

**New Firms, Capital Intensity  
and the Labor Share:  
New Theoretical and  
Empirical Insights**

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# New Firms, Capital Intensity and the Labor Share: New Theoretical and Empirical Insights

## Abstract

This paper considers a two sectors heterogeneous firms model where firms' specific production technology and capital intensity are endogenously determined through business dynamics. It shows that a shock to the relative price of investment goods is followed by the entrance of new firms characterized by higher capital intensity of production and lower labor income share. Using ORBIS firm-level data of the US economy, the paper finds strong and robust evidence confirming that new firms enter the market with higher capital intensity. Furthermore, firms-level data are used to show that the labor share is significantly affected by capital intensity, as well as by firms' size and firms' mark-up.

JEL-Codes: E210, E220, E250.

Keywords: firms dynamics, firms heterogeneity, labor income share, capital intensity, capital technological change, ORBIS microdata.

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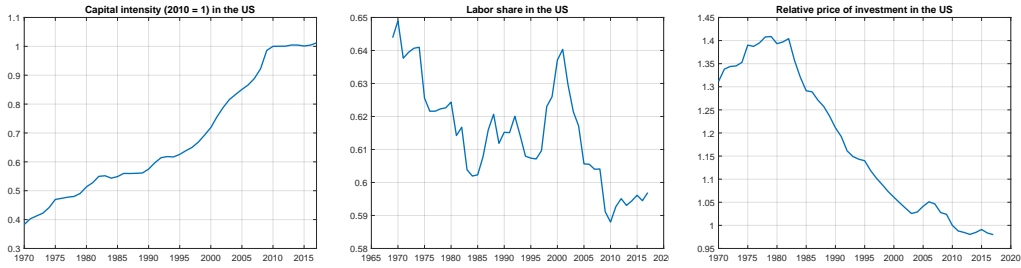
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# 1 Introduction

How do firms' entry decisions affect the capital to labor ratio (capital intensity) and the labor income share? In the presence of a declining relative price of investments, do new entrants choose a more capital intensive technology than incumbents? What is the effect of their choice on labor income share? This paper addresses these questions both theoretically and empirically. The first part of the paper considers an RBC model characterized by heterogeneity in firms technology and endogenous firms dynamics. The model shows that a negative and permanent shock to the relative price of investments is followed by an increase of capital intensity and by a decline of the labor income share. Most importantly, it shows that these results are mainly explained by the entrance of new firms. The main contribution of the theoretical model is indeed to show that a negative shock to the relative price of investments leads new firms to adopt technologies with relatively high capital intensity and low labor share. In the second part of the paper, ORBIS firm-level data are used to validate the predictions of the theoretical model.

This paper offers a new interpretation of the increase of capital intensity and the decline of labor share witnessed in the last 40 years. In the United States, and in most of the industrialized countries, capital per worker has increased steadily from the 1950s. Since the late 1970s, this positive trend has been accompanied by a steady decline of the labor share of income. The latter phenomena has received much attention in the recent literature, since it contradicts the conventional wisdom regarding constant factor shares of income that was first presented in [Kaldor \(1961\)](#). [Figure 1](#) shows the secular trends of capital intensity, labor share and the relative price of investments in the US.

The steady increase of capital intensity is traditionally explained by growth theory literature with the increase of labor productivity. The simplest model accounting for this phenomena is the Solow model, which shows that capital per worker on the balanced growth path follows the growth rate of technology ([Solow, 1956](#)). Recent evidence further suggests that starting from the 1980s the relative price of investment has decreased possibly contributing to the increase of the capital income ratio, as showed in [Karabarbounis and Neiman \(2014\)](#). In the same paper, [Karabarbounis and Neiman \(2014\)](#) show that the relative price of investment can explain half of the observed decline



**Figure 1:** **Left:** Capital intensity in the US computed as Capital services at constant 2011 prices over (Number of persons engaged (in millions)  $\times$  Average annual hours worked by persons engaged). Data: Penn World Table. **Center:** Share of Labour Compensation in GDP at Current National Prices for United States (Data: FRED). **Right:** Relative price of investment in the US (Data: WDI).

in the labor share.<sup>1</sup> To achieve such result it is necessary to assume that capital and labor are strong substitute inputs. Technically, this requires a production function featuring an input elasticity of substitution greater than one. Karabarbounis and Neiman (2014) find evidence in favor of an input elasticity greater than one using cross country macro data. Piketty (2014) also estimates an elasticity of substitution between labor and capital greater than one. However, these estimates are at odds with most of the literature. The majority of the evidence, both macro and micro, reports estimates of the elasticity of substitution lower than one, implying that the two inputs are complements rather than substitutes.<sup>2</sup> Because of this, recent theoretical literature has cast doubts on the relevance of the decline of the relative price of investments and of the consequent capital accumulation as a possible explanation for the decline of labor share and the increase of capital intensity. In particular, Oberfield and Raval (2014) find a value of the aggregate elasticity of substitution between capital and labor smaller than one in the manufacturing sector. They also find that capital accumulation increases in response to a decline of the relative price of investments but this, according to their results, cannot explain the decline of the labor income share that have characterized the manufacturing sector. In fact, they argue that if the estimated elasticity of substitution between capital and labor is smaller than one, a higher capital-labor ratio would imply an increasing labor share rather than a declining one. They thus conclude that another mechanism based on

<sup>1</sup>Other mechanisms influencing factor shares are increasing profits share, capital-augmenting technology growth, and the changing skill composition of the labor force.

<sup>2</sup>de La Grandville (2016) explains the importance of the elasticity of substitution, while Chirinko (2008) writes a comprehensive survey of the values estimated by the empirical literature

a bias of technical change must be at work. Similarly, in a more recent paper, [Hergovich and Merz \(2018\)](#) find that both the declining relative price of capital and the increase in factor substitutability contribute to the rise of the capital-to-labor ratio and the level and volatility of corporate profits, but only increased factor substitutability generates the observed decrease in the labor share of income.

None of the works mentioned above however investigate the role of firms entry and heterogeneity, neither theoretically nor empirically. This paper instead considers a simple RBC model characterized by two additional ingredients: i) a continuum of heterogeneous firms, each adopting a Cobb-Douglas production function with a specific elasticity of output with respect to capital; ii) an endogenous business creation mechanism. It shows that, thanks to these two additional ingredients, the decline of the relative price of investments is still key to explain the increased capital to labor ratio and the decline in the labor income share. Remarkably, differently from [Karabarbounis and Neiman \(2014\)](#), [Piketty \(2014\)](#) and [Piketty and Zucman \(2014\)](#), a standard Cobb-Douglas production function where capital and labor are complements - rather than substitute - is sufficient to obtain the result. This occurs because in this model, thanks to the entrance of new firms, capital and labor are inter-temporal rather than intra-temporal substitutes. Mimicking the analysis by [Karabarbounis and Neiman \(2014\)](#), it is shown that the model with heterogeneous firms and endogenous business creation reacts to a cut to the interest rate (or to a relative price of investments) *as if* the aggregate production function was a CES with an elasticity of substitution greater than one. This result is remarkable, since our exercise stresses that their estimates may result from the entrance of new firms and by firms' heterogeneity, rather than from a CES production function with an elasticity of substitution greater than one. Thus, the theoretical results of this paper are coherent with the analysis in [Karabarbounis and Neiman \(2014\)](#), however the mechanism leading to these results is completely different.

In particular, the main mechanism behind the result is the following. When the relative price of investments declines, households' supply of capital increases reducing the return of capital and bringing about an increase of capital accumulation, production and wages. Lower interest rates give a competitive advantage to relatively high capital intensity technologies. As consequence, incumbent firms increase both their capital and their labor demand, because capital and labor are intra-temporal complementary inputs. In a "traditional" model with homogeneous firms, capital accumulation and

output increase, and labor share remains constant. In a model with heterogeneous production functions, firms with a relatively high capital intensity and low labor share are favored. Therefore, highly capital intensive firms increase their market share leading to a smaller aggregate labor share. This is the effect of heterogeneity. This effect is augmented by the entry mechanism. In fact, after the shock firms with relatively high capital intensity enter the market, changing the composition of firms in the economy and leading to an additional increase of capital intensity and decline of the labor share. Overall, the average and aggregate labor income share decline, while capital income share and the profits share increase.

More in details, the model predicts that, after a negative and permanent shock to the relative price of investments, all firms increase their capital intensity and that firms entering the economy in later periods will display higher capital intensity and lower labor share. This prediction is tested empirically in the second part of the paper using ORBIS firm-level data for the US-economy. To this end, random effect panel models and pooled cross-section models are estimated. The validation of the theoretical model proceeds in two steps. In the first step, firms' capital intensity is regressed on firms' year of birth and on firms' age, controlling for firms' size and sector. All the regressions considered imply that, *ceteris paribus*, new firms enter the market with higher capital intensity than the average. Importantly, both firms' year of birth and firms' age positively affect the degree of firms capital intensity. Given the steady decrease of the relative price of investments in the period considered, empirical results are coherent with the idea that, in such circumstances, both incumbents and new firms increase their capital intensity. However, empirical evidence further suggests that the year of birth effect (also called the "new entrants or extensive margin" effects in the rest of the paper) is stronger than the age effect (also referred to "incumbents or intensive margin" effect). This result consistent with theoretical predictions and is therefore interpreted in favor of the entry mechanism described by the model. Then, to further assess the relevance of the relative price of investments, firms' capital intensity is regressed on the relative price of investments *in the year of birth*. Results confirm the importance of the relative price of investments in the year of birth. This variables has a negative impact on capital intensity. Thus, the estimations confirm the idea that the decline of the relative price of investments had a significant effect on the capital technology adoption of new firms, corroborating the mechanism described by the theoretical model.

In the second step, firms' labor income share is regressed on firms capital intensity, controlling for a measure of the firms' markup together firm-size and sectoral effects. The estimates show that firms' labor income share is significantly and negatively affected by capital intensity, by firms' mark-up and by firms' size.

Overall, the paper claims that the decline of the relative price of investment and the entrants of new firms with higher capital embodied technology are important determinants of the dynamics of firms' capital intensity and indirectly, through its effect on capital intensity, for the decline of the labor income share. Though this, the paper is not intended to take a stand on a single explanation of the declining labor income share and increasing capital intensity. The main contribution of the paper is indeed to emphasize the role of new firms as an important driver of capital to labor ratio and labor share. An explanation that has been almost neglected by the recent theoretical and the empirical literature.

The remainder of the paper is organized as follows. Section 2 relates this paper to the recent literature. Section 3 describes the model economy and the main mechanism behind the declining labor share. Section 4 presents descriptive analysis and new empirical evidence on firms capital intensity and the labor share of income using ORBIS firm-level data on the US economy. Section 5 concludes.

## 2 Related Literature

This paper relates to several strands of literature. First, it relates to the research on factor substitutability in output production and its implications for factor shares and capital intensity. Explanations of the increasing capital intensity and declining labor income share have been recently found in the literature on automation ([Acemoglu and Restrepo, 2017, 2018](#); [Martinez, 2019](#), among others). In particular, [Acemoglu and Restrepo \(2017\)](#) empirically find that robots have a large negative effect on employment and wages. Though the simple theoretical model presented in the next section does not explicitly model firms robotization, the heterogeneity in firms capital embodied technology can be interpreted as a short-cut of different degrees of firms robotization. Read through these lenses, in the model presented in the next section, the decline of the relative price of investments is the driver of the entrance of new firms with higher capital intensity, higher degree of



robotization/automation and lower labor income share.

Second, this work relates to other recent papers explaining the trend in the labor income share by the increased market concentration. [Grullon et al. \(2019\)](#) show that increased concentration across most U.S. industries has contributed to the labor share decline. Other important explanations for the decline in the labor share have been found in the rise of superstar firms ([Autor et al., 2019](#)) and in the increase in firms markups and thus in the profit shares ([Blanchard and Giavazzi, 2003](#); [De Loecker and Eeckhout, 2017](#); [Barkai, 2019](#)). In particular, [Barkai \(2019\)](#) and [Autor et al. \(2019\)](#) both report a positive correlation between industry concentration and the decline in the labor share. This evidence justifies the introduction of firms' markups as a control variable of the empirical models presented in Section 4 of this paper.

Finally, the present paper mostly relates to the recent works in [Karabarbounis and Neiman \(2014\)](#), [Hergovich and Merz \(2018\)](#) and [Martinez \(2019\)](#). [Karabarbounis and Neiman \(2014\)](#) find that the decline in the labor share is a within-industry, rather than a cross-industry, phenomenon, primarily due to the decline of the relative price of investment goods. Similarly to [Karabarbounis and Neiman \(2014\)](#), this paper finds that the decline of the relative price of investments positively affects firms capital intensity and negatively affect the labor income share. Differently from [Karabarbounis and Neiman \(2014\)](#), this paper shows that the previous result holds even when firms have a Cobb-Douglas production function.<sup>3</sup> Also, differently from [Karabarbounis and Neiman \(2014\)](#), the decline of the labor income share is not followed by a one to one increase of the capital income share, but also by an increase of the profits shares. Regarding the latter effect, recently [De Loecker and Eeckhout \(2017\)](#) and [Barkai \(2019\)](#) claim that profits share has increased by almost thirty percent, whereas capital income share has decreased in the last three decades, thus challenging theories sustaining capital technological change as possible explanation of the decline of the labor share. These studies have been questioned by [Karabarbounis and Neiman \(2019\)](#). [Karabarbounis and Neiman \(2019\)](#) provide new support to a decline of the labor share due to an

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<sup>3</sup>[Jones \(2005\)](#) shows that the aggregate production function must be Cobb-Douglas in the long-run, implying that labor and capital are complementary factor rather than substitute factors, as in our paper. Also the Cobb-douglas assumption is consistent with the balance growth path requirements which are not satisfied with a CES production function, as emphasized by [León-Ledesma and Satchi \(2019\)](#). Thus, the model is consistent with empirical evidence that short-run dynamics are characterized by gross complementarity.

increase in capital income share resulting from capital technological change. They claim that the surge in the profits shares and the decline of the capital income share documented by [Barkai \(2019\)](#), are most probably due to a measurement problem of “factorless income”, and show that unmeasured capital plausibly accounts for all factorless income in the recent decades. On the other hand, [Basu \(2019\)](#) shows that estimates of large or steeply rising markups has to be considered implausible, thus casting new doubts on the relevance of the increase of the markups and profits shares as the only explanation for the decline of the labor income share.<sup>4</sup>

[Hergovich and Merz \(2018\)](#) investigate whether trends in capital to labor ratio and factor shares can be explained by a common determinant such as the observed decline in the relative price of new capital goods, or the change in production technology towards increased factor substitutability. They use a dynamic stochastic equilibrium model of competitive search in the labor market augmented by a CES production function that allows firms to substitute between capital and labor at varying degrees. Similarly to [Oberfield and Raval \(2014\)](#), they find that the declining relative price of capital and the increase in factor substitutability each causes the capital-to-labor ratio, but only increased factor substitutability generates the observed decrease in the labor share of income. This paper instead shows that through the entrance of new firms with higher capital embodied technology, the decline of the relative price of investments cannot be a priori excluded as a possible common driver of the trends of the capital-to-labor ratio of the labor income share. Remarkably, these results are obtained using a very simple theoretical model in which capital and labor are intra-temporal complements rather than substitutes. These results are then corroborated by the empirical evidence using US firm-level data.

Similarly to this paper, [Martinez \(2019\)](#) explains the decline of the labor income share as the result of capital-biased technology progress and the endogenous entry-exit process.<sup>5</sup> In particular, [Martinez \(2019\)](#) investigates the extent to which automation can explain the observed fall in labor’s share of income in the US. In his model the production process of a firms is a set of

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<sup>4</sup>He claims that several of the prominent estimates suggest that the markup increased far more than would be necessary to explain the decline in labor’s share.

<sup>5</sup>It is worth mentioning that the entry-exit mechanism to explain variations of aggregate production function is used also in [Aaronson et al. \(2018\)](#), who shows that the reaction of employment of low-wage labor to a minimum wage hike can be explained using a putty-clay model with endogenous entry and exit.

tasks that can be performed by labor or automation capital. This specification of firms' production technology leads to a Leontief production function. Aggregating over firms, total output of the economy is given by a CES function, with parameters determined endogenously by investment and entry-exit decisions of firms with different degrees of automation. Using industry-level data, he finds evidence that automation was a significant driving force of the US labor share between 1972-2010. This paper, partly confirms the main results in [Martinez \(2019\)](#) but using different theoretical framework and empirical strategy. Further, in the model presented in this paper firms are endowed with a Cobb-Douglas production function with heterogeneous capital shares. Aggregate capital share is determined endogenously by the entry-exit decisions of firms in response to the economic environment and particularly to the decline of the relative price of investments. Moreover, differently from [Martinez \(2019\)](#), this paper tests the empirical implications of the model on US firm-level data.

The model developed in this paper is related to the growth literature studying factor substitutions, as for example [Jones \(2005\)](#), [Zuleta \(2008\)](#) and [Peretto and Seate \(2013\)](#). In these type of models, firms may change the capital intensity of their technology by investing in R&D. This leads to endogenous technical progress, changing factor elasticities and growth. In this paper changing factor elasticities are used to explain the decline of the labor share and the mechanism leading to a change of factor elasticities is based on the entry of new firms rather than investments in R&D.

[Kehrig and Vincent \(2020\)](#) investigate empirically the decline of the US labor share using micro data on the manufacturing sector. They document a reallocation of the value added toward the lower end of the labor share distribution, in line with what implied by our model. Differently from this paper, they show that this aggregate reallocation of the value added is primarily due to establishments whose labor share fell as they grew in size rather than to entry/exit or to the emergence of "superstars" firms.

Finally, [Koh et al. \(2018\)](#) study the behavior of the aggregate US labor share over the past 70 years and claim that the decline of the labor share is mainly explained by the change of the accounting standards. In fact, according to [Koh et al. \(2018\)](#) the reclassification of the intellectual property products (IPP) from expenditure to investment by NIPA may have strongly contributed to reduce the labor income share, but in a purely accounting sense. Differently from [Koh et al. \(2018\)](#), this paper does not consider accounting issues. The main contribution of this paper is instead to highlight a

theoretical mechanism to link the decline of the relative price of investments to the decline of the labor share and to provide empirical support to such mechanism. However, the proposed mechanism should not be considered as the only mechanism at work. On the contrary, it should be regarded as an additional mechanism to explain the dynamics of labor share.

### 3 The model

In this section the model is described and solved using numerical methods. The economy is described by an RBC model with heterogeneous firms and endogenous firm dynamics. A continuum of heterogeneous firms compete under perfect competition and is owned by the representative household.

#### 3.1 Households

The representative household chooses consumption  $C_t$ , investment into physical capital  $I_t$  and the supply of labor  $L_t$ . The utility in period  $t$  of the representative household is

$$U_t = \log(C_t) - x \frac{L_t^{1+\phi}}{1+\phi} \quad (1)$$

Where  $C_t$  is consumption and  $L_t$  denotes hours worked. The representative household maximizes the expected discounted value of her life-time utility, subject to the intertemporal budget constraint

$$C_t + \zeta_t I_t = w_t L_t + R_t K_t + \Pi_t \quad (2)$$

where  $\zeta_t$  is the relative price of investments (see Section 3.2) and  $\zeta_t I_t$  is the value of investments in terms of the consumption good. The budget constraint states that total expenditure in consumption and investment goods equals total income. The household receives income from working,  $w_t L_t$ , from the return of capital,  $R_t K_t$  (where  $R_t$  is the competitive interest rate) and the from firms' profits,  $\Pi_t$ . The stock of capital evolves according to the following law of motion

$$K_{t+1} = (1 - \delta) K_t + I_t. \quad (3)$$

The household's first order conditions are:

$$w_t = xC_t L_t^\phi \quad (4)$$

$$C_t^{-1} \zeta_t = \beta C_{t+1}^{-1} (R_{t+1} + (1 - \delta) \zeta_{t+1}) \quad (5)$$

where the equations represent respectively the labor supply and the Euler equation.

### 3.2 Investment Good-Producing Firms

Perfectly competitive firms purchase  $Y_t^I$  units of the aggregate final good to transform them into investment goods  $I_t$ . The investment good is then sold to households at a unit price  $P_t^I$ . The optimal problem of the investment good-producing firms is thus to maximize the profit function

$$\Pi_t^I = P_t^I I_t - P_t Y_t^I \quad (6)$$

subject to their production technology, given by

$$I_t = \frac{1}{\zeta_t} Y_t^I \quad (7)$$

where  $1/\zeta_t$  represents investment specific technology. First order condition, i.e. equality between marginal cost and marginal revenues, implies:

$$\zeta_t = \frac{P_t^I}{P_t} \quad (8)$$

which is the relative price of the investments.

### 3.3 Consumption Goods-Producing Firms

The consumption goods production sector is composed of a continuum of firms producing an homogeneous good under perfect competition. Though goods produced are homogeneous, firms differentiate in terms of their specific technology. In particular, firm of type  $i$  produces the output  $y_i$  using the following Cobb-Douglas technology:

$$y_{i,t} = A_t (k_{i,t}^{a_i} l_{i,t}^{1-a_i})^\rho \quad (9)$$

where  $A_t$  is total factor productivity. The parameter  $\rho < 1$  defines a decreasing return to scale production technology,  $a_{\min} < a_i < a_{\max}$  is the elasticity of output with respect to capital and is heterogeneous across firm types. The upper bound  $a_{\max}$  and the lower bound  $a_{\min}$  are exogenous parameters of the economy. Firms maximize profits to find the optimal capital and labor demand. Firms optimal demand for labor and capital is then given by

$$R_t^N = p_{i,t} \rho A_t (k_{i,t}^{a_i} l_{i,t}^{1-a_i})^{\rho-1} a_i k_{i,t}^{a_i-1} l_{i,t}^{1-a_i} = p_{i,t} \rho a_i \frac{y_{i,t}}{k_{i,t}} \quad (10)$$

$$W_t = p_{i,t} \rho A_t (k_{i,t}^{a_i} l_{i,t}^{1-a_i})^{\rho-1} (1 - a_i) k_{i,t}^{a_i} l_{i,t}^{-a_i} = p_{i,t} \rho (1 - a_i) \frac{y_{i,t}}{l_{i,t}} \quad (11)$$

From Eq.(11) and Eq.(10), for each type  $i$  it is possible to derive the labor share of income

$$\frac{w_t l_{i,t}}{y_{i,t}} = \rho (1 - a_i) \quad (12)$$

and capital share of income

$$k s_{i,t} = \frac{R_t k_{i,t}}{y_{i,t}} = \rho a_i \quad (13)$$

Notice that both the labor income share and the capital income share are type specific and crucially depends on type's  $i$  technology parameter  $a_i$ . The higher the value of  $a_i$ , the lower the labor income share and the higher the capital share.

### 3.3.1 Firms dynamics

The mass of firms is constant. However, the economy features firms entry and exit. In each period incumbent firms face an exogenous probability  $\eta$  to exit the market, so that a share  $\eta$  of each type of incumbent firms exits the economy. The exiting firms are substituted by a mass  $\eta$  of new entrants. The types of new firms are determined endogenously through the following entry condition:

$$v_{i,t}(a_i) = \Pi_{i,t}(a_i) + \beta v_{i,t+1}(a_i) \geq EC w_t \quad (14)$$

where

$$\Pi_{i,t} = y_{i,t} - w_t l_{i,t} - R_t k_{i,t} - f w_t \quad (15)$$

are period  $t$  real profits,  $fw_t$  are fixed operative costs and  $ECw_t$  is the sunk entry cost paid by the new firms upon entrance. Therefore, a firm of type  $i$  is willing to enter the market if and only if the stream of its discounted profits is greater than or equal to the entry cost. All types satisfying the entry condition constitutes the set of potential entrants. In each period a mass  $\eta$  of new firms uniformly distributed on the set of potential entrants enters the market.

### 3.3.2 Market Clearing

Market clearing holds on all markets. Therefore, labor demand will equal the labor supply, total capital  $K_t$  equals capital demand and total output  $Y_t$  equals total demand.

## 3.4 Steady State Analysis

This sections studies the long-run effects of a 25 percent permanent cut of the relative price of investment goods. In particular, it conducts a very simple steady state analysis imposing a relative price of investment equal to 1 before the shock and equal to 0.75 thereafter. The transition dynamics will be explored in the next section. The aim of this section is to describe the long run responses of factor income shares, capital intensity, measured as both capital to labor and capital to output ratio, production, hours worked, wage, interest rate and consumption. The model is solved numerically and calibrated at yearly frequencies. The subjective discount rate  $\beta$  is set to 0.96, the parameter of the decreasing return to scale is  $\rho = 0.85$ . The support of  $a_i \in [0.01, 0.5]$ . Capital depreciation rate  $\delta$  is 0.06, while the inverse Frisch elasticity is set to 2. Fixed operating cost and entry cost are calibrated to obtain reasonable values of aggregate labor share. Firms' exit probability  $\eta$  is set to 0.10 to match the US evidence at yearly frequency.

Table 1 shows the value of the average and the aggregate labor income share, the average and the aggregate capital income share as well of the of profits share, before and after a 25 percent cut of the relative price of investments goods  $\zeta$ . Also, it reports the average value of  $a_i$  in the economy, two measures of capital intensity, together with the values of production, total hours, wages, interest rate and consumption. Columns 1 and 2 show the level values, while column 3 shows the associated percentage changes. Column 4 shows percentage changes implied by the baseline model in the

case of no firms' dynamics. The comparison between columns 3 and 4 allows to disentangle the effects of the two main ingredients of the baseline models: heterogeneity and firms' dynamics. Finally, the last two columns of Table 1 compare the results with the values of the same variables as reported in Table 4 of the paper of [Karabarbounis and Neiman \(2014, KN hereafter\)](#). Results reported in KN are a useful benchmark, as their model features homogeneous firms and absence of firms dynamics. Column 4 of Table 1 reports their results with a Cobb-Douglas production function, while column 5 shows the values obtained with the baseline KN model, that is with a model with CES production function with an elasticity of substitution between labor and capital equal to 1.25.

As shown in Table 1, a 25 percent decline of the relative price of investments is followed by a decrease of both the average and the aggregate value the labor income share and by an increase of the average and aggregate capital income shares. The average factor share is the simple average on active types. The aggregate factor share is the ratio between aggregate remuneration of factors and aggregate GDP. The aggregate factor share can also be computed as a weighted mean of factors shares of active types in the economy, where the weights are proportional to the average size of each type. This distinction allows to draw some conclusions also on the size distribution of types in the economy. The fact that aggregate labor share is smaller than average labor share, implies that types with low labor share produce relatively more than firms with high labor share. Changes in the aggregate labor share and aggregate capital share are in line with what found in KN using a CES production function. Interestingly, while in this model capital and labor are strong complements, they are strong substitute in the KN-CES model. Further, notice that in the KN model the labor income share moves one to one with the capital income shares, while in our model it is accompanied also by an increase of the profits shares.

The comparison between columns 3 and 4 shows that a decline of the relative price of investment affects the economy with heterogeneous agents, and that such effect is augmented by the entry mechanism. In the model with no-entry, the shock on the relative price of investment favors types with low labor share, reducing aggregate labor share. The entry mechanism intensifies the effect of the shock by changing the distribution of firms in the market. In fact, with the entry mechanism, also average labor share declines.

The main mechanism behind the results in the baseline model is the following. As soon as the relative price of investment goods declines, house-



Variable	Baseline model			No entry ( $\Delta\%$ )	KN( $\Delta\%$ )	
	$\zeta = 1$	$\zeta = 0.75$	( $\Delta\%$ )		CD	CES
<i>AggLS*</i>	0.53	0.48	-5	-2.6	0	-2.6
<i>AveLS*</i>	0.63	0.52	-11	0	0	-
<i>AggKS*</i>	0.32	0.37	+5	+2.6	0	+2.6
<i>AveKS*</i>	0.22	0.33	+11	0	0	-
<i>AggPS*</i>	0.125	0.128	+0.3	+0.16	0	0
<i>AvePS*</i>	0.10	0.11	+1	-3	0	-
$a_i$ average	0.26	0.39	+13	0	-	0
$K/L$	5.29	12.14	+129	+95	-	-
$K/Y$	3.14	4.89	+55.5	+20	+51.6	+67.8
$Y$	1.47	2.19	+49	+21.8	+18.1	+22.8
$L$	0.87	0.88	+1.1	+2.0	0	-1.4
$w$	0.89	1.19	+32.6	+13.7	+18.1	+19.2
$R$	0.10	0.08	-20	-20	-22.1	-22.1
$C$	1.18	1.53	+30	+9.3	+18.1	+22.1

\* in % points.

**Table 1:** Columns 1-3: Baseline model with heterogeneous firms and with Cobb-Douglas (CD) production function. Columns 4-5: Karabarounis and Nieman 2014 (KN) with CD and CES production function.

holds' supply of capital increases and the return of capital decreases. This brings about an increase of wages and average profits.<sup>6</sup> Moreover, entry costs increase because of the increase of wages.<sup>7</sup> Profits of firms with higher capital intensity increase more than entry costs, while profits of firms with low capital intensity increase less than entry costs. Thus, only firms with high capital intensity enter the market. Meanwhile, a uniformly distributed fraction  $\eta$  of incumbents exits. This leads to a substitution mechanism, so that the average value of  $a$  increases. Since capital and labor are complements, the demand for labor and wages further increase. However, since firms with

<sup>6</sup>This is due to the presence of the fixed operating costs that allow profits shares to be not constant also in a model with perfect competition.

<sup>7</sup>Though we are aware that other important factors may affect the entry costs, e.g., market structure, degree of competition, administrative and financial costs, the dynamics of the entry costs reproduced by the model is in line with empirical evidence reporting that entry barriers have increased in the last 40 years (Philippon, 2019; Gutiérrez and Philippon, 2019; Al-Ubaydli and McLaughlin, 2017). In the model, the increase of entry costs is important to select the type of firms entering the market. The link with the real wage can be interpreted as a simple modeling short-cut to link the change of the relative price of investment with the change of the type of new firms.

high capital intensity use less labor input than average, the increase of hours worked and the increase in real wages is smaller than the increase in production. As a consequence both average and aggregate labor income share decline, while the capital share and the profits share increase.

As a further comparison with the results in KN, it is possible to compute the elasticity of substitution of a CES implied by artificial data. KN estimate the relationship between the observed change of the labor share and the observed change of the interest rate using a country cross section (see Eq. (19) in [Karabarbounis and Neiman, 2014](#)). Mimicking the analysis by KN, it is possible to compute the elasticity of substitution implied by the changes between steady states resulting from the model as follows:

$$\sigma = \frac{s_L}{1 - s_L} \hat{s}_L \frac{1}{\hat{R}} + 1 \quad (16)$$

where  $\sigma$  is the elasticity of substitution,  $s_L$  is the labor share in the first steady state,  $\hat{s}_L$  is the percentage change of the labor share between the first and second steady state and  $\hat{R}$  is the percentage change of the interest rate between the first and second steady state.<sup>8</sup> Using the baseline model, the elasticity of substitution is  $\sigma = 1.34$ , while using the No-entry model,  $\sigma = 1.21$ . This implies that if the true data generator process was represented by the baseline model, the estimation of the elasticity of substitution would suggest that capital and labor were strong substitutes. This is coherent with the analysis in KN. However, this last exercise stresses that their estimates may result from entry and exit and heterogeneity, rather than from a CES production function with  $\sigma > 1$ . In other words, an economy with entry and exit and heterogeneous production functions reacts to a cut to the interest rate *as if* the aggregate production function was a CES with  $\sigma > 1$ .

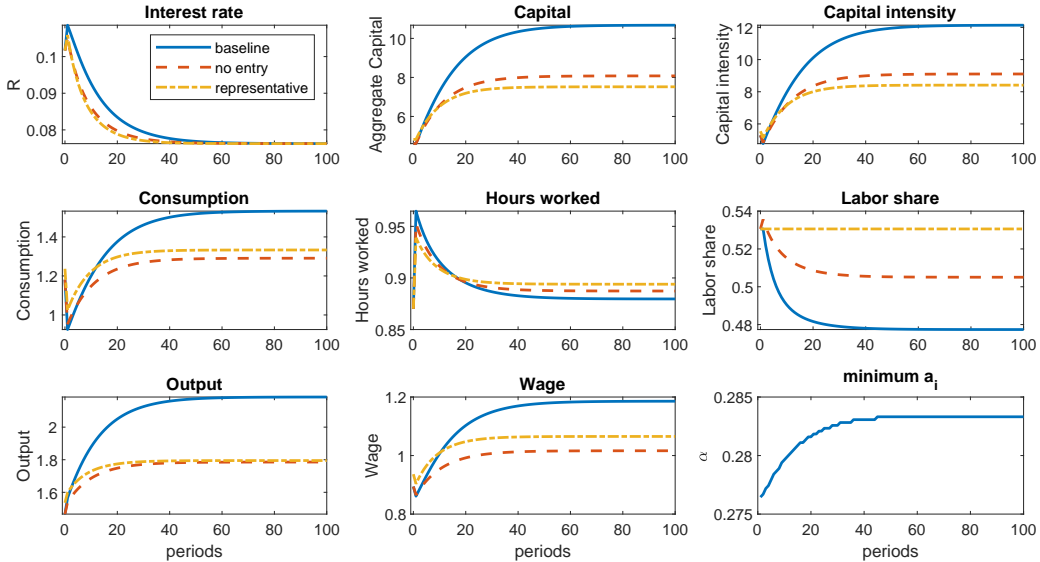
### 3.5 Transition Dynamics

This section studies the transition dynamics between the two steady states and characterizes the short run behavior of the economy in response to a 25% unexpected permanent cut of the relative price of investments. Analyzing the transition dynamics is important because it will provide an implication of the entry mechanism that will be tested empirically in Section 4. The dynamics is solved numerically through time-iteration and shown in figure 2. To

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<sup>8</sup>Notice that in this exercise the coefficient  $\gamma$  in Eq.(19) in [Karabarbounis and Neiman \(2014\)](#) is zero by construction.

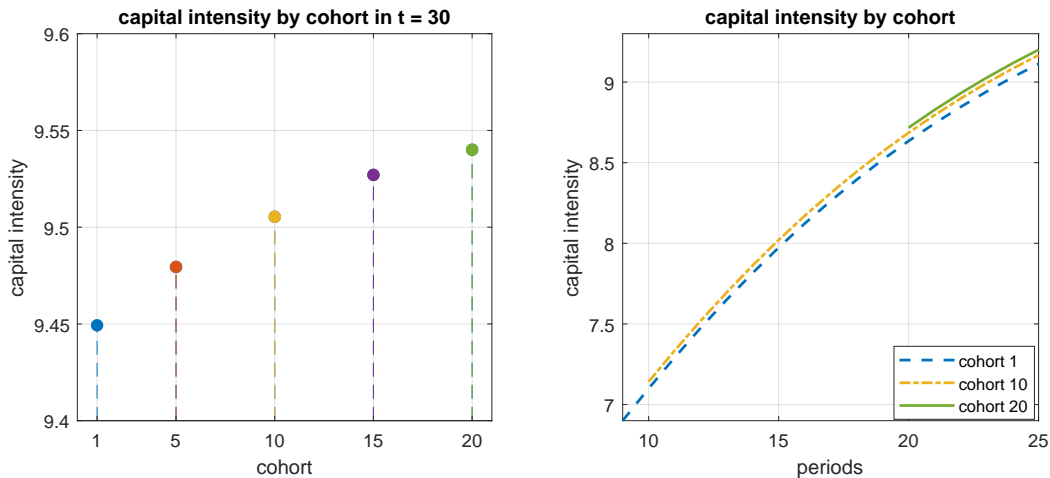
disentangle the effect of firms' heterogeneity from that of firms dynamics, the baseline model is compared with two alternative models: i) a standard representative agent model, where firms are homogeneous (labeled as *representative* model); ii) a model featuring firms with heterogeneous production functions (in terms of the  $a_i$ ) as in the baseline model but without the entry mechanism (labeled as *no-entry* model). The comparison between model i) and ii) allow to capture the effects of firms heterogeneity, while the comparison between model ii) and the baseline model captures the additional effects of having firms dynamics on the top of firms heterogeneity. The three economies are hit by the permanent shock to the relative price of investment in  $t = 1$  and slowly adjusts to the new steady state.<sup>9</sup> Figure 2 shows the implied transition of the main macro variables under the three model economies. First of all, notice that on impact the interest rate increases,



**Figure 2:** Dynamics. A 25% negative shock to the relative price of investments hits the economy in period  $t = 1$ .

hours worked increase and consumption reduces under the baseline model. However, after the first period the interest rate starts reducing and moving toward the new lower steady state value, bringing about an increase in firms capital demand. Households start to increase their supply of capital and the aggregate stock of capital in the economy slowly moves toward the

<sup>9</sup>The three models are calibrated to display the same initial steady state labor share.



**Figure 3:** **Left:** Average capital intensity in  $t = 30$  of firms born in periods 1,5,10,15 and 20. **Right:** The dynamics of average capital intensity from period 1 to period 30 of firms born in periods 1,10 and 20.

new higher steady state value. Further, capital intensity decreases slightly on impact due to the behavior of hours worked, it starts increasing from the second period onward. This occurs thanks to the increase of the stock of capital and to the subsequent fall of the hours worked. Finally, despite the increase of real wages, triggered by the capital-labor intra-temporal complementary, the labor share decreases. The strong reduction in the labor income share is explained by two effects: the presence of firms heterogeneity and the entrance of new firms with higher elasticity of output with respect to capital. The heterogeneity effect is captured by the differences between the representative model and the no-entry model. In particular, notice that the labor income share declines in the no-entry model while it remains constant in the representative agent model. In the representative agent model the labor share simply coincides with the elasticity of output with respect to capital in the Cobb-Douglas production function, which is constant and homogeneous across firms. In the no-entry model instead, the aggregate labor income share declines. In this case, the decline of the aggregate labor income share is due to the fact that the fall of the relative price of investments favors firms with relatively high capital intensive production technology. Types with higher  $a_i$  will increase production more than firms with a lower  $a_i$ . Therefore, the market share of firms with higher  $a_i$  increase and aggregate labor income share becomes smaller. Size distribution across firm types is an important determinant of the evolution of the aggregate variables and in particular of

the aggregate factor share. The entry mechanisms further amplifies the effect of heterogeneity on the labor income share and is also responsible for the stronger response of output, consumption, capital and capital intensity with respect to the no-entry model and with respect to the representative model. The contribution of firms' entry is clear by comparing the dynamics of the baseline model with the dynamics of the no-entry model. The lower right panel in figure 2 displays the minimum value of  $a_i$  satisfying the entry condition, i.e, it summarizes the behavior of the distribution of types. In fact, in each period a mass  $\eta$  of incumbent, uniformly distributed across types, exits the market. Simultaneously, a mass  $\eta$  of firms, uniformly distributed across types satisfying the entry condition, enters the market. This gives rise to a substitution mechanism. Less profitable types are replaced by more profitable types, leading to a change of the set of types in the market. The minimum value of  $a_i$  satisfying the entry condition gives an idea of this dynamics, as it shows the minimum value of  $a_i$  of firms entering the market.

The impact of the entry mechanism on firms' capital intensity during the transition dynamics is further shown in figure 3. The left panel of figure 3 shows the average capital intensity in period  $t = 30$  by cohort of birth. In particular, it shows that firms with a higher year of birth have on average higher capital intensity. The right panel of figure 3 shows the dynamics of capital intensity by selected cohorts. Capital intensity of all cohorts increases with time, but older cohorts have persistently lower capital intensity. This is particularly important because it constitutes the theoretical implication of the model that will be empirically tested in the next section, where we explore the relationship between firms' capital intensity, firms' year of birth and firms' age.

## 4 Empirical Evidence

This section presents the empirical evidence supporting the entry-exit mechanism to explain the change in capital intensity and labor share. The dataset is composed by US firm-level data and is downloaded from ORBIS. The first mechanism to be analyzed is the importance of entry on firms' capital intensity. To this end, data are collected on firms located in the US, born from 1950 onward, with a known value for tangible and intangible capital and number of employees greater than zero. This provides an unbalanced panel containing BvD ID number, the NACE Rev. 2 code (4 digits) sector,

the date of incorporation (year of birth), tangible fixed assets and intangible fixed assets evaluated in current USD and number of employees.

Data are used to compute, for each firm and in each year of observation (from 2010 to 2019), age and the nominal stock of capital as the sum of tangible fixed assets and intangible fixed assets.<sup>10</sup> The investment price deflator is used to deflate the nominal stock of capital. At the time of writing the investment deflator for 2018 and 2019 was not yet available, therefore observations from those two years have been dropped. Deflated capital intensity of firm  $i$  in year  $t$  is determined as:

$$k_{it} = \frac{\text{deflated tangible}_{it} + \text{deflated intangible}_{it}}{\text{number of employees}_{it}} \quad (17)$$

The dataset is then cleaned to keep only observations with well defined capital intensity and non-negative age. Moreover, due to data availability on the *relative* price of investment, which is used later as a regressor, only firms born after 1970 are taken into account. The aim of the first estimation is to determine the impact of the year of birth and age on firms' capital intensity. Since the year of birth is fixed in time, a random effect panel estimation is preferred to a fixed effect panel estimation. A pooled cross section estimation model is also considered. The random effect panel considers the following empirical model:

$$\log(k_{it}) = c + \text{year of birth}_i + \text{age}_{it} + \log(n_{it}) + \text{dummies} \quad (18)$$

where  $\log(n_{it})$  is the logarithm of number of employees, which is a proxy of firms' size. Other controls used in the regression are year of observation dummy and sector dummy variables. Results are listed in Table 2. Column (a) shows estimates excluding the variable age, and reports that firms year of birth affects positively firms' capital intensity. Column (b) considers the role of firm age together with the year of birth. The estimations yield a positive coefficient for job (year of birth) and age. In particular, being born 1 year later increases on average capital intensity by 3.9% and being 1 year older increases on average capital intensity by 3.3%. The equality test between the coefficient of job and of age does not accept the null with a p-value of 0.0174. This test is crucial to asses the relative importance of the new entrance effect. If the two coefficients were not statistically different firms'

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<sup>10</sup>Appendix A provides estimation results when using only tangible assets and intangible assets to define capital stock.

entry would be a perfect substitute of firms' aging. In our case instead, new firms have on average higher capital intensity with respect to incumbents, thus being an important determinant of the growth rate of aggregate capital intensity. Since the relative price of investments have been declining during the period considered, the estimation results can be interpreted in favor of the mechanism described by the theoretical model. In fact, estimation results are coherent with the dynamics displayed in figure 3. Firms entering later in the market display a persistently higher level of capital intensity.

In order, to verify the importance of the relative price of investment the following random effect model is also estimated:

$$\log(k_{it}) = c + \log(\text{pi}_i^{yob}) + \log(n_{it}) + \text{dummies} \quad (19)$$

where  $\text{pi}_i^{yob}$  is the relative price of investment in the year of birth of firm  $i$ . Dummies variables include year of observation and sector dummy. Results are listed Table 2 (column c). The aim of this second estimation is to provide an explanation for the new entrants effect. The assumption is that the capital intensity chosen at birth depends on relative price of investment in the year of birth, captured by the coefficients of  $\log(\text{pi}_i^{yob})$ . Results confirm the importance of the relative price of investment in the year of birth and its dynamics during firms life. The relative price of investment in the year of birth has a negative impact on capital intensity. This is in accordance with our theoretical model and the literature on the effect of relative price of investment, such as [Karabarbounis and Neiman \(2014\)](#).

It is important to notice that, due to the nature of data, firms bankrupted before 2010 are not included in the dataset. This can clearly bias the estimation results. However, it is possible to argue that a positive bias occurs only if on average bankrupted firms have relatively high capital intensity. In fact, this would reduce capital intensity of firms with earlier year of birth observed in the dataset, and produce an upward bias on the estimated impact of the year of birth. On the contrary, if bankrupted firms were characterized by a relatively low capital intensity, the estimated coefficient would be downward biased. To control for this bias, columns (d), (e) and (f) of Table 2 report the results of the same estimations, but including firms established from 1980. The aim of including only more recent firms is to reduce the bias caused by the impossibility to observe bankrupted firms. The estimated impact of the year of birth on capital intensity increases.

Next, we consider the pooled cross section estimation. We pool together

Panel estimation with random effect. Dependent variable:  $\log(k_{it})$

	yob from 1970			yob from 1980		
	(a)	(b)	(c)	(d)	(e)	(f)
yob	0.006** (0.002)	0.039*** (0.004)		0.009*** (0.003)	0.042*** (0.004)	
age		0.033*** (0.004)			0.034*** (0.004)	
log n	0.069** (0.019)	0.069*** (0.019)	0.068*** (0.019)	0.075*** (0.019)	0.075*** (0.019)	0.075*** (0.019)
log price			-0.48* (0.27)			-0.65** (0.30)
Number of observations:	22768	22768	22768	21683	21683	21683

Robust standard errors in parenthesis.

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

**Table 2:** Random effect panel. We control for the year of observation dummy and sector dummy.

Pooled Regression. Dependent variable:  $\log(k_{it})$

	yob from 1970			yob from 1980		
	(a)	(b)	(c)	(d)	(e)	(f)
yob	0.010*** (0.001)	0.057*** (0.007)		0.013*** (0.001)	0.058*** (0.007)	
age		0.046*** (0.007)			0.045*** (0.007)	
log n	0.133*** (0.006)	0.133*** (0.006)	0.131*** (0.006)	0.135*** (0.006)	0.135*** (0.006)	0.133*** (0.006)
log price			-0.95*** (0.11)			-1.09*** (0.126)
Number of observations:	22768	22768	22768	21683	21683	21683

Robust standard errors in parenthesis.

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

**Table 3:** Cross section estimation.



all observation and first estimate the following empirical model:

$$\log(k_j) = c + \text{year of birth}_j + \text{age}_j + \log(n_j) + \text{dummies} \quad (20)$$

Results are listed in Table 3 (column a-f). As in the previous estimation exercise, the coefficient of year of birth is positive. Including both year of birth and age results in positive coefficients both for the year of birth and age. The test does not accept the null hypothesis of equality between the job coefficient and the age coefficient with a p-value of 0.0047. Results suggest that firms' observed capital intensity depends positively both on the year of birth and age, and that the new entrants effect is significantly different (larger) than the aging effect. The results of the random effect panel regression are confirmed. As before, the importance of the log relative price of investment on firms' capital intensity is investigated by regressing the following equation:

$$\log(k_j) = c + \log(\text{pi}_j^{\text{yob}}) + \log(n_j) + \text{dummies} \quad (21)$$

where symbols have the same meaning as before. Again, estimated coefficients are in accordance with those found in Table 2. The relative price of investment in the year of birth have a negative impact on observed capital intensity. Finally, tables in appendix A show that the results are robust when considering the same empirical model capital intensity measured using either only fixed tangible assets or only fixed intangible assets.

## 4.1 Labor share and capital intensity

In a standard Cobb-Douglas model, an increase in capital intensity does not affect the labor income share, as it is constant and equal to the output elasticity with respect to the labor input. The simple model presented in Section 3 shows that the entry mechanism introduces an inter-temporal substitution effect between capital and labor. The entry mechanism, together with firms' heterogeneity, leads to a negative correlation between capital intensity and labor income share even when the production is Cobb-Douglas. In a CES model instead, any increase in capital is followed by a decline in the labor income share if, and only if, capital and labor are substitute, i.e., when the elasticity of substitution between capital and labor is greater than one. The objective of this sub-section is to investigate the empirical relation between

capital intensity and labor income share at the firm level. To this end firm-level data have been downloaded from ORBIS database. In particular, data are downloaded for firms located in the US born from 1950 onward with non negative number of employees and added value. The dataset is an unbalanced panel containing the BvD ID number, the NACE code (4 digits), date of incorporation, tangible and intangible fixed assets, number of employees, added value, cost of employees, net sales, costs of goods sold and other operating expenses. All values are in thousands of current US dollars and observed from 2010 to 2019. Similarly to the previous section, the last two years have been discarded due to the unavailability of the investment deflator. Also in this case all firms born from 1970 onward are considered in the regression. Deflated capital intensity is computed as in Eq. (17). Markups are computed as the net profit margin, as defined in [Anderson et al. \(2018\)](#):

$$\text{markup}_{it} = \frac{\text{net sales}_{it} - \text{cost of goods}_{it} - \text{other expenses}_{it}}{\text{net sales}_{it}} \quad (22)$$

and the labor income share of each firm in each year as:

$$\text{ls}_{it} = \frac{\text{cost of employees}_{it}}{\text{value added}_{it}} \quad (23)$$

All observations with a value of the net markup negative or larger than one or with negative added value have been dropped. Unfortunately, these filters reduce the number of observations available because many firms in ORBIS do not provide data on value added and net sales. To determine the importance of capital intensity on labor share the following random effect panel model is estimated:

$$\text{ls}_{it} = c + \log(k_{it}) + \text{markup}_{it} + \log(n_{it}) + \text{dummies} \quad (24)$$

where the dummies include year of observation dummy and sector dummy. Results are listed in Table 4. First, notice that the estimates imply that firms with higher markup have lower labor share. This is consistent with the literature connecting the increasing trends in markups with a declining labor share (e.g., [Barkai, 2019](#)). Moreover, notice that larger firms, i.e., firms with a larger number of employees, have relatively lower labor share. This result is also consistent with the literature linking the increase of market concentration and firms' market shares with the decline of labor share. Finally, firms with

Panel estimation with random effect. Dependent variable:  $ls_{it}$

	yob from 1970	yob from 1980
	(a)	(b)
log k	-0.016*** (0.003)	-0.017*** (0.004)
markup	-0.599*** (0.038)	-0.597*** (0.039)
log n	-0.012*** (0.004)	-0.013*** (0.005)
Number of observations	4088	3850

Robust standard errors in parenthesis.

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

**Table 4:** Random effect panel.

Pooled cross-section. Dependent variable:  $ls_{it}$

	yob from 1970	yob from 1980
	(a)	(b)
log k	-0.025*** (0.002)	-0.026*** (0.002)
markup	-0.428*** (0.025)	-0.410*** (0.026)
log n	-0.018*** (0.002)	-0.019*** (0.002)
Number of observations	4088	3850

Robust standard errors in parenthesis.

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

**Table 5:** Pooled cross-section estimation.

higher capital intensity have lower labor share. This is consistent with the estimates for the UK found in [Adrjan \(2018\)](#).

Overall this confirms the presence of a negative correlation between capital intensity and labor income share, as found in our theoretical model. These results are reinforced by the pooled cross section estimation:

$$ls_j = c + \log(k_j) + \text{markup}_j + \log(n_j) + \text{dummies} \quad (25)$$

Results are shown in [Table 5](#). The effect of capital intensity, markup and firms' size are consistent with the panel estimation.

## 5 Conclusion

This paper considers a two sectors heterogeneous firms model where firms' specific technology and capital intensity are endogenously determined through business dynamics. The model implies that after a shock that permanently changes the relative price of investment goods, new firms enter the market with higher capital intensity of production and lower labor income share. Remarkably and differently from [Karabarbounis and Neiman \(2014\)](#) and [Piketty \(2014\)](#), our results are obtained with a standard Cobb-Douglas production function technology. This represents the first contribution of our paper. The second contribution comes from the empirical section. This section uses ORBIS firm-level data of US economy and finds strong and robust evidence confirming that new firms enter the market with higher capital intensity and lower labor income share than the average. Remarkably, this evidence shows that the labor share is significantly affected by capital intensity, as well as by firms mark-up and by the relative price of investment in the year of birth of new firms. Though, the paper is not intended to take a stand on single explanation of the declining labor income share, its main contribution is to have emphasized the role of firms heterogeneity in production technology and business dynamics in determining the aggregate production function. Such a role has been neglected by the recent literature. According to our results and to the best of our knowledge our paper makes a step ahead in the literature by using firms' level data that allow to investigate the importance of the entrance of new firms for the long run pattern of the factor income shares together with that of capital intensity.

## A Robustness

This appendix is devoted to provide a set of robustness tests of the empirical section. In particular, it shows that the definition of capital used to compute capital intensity does not impact the estimation results, especially when only firms born after 1980 are considered. In the main text capital is defined as the sum of tangible and intangible capital. Tables 6 and 7 displays the estimation results when considering tangible assets as capital. Tables 8 and 9 shows estimation results when considering intangible assets as capital.

Panel estimation with random effect. Dependent variable: tangible assets.

	yob from 1970			yob from 1980		
	(a)	(b)	(c)	(d)	(e)	(f)
yob	0.005*	0.016***		0.008***	0.020***	
	(0.0026)	(0.004)		(0.003)	(0.004)	
age		0.011***			0.012***	
		(0.003)			(0.003)	
log n	0.037*	0.037*	0.036*	0.047**	0.047***	0.047**
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
log price			-0.385			-0.68**
			(0.27)			(0.30)
Number of observations:	22544	22544	22544	21463	21463	21463

Robust standard errors in parenthesis.

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

**Table 6:** Random effect panel with tangible assets. We control for the year of observation dummy and sector dummy.

Pooled Regression. Dependent variable: tangible assets.

	yob from 1970			yob from 1980		
	(a)	(b)	(c)	(d)	(e)	(f)
yob	0.010*** (0.001)	0.041*** (0.007)		0.012*** (0.001)	0.042*** (0.007)	
age		0.031*** (0.007)			0.030*** (0.006)	
log n	0.106*** (0.006)	0.106*** (0.006)	0.105*** (0.006)	0.111*** (0.006)	0.111*** (0.006)	0.110*** (0.000)
log price			-0.87*** (0.11)			-1.11*** (0.122)
Number of observations:	22544	22544	22544	21463	21463	21463

Robust standard errors in parenthesis.

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

**Table 7:** Cross section estimation with tangible assets. We control for the year of observation dummy and sector dummy.

Panel estimation with random effect. Dependent variable: intangible assets.

	yob from 1970			yob from 1980		
	(a)	(b)	(c)	(d)	(e)	(f)
yob	0.015*** (0.003)	0.057*** (0.006)		0.017*** (0.004)	0.061*** (0.006)	
age		0.042*** (0.005)			0.043*** (0.005)	
log n	-0.060*** (0.02)	-0.060*** (0.09)	-0.061*** (0.021)	-0.062*** (0.02)	-0.062*** (0.021)	-0.064*** (0.021)
log price			-1.199*** (0.35)			-1.29*** (0.40)
Number of observations:	16923	16923	16923	16084	16084	16084

Robust standard errors in parenthesis.

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

**Table 8:** Random effect panel with intangible assets. We control for the year of observation dummy and sector dummy.

Pooled Regression. Dependent variable: intangible assets

	yob from 1970			yob from 1980		
	(a)	(b)	(c)	(d)	(e)	(f)
yob	0.013*** (0.002)	0.085*** (0.008)		0.015*** (0.002)	0.088*** (0.009)	
age		0.072*** (0.008)			0.073*** (0.009)	
log n	0.001 (0.007)	0.001 (0.007)	-0.001 (0.007)	-0.004 (0.007)	-0.004 (0.007)	-0.006 (0.008)
log price			-1.077*** (0.15)			-1.09*** (0.172)
Number of observations:	16923	16923	16923	16084	16084	16084

Robust standard errors in parenthesis.

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

**Table 9:** Cross section estimation with intangible assets. We control for the year of observation dummy and sector dummy.

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