between marginal revenue products of capital and the length of lending relationships is also less negative in more concentrated markets. However, the effect of duration on marginal revenue products of capital swamps the variation in interest rates across all degrees of credit market concentration.

Before examining the relation between MRP-cost gaps and the length of lending relationships, we highlight an additional piece of empirical evidence in line with the asymmetric information hypothesis that comes from the relation between productivity, defaults, and interest rates. In frictionless credit markets, theory predicts a negative correlation between firm-specific productivity and the cost of debt. In Appendix C, we show that, under an efficient risk classification system and frictionless credit markets, theory predicts that ceteris paribus high-productivity firms should be safer customers from a bank's perspective because they are less likely to default on their debt obligations. Column (1) shows that, conforming with these theoretical predictions, more productive firms are indeed less likely to default on their credit obligations. Ceteris paribus, a one-standard deviation difference in TFPR (0.40 in the subsample of borrowers with loans in TAXIA) is associated with a reduction of the observed probability of default of 0.2 percentage points. This effect is economically significant in light of the 1.5% unconditional probability of default among firms in the regression sample. Despite the incidence of productivity on default rates, however, the data provide weak support for the proposition that interest rates vary with firm-level productivity. In fact, we find a positive and not statistically significant correlation between productivity. These results suggest productivity may not belong to the variables in banks' pricing kernel, possibly because it is unobservable to banks, and that the positive coefficient is likely a reflection of more

[54] The stickiness of interest rates and the importance of credit limits as the primary margin of adjustment of credit contracts has been also shown in the market for credit cards (see Agarwal et al. 2017 and references cited). Other types of non-price adjustments of the terms of credit contracts have been documented in other consumer credit markets, for example, the downpayment requirements for subprime auto loans in Adams et al. (2009) and Einav et al. (2012).

[55] See Sharpe (1990), Rajan (1992), and Hauswald and Marquez (2006) for a theoretical treatment on the link between credit market competition, information acquisition incentives, and credit-supply.

productive firms' greater willingness to pay of more productive firms'.[56] Imperfect competition ("lock-in" hypothesis) might also explain the relation between the two variables. However, as we show in Appendix H.1, we find no economically significant difference in the response of borrowing rates to productivity, irrespective of the degree of credit market concentration.[57]

Length of lending relationships and MRP-cost gaps – Given the sluggish response of interest rates and much larger sensitivity of MRPK, we expect to find a strong relation between MRP-cost gaps of capital and the variable $\textsc{Length Relation}_{it}$. The solid line in Figure 5 (Panel a) shows that this prediction finds strong support in the data. With respect to the year in which relationships are established, the gap τ^K is 2 times (3 times) lower after three years (six years) of continuous interactions.

Next, we turn to regression analysis to try to isolate the effect of a relaxation of information frictions from alternative explanations and confounding factors that might drive the correlation between the two variables. We estimate the following regression model:

$$\tau^K{}_{it} = \beta_1 \cdot \omega_{it} + \beta_2 \cdot \text{Length Relation}_{it} + \Gamma X_{it} + \iota_{spt} + \epsilon_{it}\,. \tag{10}$$

The vector X_{it} includes the same set of controls of model (9). By controlling for firm-level TFPR and profitability, and by restricting our analysis to variation within industry-year-province bins (ι_{spt}), we tackle the concern that the dispersion in the realized MRP-cost gaps is driven by idiosyncratic variation in investment opportunities, industry-specific demand shocks (Asker et al. 2014), or time-varying risk premia.[58] The flexible controls for age and size are also crucial. As Foster et al. (2016) point out, young and small firms face a more volatile demand that might discourage them from undertaking partially irreversible investments, regardless of the cost and availability of external financing. They also differ from older and larger firms in terms of their exposure to systematic risk, which affects the rate at which future cash flows are discounted (David et al. 2018).

Regression results are reported in Table 5, Panel a. Column (4) shows that MRP-cost gaps strongly correlate with the average length of lending relationships between a bank and its lenders. Net of the variation explained by firm characteristics and local market dynamics, longer lending relationships allow firms to gradually implement more efficient investment policies. Ceteris paribus, one additional year of continuous borrower-lenders interactions is associated with a reduction in the *absolute value* of MRP-cost gaps of capital by about 216 basis points. We estimate model (10),

[56] An econometric explanation of this result would be that our estimates of productivity have no empirical content, due to measurement and/or misspecification errors. Prima facie, this explanation seems implausible. Our estimates of TFPR are highly correlated with credit-default outcomes and, as we show in Appendix D, both investment rates and changes in labor demand are closely related to productivity dynamics, as theory would predict.

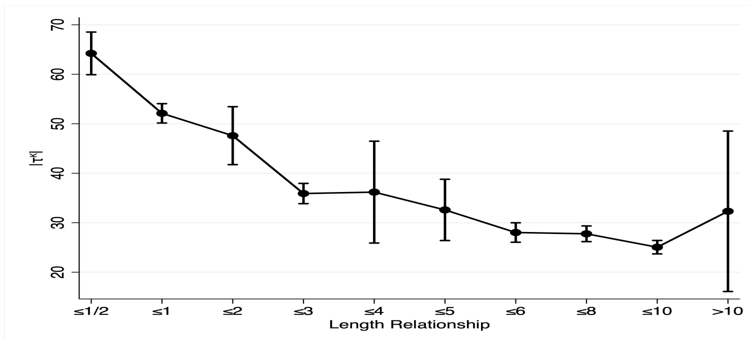
[57] A possible explanation for this result is that competition among credit suppliers works to eliminate systematic misclassifications due to imperfect information. For example, if a firm is - by mistake - classified as excessively risky or not creditworthy by one lender, competitive lenders may offer a lower interest rate to attract that customer.

[58] In the baseline regressions, we use 2-digit industries for the construction of year-by-province-by-industry dummies. This choice does not affect our results. In fact, using a more (4-digit industries) or less restrictive (macro industries) definition of industries, the coefficients remain remarkably stable. We also experimented with replacing the vector of contemporaneous controls with its lagged counterpart. Results are unchanged and are available upon request.

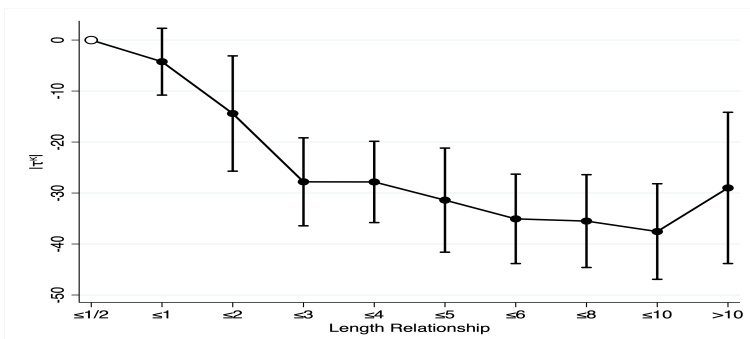
Figure 5: **MRP-cost gaps of capital and length of lending relations**

This figure displays the relationship between MRP-cost gaps of capital (τ_{it}^{K}) and the length of lending relationships (Length Relation$_{it}^{wmean}$). Panel a displays the raw correlation. Panels b, c, and d plot the regression coefficients associated with dummy variables indicating a different length of lending relationships (omitted category: Length Relation$_{it}^{wmean}$$\leq$0.5 years). The regression model includes firm-level controls and industry-by-province-by-year fixed effects. In Panel c, undercapitalized firms are those with $\tau_{it-1}^{K} > 0$. In panel d, high-TFPR firms are those with TFPR above the median of the distribution of TFPR (ω_{it}). All quantities on the y-axis are expressed in percentages. Length of relationships are expressed in years.

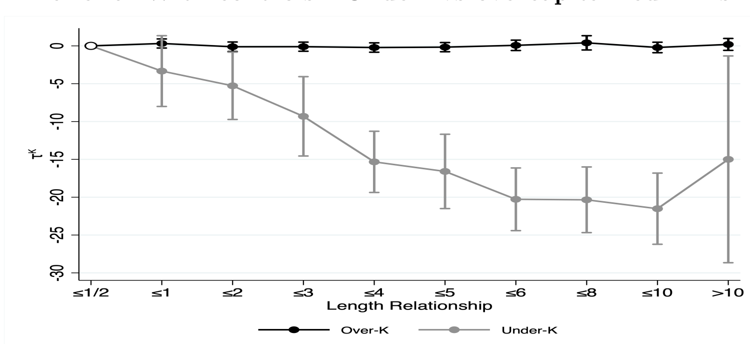
Panel a: Raw correlation



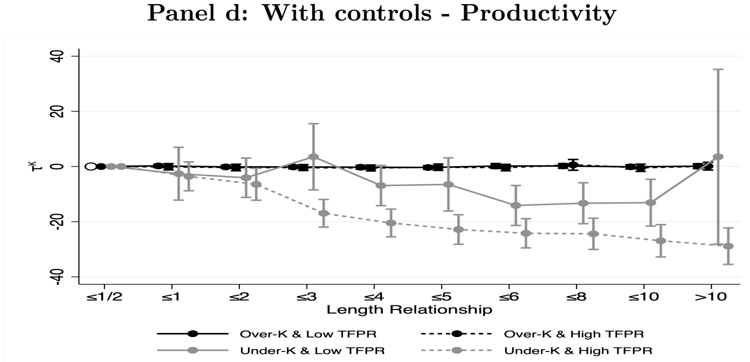
Panel b: With controls



Panel c: With controls - Under- vs overcapitalized firms



Panel d: With controls - Productivity



replacing the continuous variable Length Relation$_{it}$ with a set of dummy variables. Figure 5, Panel b, plots the regression coefficients associated with each dummy variable (Length Relation$_{it}$$\leq$1/2 is the baseline category, which is omitted in the regression). It shows that the negative correlation between the two variables holds across the entire distribution of Length Relation$_{it}$. Confirming the patterns in row data, we find an economically and statistically large drop in the gap occurring over the first years of firm-bank interactions: τ^K drops by 30 percentage points after three years of continuous interactions. Finally, we also note that the sign of the coefficient associated with the number of active credit relations - not reported in Table 5 - is negative and significant, which is in line with our intuition because a larger pool of lenders provides firms with a larger set of financing options.

Heterogeneous effects – The average effect, however, masks substantial heterogeneity across producers. In column (5), we interact the length of the lending relationships with a dummy variable that indicates whether the firm was operating below its target capital endowment in period $t-1$ (Undercapitalized$_{it-1}$ $= \mathbf{1}\{\tau^K_{it-1} > 0\}$), as well as the full set of interactions of the dummy Undercapitalized$_{it-1}$ with the vector of controls and fixed effects in the regression model (10).[59] Consistent with MRP-cost gaps being linearly related to the shadow cost of funds, we find that the economic benefits of longer credit relations are entirely concentrated among under-capitalized producers, helping them overcome potential information frictions that constrained the availability of bank finance. Figure 5, Panel c, forcefully makes this point by showing the effect of longer relationships for Undercapitalized$_{it-1}$ $= \{0, 1\}$ across the distribution of Length Relation$_{it}$. We find a negligible impact of longer lending relationships on the MRP-cost gap of firms that operate with a capital endowment that, according to our measure, exceeds the one more consistent with unconstrained profit maximization. Despite its small magnitude, the negative sign of the coefficient on Length Relation$_{it}$ suggests longer relationships might actually allow some overcapitalized firms to maintain or even increase their capital endowment.

Another testable implication of the theory of gaps is the relation to firm-level productivity. As discussed in section 3, theory suggests the MRP-cost τ^K is proportional to the multiplier attached to the borrowing constraint (χ_{it}). The shadow cost of funds χ_{it} is increasing with the firm's productivity because, ceteris paribus, more productive firms are capable of transforming one extra unit of capital into more revenues. Thus, if variation in τ^K truly reflects heterogeneous shadow costs due to binding financial constraints, the benefits of bank-firm interactions should be larger for more productive firms that appear to be undercapitalized. These theoretical predictions find strong empirical support. We augment the model with the interaction between TFPR (ω_{it}) and the length of lending relationships (column (6)), and the triple interaction with Undercapitalized$_{it-1}$ (column (7)). To facilitate the interpretation of estimates, we de-mean ω_{it}, so that the coefficient associated with Length Relation$_{it}$ represents the average response of τ^K to one additional year of firm-bank interactions for a firm located at the mean of the distribution of TFPR. In column (7), the same coefficient refers to an overcapitalized firm located at the mean of the distribution

[59]The full regression table is available upon request.

of TFPR. We find a stronger correlation between gaps and the length of lending relationships for more productive firms. In particular, the sign and magnitude of the coefficient associated with the triple interaction (LENGTH RELATION$_{it}$ x UNDERCAPITALIZED$_{it-1}$ x TFPR$_{it}$) shows the benefits of relationship lending accrue, for the most part, to the subsample of the most productive firms that operate with too little capital. Figure 5 (Panel d) provides a visual representation of the heterogeneous effects of longer lending relationships along the productivity spectrum.[60]

Robustness – We augment the regression model with firm fixed effects, and study the impact of a relaxation of borrower-lender information frictions over the firm's life cycle (Table 5, Panel b). By doing so, we strengthen the identification of the coefficient of interest, because we now control for time-invariant unobservable firm characteristics and we also better address measurement error problems. The within-firm estimates largely confirm the results of the between-firm regressions, although the estimates of the coefficients interacting the relationship variable with lagged gaps are imprecisely estimated due to the lack of within-firm variation in the variable UNDERCAPITALIZED$_{it-1}$, which is quite persistent within firms.[61]

Analyzing the relation between credit market frictions and credit-supply shocks, we restricted our attention to the subsample of borrowers for which we observe the information on the APR on term loans. In Appendix H, we replicate all the analysis on the sample of borrowers for which we have information on the identity of the lender. As discussed in section 4, this subsample includes firms that only borrow drawing from credit lines, firms whose lenders are not in the TAXIA sample. Results are confirmed in both economic magnitude and statistical significance.

Finally, throughout the paper, we have used the APR on bank loans as a measure of borrowing costs. We have argued and shown empirically that investments in fixed assets display higher sensitivity to loans than to other types of credit products. How would the results of our analysis change if the APR on credit lines is used to construct τ^K? Appendix H shows the MRP-cost gaps τ^K_{it} are lower if we use the APR on credit lines, reflecting the higher level of $r^{CredLines}$ with respect to r^{Loans}.[62] However, all the statistical relationships discussed in this section are found to be highly robust to changes in the reference interest rate. Also, results are qualitatively similar if we measure the degree of information frictions using the unweighted average length of relations (LENGTH RELATION$^{mean}_{it}$) or the length of the relation with the main lender (LENGTH RELATION$^{lead}_{it}$) instead of the weighted average.[63]

[60] In the graph, the variable HIGH-TFPR$_{it}$ that takes value of 1 for observations whose productivity is above the median, and zero otherwise.

[61] Firm and year fixed effects alone can explain over 70% of the variation in UNDERCAPITALIZED$_{it-1}$. Another way to see the persistency MRP-cost gaps, is to note that the R^2 of the regression barely changed from column (1) to column (2) of Table 5, Panel b, but it almost quadruples after the inclusion of UNDERCAPITALIZED$_{it-1}$ in the between-firm regressions (from column (4) to column (5) of Table 5, Panel a). The evident presence of a firm-specific component of gaps resembles the results in David and Venkateswaran (2017).

[62] On average, the nominal APR on credit lines is 12.5%.

[63] Regression results are available upon request.

5.2.2 Access to credit

Up to now, we have restricted our analysis to producers that actively engage in credit market transactions. The summary statistics reported in Table 2, however, show the gaps between marginal revenue products of capital and user costs are, on average, twice as large for firms that do not engage in credit market transactions.[64] Not surprisingly, we also observe a significant difference between the MRP-cost gaps of firms that report outstanding loan obligations and the estimated MRP-cost gaps of firms whose only access to credit markets is through revocable lines of credit. Credit lines are an important source of financing for firms (Sufi 2009), often the first type of credit granted by banks in order to test borrowers' creditworthiness. The high interest rates, relatively low credit limits, and its revocable nature, however, make this type of credit product an inappropriate and expensive source of financing for capital expenditures in fixed assets (see Appendix B.1).

This stylized fact suggests access to finance (i.e., the extensive margin), other than the amount of credit conditional on acceptance, is a key force influencing the efficiency of capital accumulation. We investigate this aspect more formally. We run the following non-parametric difference-in-differences regression and analyze, within firm, the evolution of τ^K around the year in which firms enter the credit market:

$$y_{it} = \sum_{j=-3}^{7} \beta_j \mathbf{1}\left\{(t-t_0)=j\right\}_{it} + \mathit{\Gamma} X_{it} + \iota_t + \iota_i + \epsilon_{it}\,, \tag{11}$$

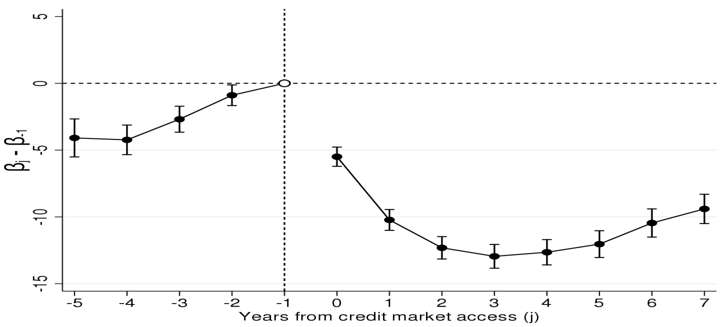
where t_0 represents the year of the change in status: $\textsc{Borrower}_{it_0-1} = 0$ (no outstanding bank debt) and $\textsc{Borrower}_{it_0} = 1$ (positive outstanding bank debt). We control for time trends with year fixed effects (ι_t); firm fixed effects (ι_i) allow us to exploit only within-firm variation. The vector of time-varying controls X_{it} includes a second-order polynomial in age, the natural logarithm of lagged assets, and lagged credit score. We allow the error term ϵ_{it} to display serial correlation at the firm level. Figure 6 displays the estimates of the coefficients. $\hat{\beta}_j$ captures the average change in τ^K_{it} from year $j=-1$ (the baseline category in Model (11)) to year $j \neq -1$. The empirical model in equation (11) allows us to better disentangle the impact of credit market participation from important confounding effects. For example, credit market participation naturally covaries with other phenomena affecting firm policies over their life cycle, and borrowers differ from non-borrowers in terms of age, size, and industry affiliation. Young and small firms may voluntarily restrain themselves from undertaking (partially) irreversible investments even if debt financing is available, especially when they operate in industries characterized by high demand uncertainty (Foster et al. 2016; Bloom 2009; Asker et al., 2014).

Comparing the level of the gap the year before credit market entry with the level observed the year of entry and the one observed the following year, we estimate an average drop of 5 and 10 percentage points in τ^K, respectively. These stylized facts are revealing. They highlight that credit

[64] We do not observe the borrowing costs for firms that do not engage in credit market transactions. We follow the procedure described in section 4.1 and Appendix B.2 to construct an estimate of the interest rate they might have charged had they been able/willing to borrow.

Figure 6: **Access to credit markets**

This figure displays the dynamic of MRP-cost gaps for capital (τ_{it}^{K}) before to after transition of a firm into the credit market. The regression model is described by equation (11). All quantities on the y-axis are expressed in percentage points.



market participation (extensive margin) matters as much as, or even more than, the intensity of credit market interactions (Jeong and Townsend 2007; Midrigan and Xu 2014). Despite its importance, the extensive margin has received limited attention in the empirical literature, typically because of the lack of micro-level records that allow researchers to follow firms in their transition into credit markets.

Robustness – A concern with the comparison of borrowers and non-borrowers is related to an incorrect estimation of the missing borrowing costs when not available. We worry the larger gaps observed for non-borrowers might be driven by a systematic underestimate of their user cost of capital. A simple back-of-the envelop exercise suggests the imprecise estimates of the unobservable interest rates are unlikely to explain the large differences between borrowers and non-borrowers, because the interest rate of non-borrowers should be over 20 *percentage points* higher for non-borrowers in order to equalize their average gap to the average gap of borrowers. In Appendix B.2, we provide other formal tests indicating that an incorrect assessment of the potential borrowing rate that non-borrowers face is unlikely to be the driver of the estimates of model (11). First, we look at "crossover firms." That is, we identify those firms that are borrowers in year t but were not borrowers in $t-1$. For these observations, the difference between the observed interest rate in period t and the imputed interest rate in $t-1$ is only 28 basis points on average (median 0.18). We also perform an out-of-sample test, excluding a random sample of 10% of the firms for which we observe the interest rates, and implement our imputation procedure using the remaining 90% of the observations. For the subsample of excluded observations, the difference between the imputed and observed rate is, on average, economically negligible (-0.1 percentage points) and not significantly different from zero. Thus, consistent with previous evidence on the rigidity of interest rates, the change in τ^{K} as firms transition into the credit market is by and large driven by a drop in the MRP^{K} that signals that firms use bank credit to harvest profitable investment opportunities.

5.3 Labor Market Distortions

We now move to the analysis of the relation between labor gaps and labor market frictions, taking advantage of the institutional features of the Italian labor market. We study how MRP-cost gaps respond to the presence of implicit costs generated by regulations that differentially affect firms, as a function of the number of workers they employ. We begin with a review of the salient features of the institutional features of the Italian labor market relevant for our analysis.

5.3.1 Institutional background

Employment protection law – During our sample period, a stringent employment protection law (EPL) allowed firms to individually and collectively dismiss workers with open-end contracts only on a "just cause" basis.[65] When workers appeal to the court against dismissal, and judges rule the dismissal unfair (i.e., lacking a "just cause"), firms must provide compensation in the form of severance payments that vary according to firm size. For firms with more than 15 employees, the firing costs are substantial. Under Art.18 of the Italian Worker's Statute (Law 300/1970), such firms are obliged to reinstate the unfairly dismissed worker, unless the worker opts for a severance payment of at least 15 months of salary. Moreover, employers also have to compensate unfairly laid-off workers for the forgone wages in the time elapsing between the firm's dismissal and the final sentence. This process can take up to five years due to the inefficiency of the Italian legal system. Thus, a firm with more than 15 employee faces severe expected firing costs when it attempts to scale down its workforce (Garibaldi and Violante 2005; Schivardi and Torrini 2008).[66] By contrast, Article 18 does not apply to firms with 15 or fewer employees, and their expected firing costs in case of unfair dismissals are substantially lower: a severance payment that varies between 2.5 and 6 months of a worker's salary; or, as an alternative to the severance payment, firms can opt to reinstate the worker. The potential high cost in case of loss, together with a particularly restrictive definition of "fair" dismissal (Ichino 1996) and significant legal uncertainty about the result of the case (Ichino 1996), is a strong deterrent to initiating a dismissal procedure even when the firm might think it has the right to do so. Thus, the expected firing cost should be substantially higher for firms with more than 15 workers, to which Article 18 of the Italian Worker's Statute applies.

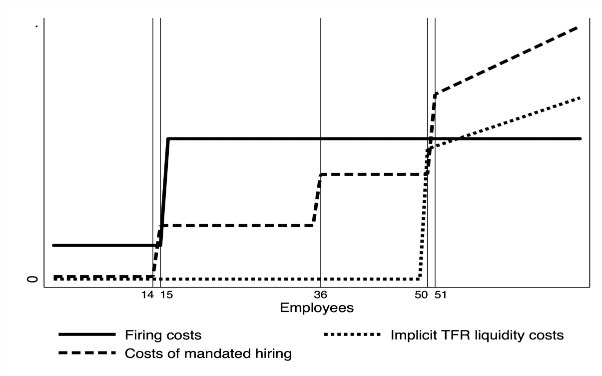
Quotas for workers with disabilities – The Italian law ratifying the rights of people with disabilities (Law 68/1999) requires employers to hire a certain number of workers with disabilities. In particular, under Art.3 of the law, firms that employ between 15 and 35 employees are required to hire one full-time employee with a disability; firms that employ between 36 and 50 employees are required to hire two full-time employees with a disability; firms with 51 or more employees are

[65] According to the OECD index of strictness of employment protection regulation, Italy ranks fifth among the OECD countries. Size-dependent regulations in labor markets are common in both developed and developing countries (see Guner et al. 2008). Gourio and Roys (2014) and Garicano et al. (2016) analyze the effect of size-dependent regulations in France; Braguinsky et al. (2011) in Portugal; Abidoye et al. (2009) in Sri Lanka; and Martin et al. (2017) in India. In the US under the US Affordable Care Act, penalties are levied against firms with more than 50 full-time employees that do not offer health care insurance to their employees.

[66] Article 18 was substantially reformed in 2012 and finally abolished in 2014.

Figure 7: **Implicit costs of size-dependent regulations**

This figure provides a schematic representation of the implicit costs associated with different regulations for firms of different sizes. We assumed an implicit cost per worker f due to the employment protection law for 15 or fewer employees, and an implicit cost per worker F for firms with more than 15 employees, with $f < F$. We also assumed an implicit cost of $q > 0$ for every worker with a disability, and an implicit liquidity cost per worker of $z > 0$ due to the transfer to the TFR contributions from the firm to the treasury for firms with 50 employees or more.



required to have 7% of their workforce represented by employees with a disability. By contrast, firms with fewer than 15 employees are exempted from the provisions of the law on the rights of people with disabilities. Because adapting the workplace to the disabled can be expensive, and because the firm might be more exposed to the risk to future labor-related litigations, the provisions of the labor law protecting disabled workers might have significant employment effects on firms of different size.

End-of-service benefit to employees – Employers in Italy are required to provide an end-of-service benefit to employees, known as Trattamento di Fine Rapporto (TFR), payable on termination of employment for any reason. Historically, TFR benefits were unfunded or book reserved. As part of a pension reform passed by the Italian government in 2006, companies with 50 or more employees as of December 31, 2006, were required to transfer future accruals to a treasury fund managed by INPS (the Italian social security agency) or to an external pension provider. For smaller companies, employees individually can decide whether their accruals should be externalized in this way. Hence, starting from 2007, employing more than 50 employees entails a liquidity shock due to the transfer of firms' TFP liabilities to the treasury. Therefore, the reform might effect the likelihood of firms growing above the 50-employees threshold, similar to the effect of firing costs and employees quotas.

Wage setting mechanism – In the absence of wage rigidities, theory predicts that appropriately designed wage contracts would neutralize the labor market effects of the above-mentioned regulations, because the implicit costs would be transferred to workers in the form of reduced wages, with no effects on firms' employment policies (Lazear 1990). Instead, if contractual frictions prevent or limit wage adjustments, we expect size-dependent provisions of the laws to have an effect on employment policies and on the allocation of labor across producers. This is the case of Italy, where wages are predominantly determined by a two-tier bargaining structure: (1) The first-level bargaining is collective and takes place at the national-sectoral level. It determines the general terms and conditions of employment for different occupations and basic minimum-wage guarantees.[67] (2) The second-level takes place at the regional level or at the firm level, and it allows firms and workers to supplement national contracts. Second-level bargaining is optional, and, importantly, it is restricted to upward wage adjustments with respect to the minimum wage guarantees set by the first-level negotiations.[68] Evidence of wage rigidity can be gathered from nationally representative firm-level surveys. According to the 2010 Bank of Italy survey on industrial and service firms, only 20% of firms engage in some form of firm-employees wage negotiations. On average, the nationally negotiated minimum wage contracts account for 80% of the total wage, whereas the residual 20% is set at the firm level (D'Amuri et al. (2015); Adamopoulou et al. 2016).[69] Firm-level wage bargaining, in the sporadic instances when it takes place, is limited to upward adjustments because nationally-set minimum wages are legally binding (Devicienti et al. 2007). Our data corroborate these findings.[70] All in all, these facts suggests that *de facto* wages are anchored to the occupational wage rate periodically set at the national level, rather that linked to firms' or workers' productivity.

To summarize, Figure 7 provides a graphical representation of the implicit costs associated with the three size-dependent regulations borne by firms of different sizes. Size-dependent policies of the kind described above, coupled with wage rigidity, lead to resource misallocation: Some firms downsize to avoid taxes; moreover, these policies generate correlated distortions leading to downsizing of firms above the threshold and over-expansion of those below the threshold (Guner et al., 2008; Hopenhayn, 2014).

5.3.2 Effect of size-dependent regulation on firms' employment policies

Labor supply adjustments and size distribution – We begin documenting the impact of the size-dependent regulations on workforce adjustments on the size distribution of firms. Figure 8 (right) displays the probability of increasing the labor force within one year ($\text{Employees}_{it+1} > \text{Employees}_{it}$, left axis) and the probability of labor-force inertia ($\text{Employees}_{it} = \text{Employees}_{it-1}$, right axes) as a function the number of employees of the firm. The probability of workforce inertia is higher for firms below the thresholds and then it adjusts down past the thresholds. The impact of the employment protection provision on firms' workforce is also reflected in their propensity to

[67]The general terms and conditions of employment contracts and minimum-wage guarantees agreed upon in the first-level bargaining are renegotiated, for different occupations, every four and two years, respectively.

[68]Only in well-delimited cases of a firm's restructuring or distress can, second-level deals can (temporarily) cut wages below the nationally set sectoral minimum. Still, although legally possible, evidence of firm-level agreement envisaging a decrease in the wage below these minima is scant (see D'Amuri et al. 2015). The amendments to the national contracts renegotiated in the second-level bargaining are valid for four years.

[69]Heckman et al. (2006) reports similar estimates for the 1990s.

[70]We run a linear regression that includes a set of year-by-province-by-industry dummies, and dummies for age and size deciles. This simple model explains 50.3% of the dispersion in average annual wages. Firm-level (log) TFPR and ROA - two measures of productivity and profitability - are able to explain only an additional 1% of the variance in wages. In a similar institutional context, Doraszelski and Jaumandreu (2015) shows that a large share of the observed wage dispersion across Spanish manufacturing firms is explained by geographic and temporal differences in labor markets.

grow. Because adjustment has an option value, firing costs also affect hiring decisions (Hopenhayn and Rogerson 1993): In anticipation of a possible reversal of consumer demand, firms will hire less than they would have in a frictionless environment, in order to avoid incurring high firing costs when downscaling is needed. Consistent with this prediction, we find a sharp drop in the probability of hiring new workers before and at the thresholds, inverting the upward trend observed to away from the threshold. The effect of the size-dependent regulations seem to be particularly pronounced around the 15-employees threshold, above which the Italian EPL imposes significant firing costs on firms.

Figure 8 (left) illustrates that the size-dependent provisions of the law have visible implications for the size distribution of firms. The fraction of firms by number of employees generally decays with size following a power law, but the rate of decay changes markedly past the thresholds. Once again, these patterns are particularly evident around the 15-employees threshold for which we observe both a change in the slope and a significant jump in the distribution denoting a missing mass of firms (Garibaldi et al. 2004, Schivardi and Torrini 2008, Hijzen et al. 2013).

MRP-cost gaps – Next, we show the interplay of the size-dependent provisions and wage rigidities distort firms' employment policies of firms of different sizes, opening a gap between the marginal product of labor and its user cost. Figure 9 plots the median MRP-cost gap τ^L across firms of different size (gray dots), and estimate an isotonic regression of the relationship between labor gaps and the number of employees of the firm (black line).

The fit of the isotonic regressions is quite good; that is, labor gaps appear to be (nearly) monotone in firm size. Yet we observe kinks in the size gradient around the regulatory thresholds: Gaps increase as we approach the thresholds from the right, but the size gradient flattens after the threshold. Moreover, we observe significantly positive deviations from the isotonic predictions for forms located right at the thresholds. Once again, these patterns are particularly marked for the 15-employees threshold.

We provide a formal test for the presence of kinks in size-gradient. For different regulatory thresholds, we estimate local changes in the slope of the conditional expectation function of τ^L given the number of employees:

$$\mathbb{E}[\tau^L_{it}|L_{it} = x_{it}] = \delta \cdot (D^j_{it}(x_{it} - k^j)) + \gamma \cdot (x_{it} - k^j) + \iota_s + \iota_t + \iota_p + \epsilon_{it} \tag{12}$$

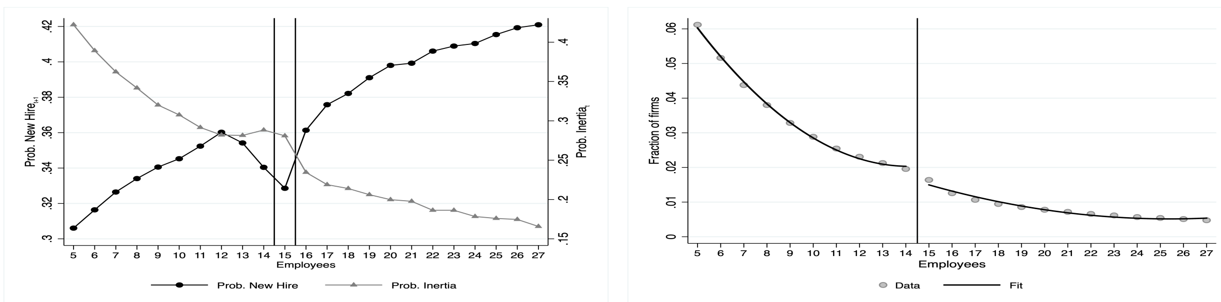
where $j = \{14, 35, 49\}$ indexes a regulatory threshold. $D^j_{it} = \mathbf{1}\{x_{it} > k^j\}$ is an indicator for being above the kink threshold j. For each threshold j, we restrict our attention to observations falling within an interval of ± 5 employees from the kink (i.e., $(x_{it} - k^j) = \{-5, ...0, ..., 5\}$). ι_s,ι_t, and ι_p are industry, year, and province fixed effects, respectively. The coefficient of interest is δ. It measures the change in the slope of the conditional expectation function before and after the threshold. We cluster standard errors at the industry and year level to allow for serial correlation in the errors driven by the collective nature of the wage bargaining process.

Table 6, Panel a, shows the results for the baseline specification (12) for all thresholds (columns (1)-(3)) and for the pooled sample (column (4)). Corroborating the graphical evidence of Figure 9,

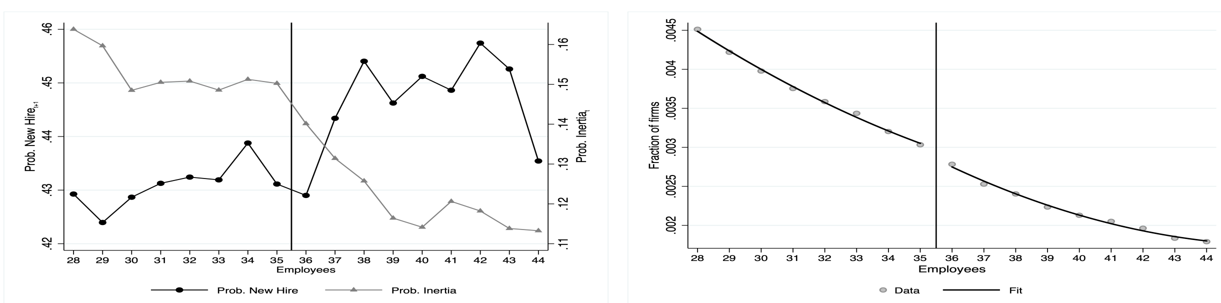
Figure 8: **Effect of size-dependent regulations on workforce adjustment and size distribution**

This figure studies the impact of size-dependent government-mandated severance payments on firms' employment policies. Each panel reports the probability of employment inertia and probability of upward adjustment across firms of different sizes (right) and a snapshot of the size distribution (left) as a function of firm size around each regulatory threshold. The probability of inertia is the probability that Employees_{it}=Employees_{it-1}; the probability of hiring is Employees_{it+1}>Employees_{it}. The vertical lines mark different regulatory thresholds above which firms face higher implicit costs imposed by severance payments, mandatory quotas for workers with disabilities, and transfer of employees' end-of-service benefits.

panel a: 15-employees threshold



panel b: 36-employees threshold



panel c: 50-employees threshold

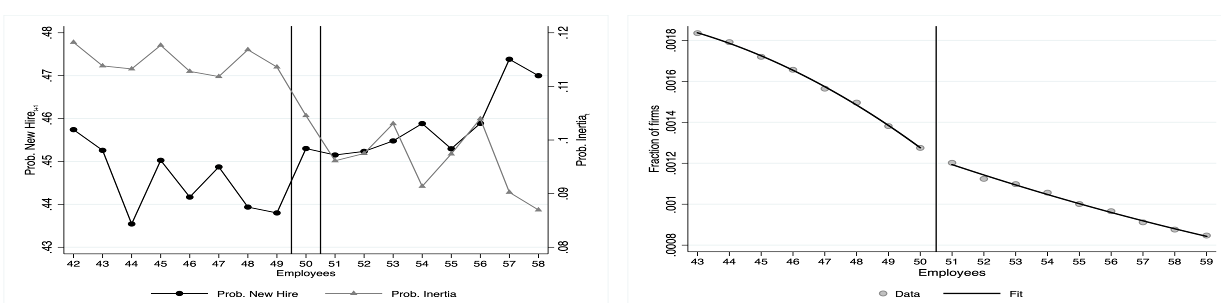


Figure 9: **Effect of size-dependent regulations on workforce adjustment and size distribution**

This figure plots the median MRP-cost gap of labor (τ_{it}) across the distribution of firm size. The labor gap is measured in thousands of euros. The vertical lines mark different regulatory thresholds above which firms face higher implicit costs imposed by severance payments, mandatory quotas for workers with disabilities, and transfer of employees' end-of-service benefits.

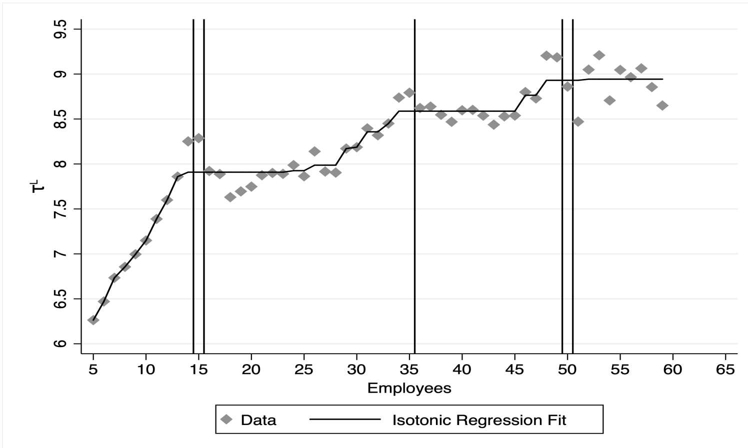


Table 6: **MRP-cost gaps and implicit costs of size-dependent regulations**

This table presents the estimates of the regressions of in equation (12). In Panel a, the dependent variable is the MRP-cost gap of labor (τ^L). In Panel b and c the dependent variables are the components of the labor gap: the marginal product of labor (MRP^L) and user cost of labor (w_{it}). The regressions in columns (1)-(3) and (5) are estimated on subsamples of data around each regulatory threshold (± employees). The regression in column (4) is estimated on a subsample that pools the three subsamples of observations around each threshold. Standard errors (in parentheses) are clustered at the industry (2-digit) and year level.

	(1)	(2)	(3)	(4)	(5)	
	15-threshold	36-threshold	50-threshold	Pooled	50-threshold	
					Pre-2007	Post-2007
			Panel a: τ^L_{it}			
$\hat{\delta}$	-0.292***	-0.123*	-0.209**	-0.153***	-0.092	-0.343**
	(0.031)	(0.062)	(0.103)	(0.027)	(0.136)	(0.146)
R^2	0.151	0.177	0.198	0.138	0.199	
			Panel b: MRP^L_{it}			
$\hat{\delta}$	-0.442***	-0.148**	-0.209**	-0.219***	-0.059	-0.382**
	(0.032)	(0.066)	(0.110)	(0.028)	(0.141)	(0.159)
R^2	0.261	0.257	0.276	0.237	0.276	
			Panel c: w_{it}			
$\hat{\delta}$	-0.154***	-0.027	0.006	-0.065***	0.054	-0.046
	(0.009)	(0.018)	(0.028)	(0.007)	(0.034)	(0.045)
R^2	0.395	0.452	0.473	0.400	0.473	
Year Fixed Effects	Y	Y	Y	Y	Y	
Industry Fixed Effects	Y	Y	Y	Y	Y	
Province Fixed Effects	Y	Y	Y	Y	Y	
Observations	946,296	173,980	81,243	1,201,519	81,243	

we estimate a significant kink in the distribution of τ^L once new size-dependent provisions apply. Panels c and d of Table 6 reports the estimated kinks in the distribution of the components of the labor MRP-cost gap. Consistent with the rigidities in the wage setting mechanism described in Italy, wages display little or no adjustments around the regulatory threshold. We find some evidence of kink in the wage distribution only around the 15-employees threshold. By contrast, the kinks in the distribution of MRP^L are statistically significant and large in magnitude at all regulatory thresholds, suggesting the effects of the size-dependent regulation distorts firms' employment choices rather than affecting wages.

The pension reform of 2007 allows us to exploit time-series variation in the size-dependent regulatory costs to test their effect on labor gaps in the cross-section of producers. As explained in the previous section, starting from 2007, firms employing more than 50 employees experience a significant liquidity cost relative to smaller firms as they are mandated to transfer their TFP liabilities to the treasury. Because these costs are significant, we expect the reform to have a distortionary effect firms' labor policies - above and beyond the effect of the quotas for workers with disabilities - which would accentuate the kink in the distribution of τ^L after 2006. To test this prediction we estimate a difference-in-differences version of equation (12), by allowing for a different change in slope before to after 2006. Results, reported in Column (6) of Table 6, show the kink around the 50-employees threshold becomes significant only after 2007, when the liquidity costs add to the implicit cost due to the quotas, discouraging firms from hiring more workers despite the fact that profitable growth opportunities seem to be available.[71]

Robustness – Appendix I offers a number of robustness tests that further shed light on the effect of the implicit costs generated by size-dependent regulations on firms' labor demand. First, exploiting cross-industry heterogeneity, we show that kinks are statistically significant in both highly unionized industries (e.g., manufacturing) and in industries with low unionization levels (e.g., services). Because in highly unionized industries labor force under-reporting is difficult, this finding suggests that kinks are unlikely driven by firms' misreporting of their actual labor force.[72]

Second, if capital and labor are partially substitutable in production, economic theory predicts firms should respond to an increase in the cost of labor by demanding more capital. The ability to effectively substitute labor services for capital services is a function of the relative intensity of these two inputs in production. Thus, we expect employment policy distortions to be higher in labor-intensive industries than in capital-intensive ones. We construct an industry-specific measure of labor intensity (relative to capital) of firms' production technologies using the within-industry

[71] After 2008, the burst of the financial crisis worsened the financial position of many Italian firms. As a result, we cannot exclude a stronger impact of the quotas for workers with disabilities after 2006 in the absence of the TFR reform. Yet, the estimates of the difference-in-differences model around the 15- and 36-employees thresholds suggest an exacerbation of the implicit costs due to the quotas alone is unlikely to explain the different change in slope post-2006 around the 50-employees threshold. In fact, around the 15-employees threshold, we find the kink is not statistically different for the two sub-periods; around the 36-employees threshold, the kink is *smaller* after 2006 than before.

[72] Anecdotal evidence suggests the problem of hidden labor is more severe in the informal sector of the economy. All firms in our sample, instead, are incorporated entities, which are subject to closer scrutiny by government officials and unions.

average capital-labor ratios (K/L). We classify industries into high-, medium-, and high- labor intensity groups based on the terciles of the distribution of capital-labor ratios. We find that firm-level gaps τ^L respond more strongly to the size-dependent provisions of the law for firms that operate in labor-intensive industries, whereas we find either no kink or a kink in the opposite direction for firms that operate in more capital-intensive industries.

Third, we investigate whether the evidence presented in this section is sensitive to the choice of our measure of the user cost of labor. We re-estimate the labor gaps using wages paid to newly hired workers calculated across firms that operate in the same local labor market (see section 4.1). Because wages of new workers tend to be higher than average firm-level wages, these alternative estimates of τ_{it}^L are lower than the baseline ones (15% lower, on average).[73] Despite this difference, the implications of the size-dependent regulations are robust and even stronger when we construct gaps using this alternative measure of user costs.

Another concern is related to the possibility that firms might respond to the size-dependent regulations by adjusting the number of hours they ask their employees to work, or by incentivizing overtime. The data in our possession do not contain information on these variables. However, the Italian institutional framework and the findings of previous empirical studies leave us confident that these factors are not a major force driving our results. For example, firms are limited in their ability to increase hours, because the Italian labor law allows a maximum of fourthly hours per week and eight hours per day. Moreover, Adamopoulou et al. (2016) show that overtime pay accounts for a relatively low portion (around 4%) of monthly earnings in the industrial sector. The authors also find that overtime hours (as a fraction of total hours) are uncorrelated with the degree of wage rigidity at the firm level.

Finally, in light of the incidence of informal labor on the Italian economy, one might argue these patterns could be explained by firms misreporting their labor force, in order to avoid being subject to the provisions of Article 18. Anecdotal evidence suggests the problem of hidden labor is more severe in the informal sector of the economy. All firms in our sample, instead, are incorporated entities, which are subject to a closer scrutiny by government officials and unions. Moreover, we find reassuring the fact that the impact of the size-dependent regulations on the distribution of τ^L is large and significant also in highly unionized industries.

6 Aggregate Implications: Misallocation, TFP, and Lost Output

Aggregate productivity is affected by both the underlying distribution of productivity across firms in the economy and by the allocation of resources across them. This insight has led a number of recent studies to conclude that resource allocation is a key explanatory factor of the disparity in economic growth across and within countries (Banerjee and Duflo 2005; Restuccia and Rogerson 2008; Hsieh and Klenow 2009; Hopenhayn 2014). In the case of Italy, the broad consensus is that

[73] The higher wages for newly hired workers are likely a result of a combination of nominal rigidities in the inter-temporal adjustment of wages of infra-marginal workers and of a different skill composition of the two groups of employees.

the country's spectacular failure to sustain aggregate productivity growth and contemporaneous economic stagnation of the last 20 years can be attributed in large part to malfunctioning financial, labor, and product markets that jeopardized the efficiency of the allocation of resources across their different uses (Bugamelli and Lotti 2017).[74]

In this section, we quantify the extent to which idiosyncratic distortions in firms' investment and employment choices translate into a loss in aggregate output and aggregate productivity, and investigate how potential gains from a reallocation of resources evolve over time and vary across space and different sectors of the Italian economy.

We compute the following firm-level counterfactual quantities:

$$L^{**}_{ist} = m^L_{ist} L^*_{ist}$$
$$K^{**}_{ist} = m^K_{ist} K^*_{ist},$$

where $m^L_{ist} \gtreqless 0$ and $m^K_{ist} \gtreqless 0$ are reallocation weights of firm i in year t that operate in industry s. The endowments L^*_{it} and K^*_{it}, defined in section 4.4 of the paper, and they represent the amount of target input demands that close the gaps τ^L_{it} and τ^K_{it} at the observed user costs. We look for reallocation weights that meet the following criteria:

1. $\sum_i X^{**}_{ist} = \sum_i X_{ist}\ \forall s, t$.
2. $m^X_{ist} \geq 0$ when $\tau^X_{ist} > 0$.
3. when $a_{jst} \geq a_{ist}$: (i) $m^X_{jst} \leq m^X_{ist}$ if ($\tau^X_{jst} \leq 0$ & $\tau^X_{ist} \geq 0$); (ii) $m^X_{jst} \geq m^X_{ist}$ otherwise,

where $X = \{K, L\}$ and a_{jst} is firm-level productivity defined in Section (4). Criterion 1 is resource constraint. It forces the reallocation to take place with no change in the aggregate capital and labor endowment of each industry. We focus on reallocation across firms that in a given year operate within the same narrowly defined industry (4-digit code). This is important because capital and labor are not fully redeployable across industries. Criteria 2 and 3 force resources to move in a welfare-enhancing direction: from negative MRP-cost gap producers toward positive gap firms (criterion 1), and following a productivity rank (criterion 2).[75] Appendix J.1 provides a detailed explanation of a reallocation algorithm that satisfies these criteria. In short, for every industry-year pair, we group firms into positive and negate MRP-gaps. Then, we reallocate resources away from the lowest-TFP firm belonging to the negative-gap group, and toward the highest-TFP firms in the positive-gap group. The reallocation stops when the aggregate constraint binds ($X^{**}_{st} = X_{st}$). Evidently, it must be the case that $X^{**}_{ist} < X^*_{ist}$ for some firms in the economy when $X^*_{st} > X_{st}$, and $X^{**}_{ist} > X^*_{ist}$ for some firms in the economy when $X^*_{st} < X_{st}$. When $X^*_{st} < X_{st}$, we first set $X^{**}_{ist} = X^*_{ist}$ for all firms, and then we reallocate the difference $X_{st} - X^*_{st}$ across firms in a way that

[74] Data from the Italian National Statistical Institute show the Italian year-on-year TFP growth was, on average, 0.05% in the decade 1997-2007, and -0.3% between 2008 and 2013. Data are available at https://dati.istat.it (access October 2017). Bugamelli and Lotti (2017) highlights the importance of frictions in labor, capital, and output markets in preventing Italian firms from effectively responding to the competitive pressures of increasingly globalized markets, and benefit from the opportunities offered by technological innovation and EU integration.

[75] Another way to restate criterion 2 is $\frac{\partial P\{m^X_{it} > 0\}}{\partial \omega_{it}} \geq 0$ if $\tau^X_{it} \geq 0$; $\frac{\partial P\{m^X_{it} < 0\}}{\partial \omega_{it}} \leq 0$ if $\tau^X_{it} < 0$.

is proportional to the relative productivity a_{ist}.

Then, for every firm-year observation, we reconstruct a counterfactual level of output (Y_{it}^{**}) that it could have produced employing K_{it}^{**} and L_{it}^{**},

$$Y_{it}^{**} = e^{a_{it}} \cdot (K_{it}^{**})^{\gamma_s} (L_{it}^{**})^{1-\gamma_s} , \tag{13}$$

where we suppressed to s subscript to simplify the notation. Finally, we aggregate across producers and industries ($Y_t^{**} = \sum_i Y_{it}^{**}$) and construct our measure of aggregate output and TFP gains from reallocation as follows,

$$\text{Aggregate gains from reallocation}_t = \frac{Y_t^{**} - Y_t}{Y_t} = \frac{TFP_t^{**} - TFP_t}{TFP_t} ,$$

where $Y_t = \sum_i Y_{it}$, $Y_t^{**} = \sum_i Y_{it}^{**}$, and Y_{it} is the comparable measure of firm-level output that uses the observed input demands K_{it} and L_{it} (equation 8). As explained in section 4, any difference between Y_{it}^{**} and Y_{it} arises only from a different input mix, because firm-level productivity, output elasticities, and misspecification errors due to the value-added functional form assumptions are held constant. Because aggregate endowments and firm-level productivities are held constant, the gap between the aggregates Y_t^{**} and Y_t measures *output gains* as well as *aggregate TFP gains* that accrue as a result of resource reallocation.

Before presenting the empirical estimates, a number of remarks are due. Following the seminal work of work of Hsieh and Klenow (2009), several empirical papers have used micro-data on firms or establishments to estimate the scope of resource misallocation on aggregate TFP. Although the TFP accounting methodology developed by Hsieh and Klenow (2009) leads to persuasive conclusions, it crucially relies on strict assumptions required on both the demand and supply sides that allow the authors to infer misallocation from dispersion of the distribution of revenue productivity (TFPR, Foster et al. 2008), as pointed out by Haltiwanger et al. (2017). These critiques do not apply to our aggregate calculations, because they do not hinge on TFPR dispersion. Moreover, a key advantage of our bottom-up approach is the ability to transparently investigate the source of gains from reallocation. As we show below, this counterfactual exercise is performed by gradually imposing more constraints to resource reallocation by restricting the subsets of the economy within which reallocation can take place. Second, we must note the reallocation of capital and labor across producers is expected to have an impact on the level and distribution of factor prices, even when the aggregate amount of capital and labor in the economy does not change. Our analysis does not consider these important general equilibrium effects. In general, the direction and magnitude of these effects depend on the characteristics of the firms from and to which resources are mobilized. Third, our sample includes only incorporated firms. Thus, a question arises related to the generalization of the previous results to the whole Italian economy. Due to their smaller size, greater opacity, and lack of managerial capital, the non-corporate sector may exhibit investment and employment policies more distorted than the ones we found for the limited liability firms in our database (Midrigan and Xu 2014). Thus, our calculations might understate the scope of misallocation in the whole economy. Finally, we emphasize that our exercise takes the set of producers as given. Thus, it does not account for a particular form of misallocation related to the pool of producers that end up operating (selection effect).[76]

6.1 Aggregate gains from reallocation

Table 7, Panel a, presents the output (TFP) gains that accrue from reallocation of resources. Averaging across years, we find aggregate output and TFP could be 6% to 8% higher if capital and labor could be re-allocated toward high-value use producers (column 3). The share of aggregate stock of capital and labor inputs reallocated is, on average, 11% and 1%, respectively (columns 1 and 2), which implies a larger contribution of capital reallocation to the overall output/TFP gains.

In our counterfactual exercise, gains from reallocation are a function of *both* the relative size of investment and employment distortions (i.e., the distance between K_{it}^{**} and K_{it} and between L_{it}^{**} and L_{it}) and the correlation between firm-level distortions and firm-level productivity. In the data, the correlation between distortions and productivity is positive and highly significant (Table 4). The last column in Panel a of Table 7, shows that, by shutting down the productivity-rank in the reallocation (criterion 2 of the reallocation weights) and reallocating the resources of over-endowed firms toward randomly selected under-endowed firms, gains from reallocation would be almost 30% lower. This finding is consistent with the numerical results in the seminal paper of Restuccia and Rogerson (2008) and the literature that followed, according to which correlated distortions are the ones that are more damaging for the aggregate productivity.

Shifting resources from firm i to firm j might improve aggregate productivity but be unfeasible or come at the expense of increasing the volatility and risk in the economy. Geography is the most obvious feasibility constraint to resource reallocation, because workers might not be willing to move to distant locations, or moving properties and equipment could involve high re-location costs. Table 7, Panel b, presents the output and TFP gains limiting within-industry reallocation to take place only across firms that operate within the same macro-regions (north, center, and south of Italy): That is, s now represents an industry-region pair in the reallocation algorithm described above. Although the potential gains drop by approximately 1.5%, we still find significant benefits from reallocation, suggesting that a large share of the gains from reallocation can accrue within local markets.

As we documented in section 4, gaps tend to be positive and large for small and young firms. These firms have a higher bankruptcy risk and their business is more volatile than large, mature firms. Thus shifting resources from the latter to the former group of firms might negatively impact the solvency of the banking system and increase the overall volatility of the economy. How large could the scope of reallocation be if we want to leave the overall risk of the economy unchanged? We use the credit score to group firms into three subsets based on their credit risk (high, medium, or low credit risk) and calculate the output/TFP gains constraining reallocation of capital and labor

[76] Jeong and Townsend (2007) and Midrigan and Xu (2014) highlight the importance of financial friction on the extensive margin.

Table 7: **Aggregate output and TFP gains from resource reallocation**

This table presents the gains in aggregate output and TFP that accrue from resource reallocation. Panel a reports the gains when we allow reallocation to take place within the same 4-digit industry. The dashed line reports the gains when we allow reallocation to take place within the same 4-digit industry and same macro-region (north, south, and center of Italy). Panel b reports the gains when we allow reallocation to take place within the same 4-digits industry. Panel c reports the gains when we allow reallocation to take place within the same 4-digits industry, same macro-region, and same risk class (high, medium, low credit score). Columns (1) and (2) show the percentage of capital and labor reallocated; column (3) shows the implied output and productivity gains; column (4) shows the reallocation gains when resources are reallocated without following a productivity-rank rule in the reallocation of resources productivity.

	(1)	(2)	(3)	(4)
	Capital Reallocated	Labor Reallocated	Output (TFP) Gain	Output (TFP) Gain
Panel a: Reallocation within Industries				
1998 - 2001	11.76 %	0.86 %	6.79 %	4.54 %
2002 - 2007	10.77 %	1.03 %	6.98 %	5.07 %
2008 - 2009	10.93 %	1.26 %	8.47 %	6.22 %
2010 - 2013	9.63 %	1.39 %	8.29 %	6.52 %
Average	10.47 %	1.20 %	7.66 %	5.72 %
Panel b: Reallocation within Industries & Macro Regions				
1998 - 2001	11.69 %	0.86 %	5.16 %	
2002 - 2007	10.69 %	1.02 %	5.87 %	
2008 - 2009	10.88 %	1.25 %	7.09 %	
2010 - 2013	9.56 %	1.39 %	7.05 %	
Average	10.40 %	1.19 %	6.24 %	
Panel c: Reallocation within Industries & Macro Regions & Risk Class				
1998 - 2001	11.62 %	0.85 %	1.03 %	
2002 - 2007	10.58 %	1.02 %	2.20 %	
2008 - 2009	10.77 %	1.24 %	3.92 %	
2010 - 2013	9.37 %	1.37 %	3.92 %	
Average	10.26 %	1.18 %	2.80 %	

to take place only among firms that belong to the same industry, operate within the same macro-region, and have similar credit risk (i.e., s =industry-region-credit risk pair). Results are presented in Table 7, Panel c. Holding risk constant significantly lowers the gains from reallocation, which suggests that the larger part of the output gains from reallocation would require capital and labor to flow to the riskiest for the firms. This result highlights a potential trade-off for policymakers: Output gains from resource reallocation might come at the expense of increasing the volatility of the economy and the fragility of the credit system.

6.2 Business-cycle fluctuations

The times-series evolution of $(Y_t^{**} - Y_t)/Y_t$ offers interesting insights into the importance of resource misallocation in different phases of the business cycle, and in particular during periods of credit expansion versus periods of credit crunch (Figure 10). The potential output and TFP loss due to a detrimental allocation of capital and labor across industries is relatively flat in the late 90s and early 2000s. Then, from the second half of the 2000s, gains from reallocation start to increase, reaching their peak during the financial crisis and stabilizing at a high level afterward. Compared to the 1997–2004 period, gains from reallocation are over 1/4 higher after the transmission of the global financial crisis to Italy (2008–2009) and the burst of the European Sovereign debt crisis that followed (2010–2013). Importantly, these time-series dynamics do not go away if we constraint reallocation to take place only within credit risk-classes. This finding indicates that the larger gains from reallocation observed during the crisis relative to normal times might come at the expense of a larger increase in the overall risk of the economy.

A substantial body of empirical evidence documents a decline in TFP during episodes of financial crisis (Calvo et al. 2006).[77] Our findings show the strong co-integration of business-cycle fluctuations and TFP observed during episodes of financial instability might be explained, at least in part, by a deterioration of the efficiency of resource allocation (Ziebarth 2012; Oberfield 2013; Sandleris and Wright 2014). These findings are consistent with the ones in Eisfeldt and Rampini (2006) and Kehrig (2015), who show the gains from capital reallocation and the dispersion in productivity levels are countercyclical. An exacerbation of financial frictions (Cingano et al. 2010; Bottero et al. 2017) might explain these patterns.[78] An increase in economic uncertainty (Alfaro et al. 2017) and an increase in the price of risk can also explain the counter-cyclicality of gains from reallocation (David et al. 2018).[79]

6.3 Sectoral, spatial, and cross-sectional contributions

A natural question concerns whether the scope for reallocation is similar in all industries and local markets and type of borrowers, or rather is driven by some specific sectors, geographical regions, or particular types of firms. Figure 11, Panel a, displays the output gains from within-industry reallocation for three different macro-sectors of the economy: manufacturing, services, and construction. Our estimates indicate output could grow about 3%–4% by improving the allocation of capital and labor among producers in manufacturing firms, 6%–9% in the services industry, and 8%–11% in the construction industry. These findings are novel. Indeed, mostly due to the lack of comprehensive data, the large majority of the empirical studies that assess the costs of misallocation focus on manufacturing industries. Considering the growing importance of non-manufacturing industries in both developed and developing economies, our analysis suggests that

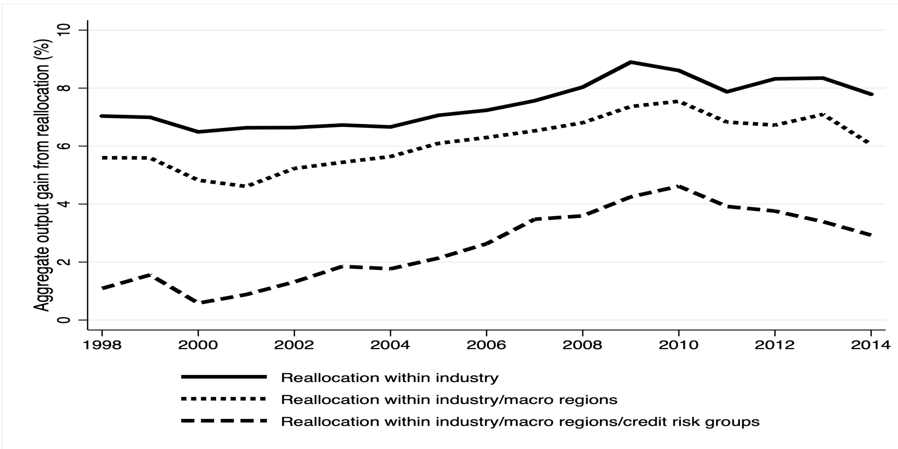
[77] Calvo et al. (2006) analyzes 22 severe crises in emerging markets and finds that output and TFP typically decline by 10% and 9.5%, respectively. Examining the Chilean economy, Oberfield (2013) performs an analysis similar to that of Hsieh and Klenow (2009) that documents a significant change in misallocation and consequent loss in TFP during the Chilean crisis of 1982. Sandleris and Wright (2014) and Ziebarth (2012) find a simultaneous decline of TFP and allocative efficiencies studying the Argentine crisis of 2001 and several US industries during the Great Depression.

[78] In a contemporaneous empirical study, Manaresi and Pierri (2017) and Dörr et al. (2017) document a loss in average *firm-level productivity* of Italian corporations during the financial and sovereign crisis, and relate it to credit market frictions. Our results complement theirs, as we focus on the *reallocation channel* rather than the productivity channel. Manaresi and Pierri (2017) also use CR data and firm-level balance sheet data from Italy, but they focus their analysis a sub-set of our dataset that is skewed toward large firms. Our findings are also in line with Schivardi et al. (2017), who provides evidence of an exacerbation of credit misallocation in Italy during the financial crisis due to ever-greening practices by banks.

[79] David et al. (2018) provide evidence of the relationship between cross-sectional dispersion in MRP^K and dispersion of risk exposure, and show that fluctuations in the price of risk, coupled with the cross-sectional heterogeneity in risk exposures, can explain the countercyclical gains from reallocation.

Figure 10: **Aggregate output and TFP gains from resource reallocation**

This figure presents the time series of gains in aggregate output and aggregate TFP that accrue from resource reallocation of resources. The solid line reports the gains when we allow reallocation to take place within the same 4-digit industry. The dashed line reports the gains when we allow reallocation to take place within the same 4-digit industry and the same macro-region (north, south, and center of Italy). The dotted line reports the gains when we allow reallocation to take place within the same 4-digit industry. The dashed line reports the gains when we allow reallocation to take place within the same 4-digit industry, same macro-region, and same risk class (high, medium, low credit score).



by extrapolating the evidence on the manufacturing sector to the whole economy, researchers might be underestimating the potential welfare losses resulting from market frictions and regulations.[80]

Figure 11, Panel b, plots output gains from a within-industry reallocation for different Italian macro-regions. We find the extent of resource misallocation is remarkably higher in the south than in the north or center of Italy. This finding is consistent with a large literature that highlights large differences in socioeconomic outcomes across Italian regions, which can be traced to different a historical backgrounds, quality of institutions, culture, and stock of social and human capital (Putnam et al. 1994; Guiso et al. 2004a; Guiso et al. 2004b).[81]

Finally, Figure 11, Panel c, plots output gains from a within-industry reallocation for different groups of firms sorted by credit risk. Reallocation gains within the subset of firms with high credit risk are both larger and more counter-cyclical than firms with low credit risk. One explanation is that firms with high credit risk face higher credit constraints. This explanation is consistent with the findings of section 5, where we show that information frictions generate heterogeneous shadow costs of capital across firms. In light of the correlation between credit scores and firm-characteristics, another explanation is that the credit score picks up idiosyncratic default risk as well as higher real rigidities and exposure to systematic risk. The two explanations can reinforce each other. For example, examining the cross-section of returns in the US, Whited and Wu (2006)

[80]For example, in the postwar-US, the share of services value added in investment expenditure has been steadily growing and it now exceeds 0.5.

[81]A comparison of the time-series evolution of misallocation for the different regions is also interesting. In the southern regions of the country, misallocation significantly increased and stayed fairly constant after the early 2000s. In the rest of the country, misallocation grew steadily, especially during the financial crisis and in the central regions.

provide evidence of the existence of a "financial constraints factor" as financially constrained firms systematically display higher expected returns than unconstrained firms.

6.4 Alternative measures of the extent of misallocation

The sign and magnitude of firm-level gaps depend on the empirical measures of firm-specific user costs. Although this choice does not seem to affect the relationship between gaps and market frictions at the micro-level (see section 5), it might affect the estimated gains from reallocation once we aggregate up. In particular, a concern is that we might be overestimating the gains from reallocation because the APR on loans understates the marginal cost of debt finance and/or the average wage might underestimate the cost of hiring a marginal worker. To evaluate the sensitivity of the aggregate estimates to our choice of empirical measures of user costs, in Appendix J, we re-calculate gains from within-industry reallocation using the APR on revolving credit lines and the wage offered to newly hired workers in local labor markets to construct capital and labor gaps. We show that when these alternative proxies are used, the potential gains from reallocation are even larger than the ones previously discussed.[82]

We conclude this section with a comparison of our estimates of allocative efficiency gains to alternative measures proposed by the literature (Appendix J.4). First, we study the time-series evolution of the OP-covariance term (Olley and Pakes, 1996). In contrast to our measure, this indicator of allocative efficiency displays a steady increase that is consistent with a gradual improvement in allocative efficiency over time. Similar to our measure, the OP covariance deviates from its upward trend during the financial crisis.

Starting from the seminal work of Hsieh and Klenow (2009), the dispersion of marginal revenue products has been largely used in cross-country analyses because, under specific model assumptions, it is proportional to the dispersion in TFPR, which, in turn, is inversely proportional to the efficiency of within-industry resources allocation. Every year, we calculate the weighted average of the within-industry standard deviation of $ln(MRP^K)$ and $ln(MRP^L)$, and $ln(\omega)$. Consistent with our measure, we find that dispersion in both marginal products and productivity is increasing over time. This pattern is particularly pronounced for capital and especially during the financial and sovereign crisis periods.[83]

Finally, we calculate a model-based measure of allocative efficiency following Bils et al. (2017)

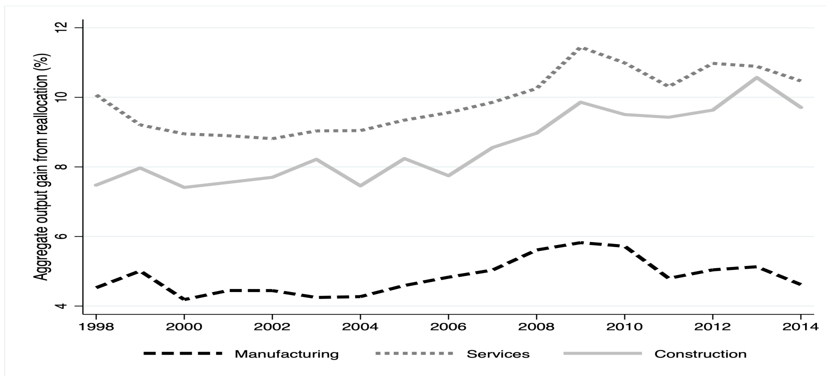
[82] Both the APR on credit lines and the wage of newly hired workers are higher than the APR on term loans and the average firm-level wages. As a result, firm-level gaps are lower (more firms display negative gaps) and a greater volume of resources is mobilized and reallocated to higher-value users.

[83] An influential study by Gopinath et al. (2017) looks at the dispersion of log MRP to investigate the extent of misallocation in Europe, arguing the productivity slowdown in Spain, Italy, and other Southern European countries may have been driven by the credit expansion that followed the establishment of the European Monetary Union. For Italy, the data source for the accounting variables used in Gopinath et al. (2017) is ultimately the Cerved database, in its release by Bureau Van Dijk. Thus, it is reassuring that the trends in log-MRP^K and log-MRP^L dispersion we obtain are very similar to those in Gopinath et al. (2017), with a particularly remarked upward trend for capital. We emphasize, however, that the time series of the dispersion of log-MRP^L differs from the one in Gopinath et al. (2017): downward in their paper, but upward in our data. This difference is likely due to the fact that we measure labor services in effective units, whereas the authors use the total wage bill.

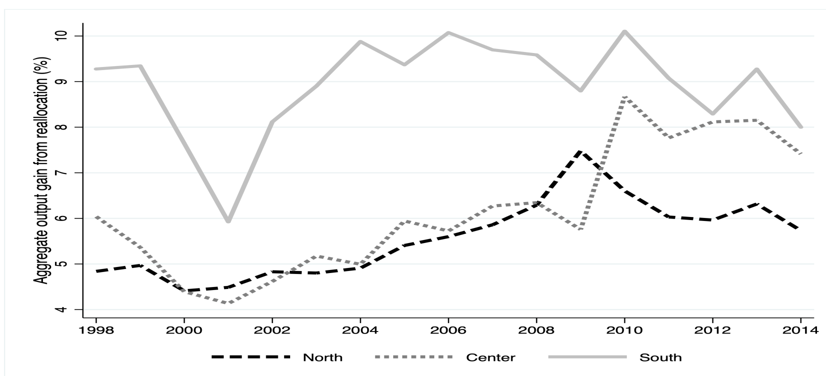
Figure 11: **Output and TFP gains from resource allocation: Industry and region decomposition**

This figure explores the extent of misallocation across different macro-industries and across different geographical regions in Italy. Panel a presents the gains from reallocation (within 4-digit code industries) separately for each macro-industry (manufacturing, services, and construction). Panel b presents the gains from reallocation (within 4-digit code industries and macro-regions) separately for each macro-region (north, south, and center of Italy). Panel c presents the gains from reallocation (within 4-digit code industries and macro-regions) separately for firms characterized by high, medium, and low credit risk.

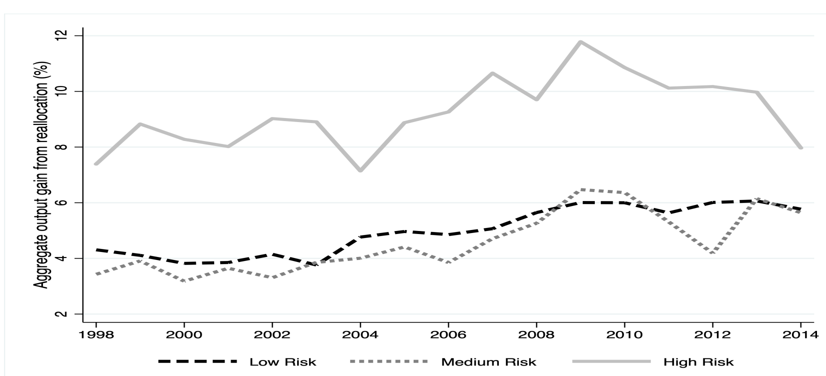
Panel a: Sectoral heterogeneity



Panel b: Spacial heterogeneity



Panel c: Credit risk heterogeneity



(Panel c of Figure A.9). Allocative efficiency in the Italian economy calculated using the Bils et al. (2017) methodology displays a downward trend, and, in line with our results, a significant output losses starting with the financial crisis and continuing afterwards.

7 Concluding Remarks and Future Research

In this paper, we combine information on firm-specific borrowing costs and wages with estimates of the marginal returns of capital and labor to produce empirical measures of deviations in from the first-order conditions that characterize firms' investment and employment policies in an undistorted environment. The sign and magnitude of MRP-cost gaps provide valuable insights into a variety of phenomena that affect firms' choices and into the aggregate implications of resource misallocation in terms of output and aggregate productivity loss.

The empirical approach we propose in this paper is capable of guiding researchers toward the primitive frictions affecting firm policies. We link variation in MRP-cost gaps to specific market frictions, focusing on the scope of asymmetric information in credit markets and on the impact of regulations that generate implicit costs of labor that vary as a function of firm size. More generally, variation MRP-cost gaps can be used to test the effects of particular phenomena and policy interventions that economists want to confront directly with the data. Examples of phenomena and policies that distort firm choices and affect resource allocation are monetary policy interventions, taxes and subsidies, anti-corruption regulations, the bureaucratic costs of doing business, the impact of legal institutions, and frictions in the market of corporate ownership and control that make equity financing costly. Because the estimation of MRP-gaps require no information on the firm market value of assets or liabilities, gaps are a particularly valuable tool to study investment and employment policies of privately owned firms, for which standard empirical metrics are not available.

Finally, we illustrate how MRP-cost gaps can be used to estimate the impact of idiosyncratic distortions in input policies on aggregate output and TFP, and document how gains from resource reallocation vary over the business cycle and in the different subsets of the economy. The bottom-up approach that allows these macro assessments is transparent and intuitive, but it does not consider the general equilibrium effects of resource reallocation on the level and distribution of interest rates and wages. Incorporating general equilibrium spillovers, without neglecting the heterogeneity across producers and its micro-foundation, would be interesting and important.

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