Labor Reallocation and Productivity Dynamics: Financial Causes, Real Consequences*

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Abstract

This paper investigates the causes and consequences of labour reallocation across sectors in advanced economies over the last 35 years. Specifically, the paper makes three contributions. First, using the industry-level decomposition of aggregate output and employment, we construct a simple index measuring the contribution of labour reallocation across sectors to aggregate productivity growth. Second, we show that this index relates significantly and negatively to measures of financial booms: When credit outgrows GDP, labour moves into lower productivity gains sectors. Third, after identifying turning points in real GDP to working population, we show that the labour reallocation index measured in the period prior to the turning point accounts for the path of productivity following the turning point: prior labour reallocation towards lower productivity gains sectors weakens subsequent productivity particularly when a financial crisis hits the economy. These results shed light on the recent secular stagnation debate and provide an alternative interpretation to the hysteresis hypothesis. They also highlight the need to incorporate the effect of credit developments when assessing trend output.

Keywords: Labour reallocation, productivity, financial booms, hysteresis.

JEL codes: E24; E51; O47

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1 Introduction

Financial booms – broadly defined as sizable expansions in the amount of credit provided to the private sector – can have important effects on output. And they can go both ways. Higher credit essentially raises output in the short term by acting as a positive demand shock and, if credit flows into productive investment, increases supply in the medium and long term. But financial booms also increase the risk of crises, which in turn tend to have massive output costs (see Cecchetti et al. (2009) for a review). Moreover there are also more subtle and less-well explored ways in which financial booms can reduce growth other than through crises. For example, higher credit can lead agents to devote a large fraction of their income to service their debts. Such high debt service burden in the late stages of financial booms can, at the aggregate level slow output even as credit continues to grow (Drehmann and Juselius (2015)). Second, financial booms may lead to resource reallocation into relatively unproductive activities (construction and housing for instance) but whose output is easy to pledge as a collateral. Rapid expansions in credit tend to go hand in hand with growth in the financial sector itself, which takes away resources from other sectors in the economy, thus lowering the overall growth of the economy (See Cecchetti and Kharroubi 2015 for these two last points). In this paper we explore in a systematic way labour reallocations across sectors, looking at their causes and their consequences.

Namely, we show empirically that strong (abnormal) credit growth tilts the allocation of labour towards sectors whose productivity grows more slowly (those sectors may also be particularly credit-intensive). We show that such productivity growth-reducing labour reallocations actually account for the bulk of the negative effect of financial booms on aggregate productivity growth. Moreover looking at the dynamic implications of labour reallocations, we present evidence that when labour was reallocated towards low productivity gains sectors in the past, then this has a significant detrimental effect on future productivity particularly when the economy experiences a financial crisis. To put it in a nutshell, this paper shows that financial booms create "misallocation" and such "misallocation" can significantly weaken productivity in the following years when the financial boom ends up as a financial crisis.

Building on the original approach of Olley and Pakes (1996) we start by decomposing aggregate labour productivity growth into two components: a common component and an allocation component. The common component depends on the unweighted average productivity growth across sectors and the unweighted average growth in employment shares across sectors. The allocation component measures the direction of labour reallocations across sectors. Specifically, when higher productivity growth sectors display higher growth in their employment shares, then the allocation component is positive. But when lower productivity growth sectors display higher growth in their employment shares, then the allocation component turns negative and acts as a drag on aggregate productivity growth. Having written-down this decomposition we raise three different questions.

First we investigate each component's statistical properties (mean, standard deviation, correlations, etc...), considering non-overlapping five-year periods, for an unbalanced panel of 23 economies ranging from 1979 to 2009. Here we come up with the three key empirical findings. We first find that aggregate real productivity growth splits on average, between a common component representing 60-65% and an allocation component representing 35-40% of the total. Labor reallocations across sectors therefore account for more than one third of aggregate productivity growth. Second, the volatility of the allocation component is approximately 40% that of aggregate productivity growth.[1] Last we find a positive and significant within country correlation between aggregate productivity growth and its allocation component.

Second, we investigate whether financial booms affect aggregate productivity growth if so through which component. Considering the same sample as previously, (unbalanced panel of 23 advanced economies ranging from 1979 to 2009), we regress average aggregate productivity growth and its two components (common and allocation) on different measures of financial boom and a set of control variables, considering non-overlapping five-year periods to compute growth rates. Consistent with Cecchetti and Kharroubi (2015), we find that larger financial booms are associated with lower aggregate productivity growth. This relationship is both statistically and economically significant and holds for various measures of financial booms, including credit to GDP growth or deviation of credit to GDP from long-run trend. What is interesting is that this

[1] Looking at the common component we find that it is actually more volatile than aggregate productivity growth itself, which means that the common and the allocation components are negatively correlated. This result is consistent with Baily, Bartelsman, and Haltiwanger (2001) which investigate the behavior of average labor productivity over the business cycle and show that short-run reallocations yield a countercyclical contribution to labor productivity.

result is entirely driven by labour reallocations: Our various measures of financial booms are all negatively correlated with the allocation component, i.e. the covariance across sectors of employment and productivity growth. In contrast, none of our measures of financial booms is significantly correlated with the common component, computed using unweighted average employment shares and productivity growth across sectors. The bottom line is therefore that financial booms are associated with stronger labour reallocation towards low productivity gains sectors. By contrast financial booms are not associated with any systematic change in productivity across sectors. We therefore provide the first set of empirical evidence that (i) during financial booms, employment grows disproportionately more in industries that experience weaker subsequent productivity growth than would otherwise be the case and that (i) this effect drives the negative relationship between financial booms and productivity growth.[2]

Last, we examine the implications of past labour reallocations on the dynamics of subsequent labour productivity. To do so, we build on Jorda, Schularick and Taylor (2013) who investigate how excess credit growth affects the dynamics of output using local projection methods. In our case, we start by identifying turning points in real GDP to working population for a broad set of advanced economies starting in 1960.[3] We then ask whether the common and/or the allocation component of productivity growth measured in the period prior to a turning point can account for the behavior of labour productivity following the turning point. In this respect, we end up with two main findings. First, the allocation component of past productivity growth has a significant effect on the path of subsequent labour productivity. By contrast, the common component of past productivity growth bears no significant implications for future productivity. Second, these two findings actually hide very different patterns that we can uncover once we allow the effect of past productivity growth components to differ according to the occurrence of a financial crisis. Specifically, when the economy does not face any financial crisis, neither the common not the allocation component of past productivity growth

[2] Although we do not tackle the question in this paper, it is useful to think about the different possible reasons for why this is so in terms of demand vs. supply mechanisms. For demand mechanisms, stronger extension in household credit can typically create a series of sector-specific shocks that would lead to corresponding employment reallocations. For supply mechanisms, stronger extension in corporate credit may come systematically with a bias towards low productivity sectors (see Cecchetti and Kharroubi 2015).

[3] The choice of focusing real GDP to working population to identify turning points as opposed to real GDP is driven by the fact that there are very few episodes where real GDP falls, especially in the early period of our sample where GDP growth rates are relatively high due to catch-up effect and also because of strong demographics. By contrast, focusing on real GDP to working population reduces the intensity of this problem which increases the number of observations in our sample.

prove to be *consistently* associated with subsequent productivity. However, when a financial crisis hits the economy, things change dramatically: both the common and the allocation component of past productivity growth are significantly and positively associated with subsequent productivity. Yet, they are not equal: the path for subsequent productivity is much more sensitive to the allocation component of past productivity growth than it is to the common component of past productivity growth. For example, the effect of the allocation component on labour productivity two years after the turning point is approximately 3.5 times larger than the effect of the common component. And after six years, the effect of the allocation component is still more than 2 times larger. This paper therefore provides the first set of empirical evidence that labour reallocations can affect dramatically the path of labour productivity when the economy is hit with a financial crisis and that the effect of labour reallocations actually dwarfs the effect of other variables.

This paper relates to three different strands of literature. It first relates to the literature which quantifies job reallocation and look at its causes and consequences. On quantification, Davis and Haltiwanger (1992) estimate in their seminal paper that job creation and destruction accounts roughly for 20% of jobs while Campbell and Kuttner (1996) find that reallocation shocks account for roughly half of the variance in total employment growth. A large literature also explores the relationship between reallocation and the business cycle given that causality can go in both ways.[4] More recently, a burgeoning literature has started looking at the effect of financial booms on reallocations: Acharya et al. (2010) looks at the effect of cross-state banking deregulation in the US on the allocation of output and employment across sectors at the state level. Gorton and Ordonnez (2014) show that credit booms can have negative implications for aggregate TFP, which can be accounted for in a model where agents do not produce information about the quality of collateral during the boom.

A second strand of literature deals with the macroeconomic implications of microeconomic distortions. The seminal paper by Hsieh and Klenow (2009) measures within-industry dispersion in productivity with the idea that such dispersion indicates resources misallocation, which has negative effects at the aggregate level.

[4] The "allocative" effect rather speaks in favor of reallocation causing downturns since it is costly and time-consuming. Alternatively, according to the "aggregate" effect, there would be a direct effect of economic downturns on job destruction. In addition, downturns may also cause stronger reallocation through an opportunity cost effect (forgone output due to reallocation is smaller during downturns).

The authors can therefore infers the increase in aggregate productivity that would result from eliminating such dispersion. Our approach is here is more based on econometric inference testing for the possibility that past labour reallocation across sectors may actually be driving future aggregate labour productivity.

Last, the paper relates to the literature on financial factors and the dynamics of the real economy. Yet contrary to most of this literature which looks at how financial frictions can directly affect output and productivity, our findings highlight that developments in the financial sector can have both direct and indirect real effects. For example when credit outgrows GDP, this comes with stronger labour reallocation towards low productivity gains sectors which represents a direct drag on aggregate labour productivity. Moreover, there is also an indirect effect as financial booms can have weaken the path for subsequent productivity through the type of labour reallocation they can generate.

The paper is organized as follows. Section 2 lays down the methodology we rely on the isolate the effect of labour reallocation across sectors on aggregate productivity growth. Section 3 develops the empirical analysis. It first details the data used and then presents the main empirical findings as to the determinants of labour reallocation across sectors. Section 4 looks at the implications of labour reallocations across sectors on the dynamics of aggregate output. Section 5 concludes. Finally, the Appendix provides the estimation details.

2 Labor reallocations and productivity growth

In this section we lay out the methodology used to isolate the effect of labor reallocations on productivity growth. For this sake, let us consider aggregate nominal output y (aggregate employment n) as the sum of individual sectors nominal output y_s (individual sectors employment n_s):

$$y = \sum_s y_s \text{ and } n = \sum_s n_s \tag{1}$$

Assuming the economy is made of S different sectors and denoting $\overline{x}$ the unweighted average for variable x_s across all sectors ($\overline{y} = y/S$; $\overline{n} = n/S$) and $\alpha_{n,s} = n_s/\overline{n}$ sector s relative employment size, aggregate nominal productivity y/n can be written as the sum of two terms:

$$\frac{y}{n} = \frac{1}{S}\sum_{s}\alpha_{n,s}\frac{y_s}{n_s} = \overline{y_s/n_s} + cov\left(\frac{y_s}{n_s};\alpha_{n,s}\right) \tag{2}$$

The first term represents unweighted average productivity computed across all sectors in the economy while the second term measures whether sectors with high productivity also account for a large share in total employment. If this is the case, the covariance is positive and aggregate productivity y/n is higher than the unconditional average sector-level productivity $\overline{y_s/n_s}$. By contrast, when sectors with higher productivity account for a lower fraction of total employment, the covariance term is negative and aggregate productivity is lower than the unconditional average sector-level productivity. Olley and Pakes (1996) apply this decomposition to the telecommunication sector, to trace the source of the increase in the telecom sector productivity after deregulation and measure how much can be attributed to reallocation towards more productive establishments. The decomposition is then computed using firm level data and productivity changes due to reallocation are captured thourgh the covariance between firm productivity and firm share in the sector total employment.[5] Given that firms belonging to a given sector are supposed to carry out relatively similar activities, the covariance term can be interpreted as measuring the quality of labor allocation, a negative covariance reflecting labor misallocation (See Bartelsman et al. 2013 for a cross-country analysis on the role of allocation in productivity differences). In this paper, we apply this decomposition to sector-level data. Instead of individual firms, our unit of analysis is industry-level aggregates within a given country. This is, of course, the appropriate level to estimate labor reallocation across sectors. Yet by doing so, we lose the ability to provide a normative interpretation to our decomposition.[6]

Building on the decomposition in expression (2) and denoting sector s relative output size as $\alpha_{y,s} = y_s/\overline{y}$, it is possible to write the growth rate of nominal output $\Delta y/y$ as the sum of two terms as is shown in

[5] In this case, the left hand variable is productivity in the telecom industry and the right hand decomposition is computed using employment and output data for the firms operating in the telecom sector. Olley and Pakes (1996) find indeed that the covariance term increased substantially following the deregulation of the US telecom sector.

[6] Intuitively, financial and credit booms affect first and foremost the allocation of labor and capital across sectors, some sectors growing much more quickly than the rest of the economy. There may also be some reallocations within sectors, possibly towards less efficient firms, but our prior is that this second hypothesis is a second order phenomenon.

expression (3) below. The first term, $\overline{\Delta y_s / y_s}$, is the unweighted average sector-level output growth while the second term, $cov\left(\frac{\Delta y_s}{y_s}; \alpha_{y,s}\right)$, represents the covariance between sector-level output growth and sector-level share in total output.

$$\frac{\Delta y}{y} = \frac{1}{S}\sum_s \alpha_{y,s}\frac{\Delta y_s}{y_s} = \overline{\frac{\Delta y_s}{y_s}} + cov\left(\frac{\Delta y_s}{y_s}; \alpha_{y,s}\right) \tag{3}$$

Let us now turn to real labour productivity growth. For this end, let us make three different remarks. First we denote p the price of aggregate output, y^r aggregate real output, i.e. $y^r = y/p$ and y_s^r sector s nominal output evaluated at the general price level, i.e. $y_s^r = y_s/p$. Second, the growth rate of sectoral output evaluated at the general price level $\Delta y_s^r / y_s^r$ writes as the product of two terms: one depending on the growth rate of total employment $\Delta n/n$ and one depending on the growth rate of sector-level real output relative to total employment $\Delta\left(y_s^r/n\right)/\left(y_s^r/n\right)$:

$$1 + \frac{\Delta y_s^r}{y_s^r} = \left(1 + \frac{\Delta n}{n}\right)\left(1 + \frac{\Delta\left(y_s^r/n\right)}{y_s^r/n}\right) \tag{4}$$

Third and last, the growth rate of sectoral output to total employment $\Delta\left(y_s^r/n\right)/\left(y_s^r/n\right)$ can be written as the product of two terms: one depending on the growth rate of sector-level employment relative size $\Delta\alpha_{n,s}/\alpha_{n,s}$ and one depending on the growth rate of sector-level labour productivity evaluated at the general price level $\Delta\left(y_s^r/n\right)/\left(y_s^r/n\right)$:

$$1 + \frac{\Delta\left(y_s^r/n\right)}{y_s^r/n} = \frac{1+\frac{\Delta n_s}{n_s}}{1+\frac{\Delta n}{n}}\left(1 + \frac{\Delta\left(y_s^r/n_s\right)}{y_s^r/n_s}\right) = \left(1 + \frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}\right)\left(1 + \frac{\Delta\left(y_s^r/n_s\right)}{y_s^r/n_s}\right) \tag{5}$$

Then, using (3), (4) and (5), aggregate real productivity growth writes as

$$1 + \frac{\Delta\left(y^r/n\right)}{y^r/n} = \overline{\left(1 + \frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}\right)\left(1 + \frac{\Delta\left(y_s^r/n_s\right)}{y_s^r/n_s}\right)} + cov\left(\left(1 + \frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}\right)\left(1 + \frac{\Delta\left(y_s^r/n_s\right)}{y_s^r/n_s}\right); \alpha_{y,s}\right) \tag{6}$$

We can now simplify this expression by decomposing each of the RHS terms of expression (6). Following equation (3), the first term which measures the growth rate of sectoral output to total employment can be written as:

$$\overline{\left(1+\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}\right)\left(1+\frac{\Delta\left(y^r_s/n\right)}{y^r_s/n}\right)} = \left(1+\overline{\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}}\right)\left(1+\overline{\frac{\Delta\left(y^r_s/n_s\right)}{y^r_s/n_s}}\right) + cov\left(\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}};\frac{\Delta\left(y^r_s/n_s\right)}{y^r_s/n_s}\right) \tag{7}$$

Moreover, the second term of expression (6) measuring the covariance between the sector-level relative output size on the one hand and the product of the growth rate of sector-level employment relative size $\Delta\alpha_{n,s}/\alpha_{n,s}$ and the growth rate of sectoral output to total employment on the other hand can be written as:

$$\begin{gathered} cov\left(\left(1+\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}\right)\left(1+\frac{\Delta(y^r_s/n_s)}{y^r_s/n_s}\right);\alpha_{y,s}\right) = \left(1+\overline{\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}}\right) cov\left(\frac{\Delta(y^r_s/n_s)}{y^r_s/n_s};\alpha_{y,s}\right) + \\ cov\left(\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}};(\alpha_{y,s}-1)\left(1+\frac{\Delta(y^r_s/n_s)}{y^r_s/n_s}\right)\right) \end{gathered} \tag{8}$$

As a result, using expressions (6), (7) and (8), the growth rate of aggregate real labour productivity writes as the sum of three different terms:

$$\begin{gathered} 1+\frac{\Delta(y^r/n)}{y^r/n} = \left(1+\overline{\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}}\right)\left(1+\overline{\frac{\Delta(y^r_s/n)}{y^r_s/n}}\right) + \\ \left(1+\overline{\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}}\right) cov\left(\frac{\Delta(y^r_s/n_s)}{y^r_s/n_s};\alpha_{y,s}\right) + cov\left(\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}};\left(1+\frac{\Delta(y^r_s/n_s)}{y^r_s/n_s}\right)\alpha_{y,s}\right) \end{gathered} \tag{9}$$

- The first term of the right hand side in expression (9) depends on the product of unweighted average growth rates in sector-level relative employment size and sector-level real productivity. Aggregate real labour productivity growth -the left hand side- is equal to this first term if sectors are homogeneous.

- The second term of the right hand side in expression (9) corresponds to the average growth rate of sector-level employment shares multiplied by the covariance between sector-level output shares and sector-level real labor productivity growth. This covariance measures whether productivity gains where realized in sectors representing a large or a small share of total output.

- The third term of the right hand side in expression (9) represents the covariance across sectors between the growth rate of sector-level employment relative size and sector-level size-weighted real productivity growth. For a given distribution of sector sizes, this term measures whether labor is reallocated towards high or low productivity gains sectors. In the former case, this term is positive and labor reallocation lifts aggregate real labour productivity growth up. But in the latter case where this term is negative, labor reallocation acts as a drag on aggregate real labour productivity growth.

To simplify our analysis, we will subsequently use a simplified version of (9) and lump together the first and the third term. We hence write the growth rate of aggregate real labour productivity as

$$1+\frac{\Delta\left(y^r/n\right)}{y^r/n}=\underbrace{\left[1+\overline{\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}}}\right]\left[1+\overline{\frac{\Delta\left(y_s^r/n_s\right)}{y_s^r/n_s}\alpha_{y,s}}\right]}_{\text{common component}}+\underbrace{cov\left(\frac{\Delta\alpha_{n,s}}{\alpha_{n,s}};\left(1+\frac{\Delta\left(y_s^r/n_s\right)}{y_s^r/n_s}\right)\alpha_{y,s}\right)}_{\text{allocation component}}\qquad(10)$$

We will call the first term of the right hand side in expression (10) the common component of real labour productivity growth (henceforth, (COM)) and the second term of the right hand side, the allocation component of real labour productivity growth (henceforth, $(ALLOC)$). We now turn to quantifying each of these two terms. In a second step, we will be investigating what drives their fluctuations and what their implications can be, in particular for the dynamics of productivity.

3 What drives labor reallocations across sectors?

3.1 Data sources

We rely on three different sources for industry-level data: the OECD-STAN database, the EU-KLEMS database and the GGDC 10-sector database. These three datasets provide information on value added and employment at the sector level following ISIC 3 rev.1 classification at the 1-digit level. Overall, we consider 9 different sectors: Agriculture (A and B), Mining (C), Manufacturing (D), Utilities (E), Construction (F), Trade services (G and H), Transport services (I), Finance, Insurance and Real Estate services (J and K), Government and Personal services (L to Q). To build our dataset, we require for each data point included in our sample that aggregate output and employment can be reconstituted using data on sector level output and employment.[7] In other words, the industry-level data must provide a partition of the aggregate economy.

[7] As is clear, we will focus in this paper on net changes in sector-level employment without separating employment destructions from employment creations. Another difference with the literature is that we focus on employment or persons employed as opposed to jobs. As a result of these two differences, we are likely under-estimating the extent of labor reallocation in the

Based on this requirement, we end up with an unbalanced sample covering some 23 countries starting in 1979 and ending 2009.[8] We consider non-overlapping five-year periods (six at most for each country) to compute growth rates of employment and real productivity at the aggregate and sector levels in order to obtain the empirical counterparts of the common and allocation components (COM and $ALLOC$) derived in expression (10). Following previous notation, using decomposition (10), aggregate real labour productivity growth in country i between year t and year $t+5$ denoted $\frac{y^r_{i,t+5}/n_{i,t+5}}{y^r_{i,t}/n_{i,t}}$ writes as

$$\frac{y^r_{i,t+5}/n_{i,t+5}}{y^r_{i,t}/n_{i,t}} = (COM)_{i,t,t+5} + (ALLOC)_{i,t,t+5} \tag{11}$$

On the right hand side, (COM) represents the common component of productivity growth and $(ALLOC)$ represents the allocation component of productivity growth as defined in decomposition (10). Two reasons guide our choice in considering a relatively long time span (five years) to compute growth rates. The first one is to ensure comparability with previous results.[9] The second relates to our prior that labor reallocation, especially across sectors, can take time.[10] Considering short periods could therefore yield noisy and hence unreliable measures of labor reallocation. However, to ensure our results are robust, we will also run our investigation computing growth rates using 3-year windows. Our sample being unbalanced, we end up with a panel of 122 observations when growth rates are computed using 5-year windows (208 observations when growth rates are computed using 3-year windows).

economy. For example, Davis and Haltiwanger (1992) estimate that each year around 20 per cent of jobs are either created or destroyed in US manufacturing. By contrast our net employment change barely represents more than **XX**% in our sample.

[8] Countries included in the sample: Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, Great-Britain, Greece, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, Norway, New-Zealand, Portgual, Sweden, USA.

[9] In investigating what drives the direction of labor reallocations, our starting point is the observation that productivity growth and financial booms tend to be negatively correlated (see Cecchetti and Kharroubi 2015). There, the approach makes use of 5-year periods to compute measures of productivity and financial booms. Following on this result, this paper tries to trace the effect of financial booms on productivity growth exploring whether it relates primarily to a negative correlation between financial booms and the common component or the allocation component, or possibly both.

[10] Blanchard and Katz (1992) look at the effect of state specific shocks to labour demand, across US states. According to their estimates, it can take up to 7 years for the effects of such shocks on state unemployment and participation to disappear. More recently, Walker (2013) using longitudunal data estimates the transitional costs associated with reallocating workers from newly regulated industries to other sectors of the economy in the context of new environmental regulations. His results suggest that the reallocative costs to the workforce are significant: The average worker in a regulated sector experienced a total earnings loss equivalent to 20% of their preregulatory earnings, almost all of the estimated earnings losses being driven by workers who separate from their firm.

3.2 A first glance at the data

Table 1 provides summary statistics for aggregate real labour productivity growth, i.e. the left hand side in expression (10) and the common and the allocation components of aggregate real labour productivity growth, i.e. respectively the first and second terms on the right hand side in expression (10). The first three columns of Table 1 provide summary statistics using five-year growth rates, the last three provides summary statistics using three-year growth rates.

Insert Table 1 here

Based on five-year growth rates, real labour productivity grows on average 8.8 percent, i.e. 1.7 percent per year. The common component represents on average around 5.6 percentage points while the allocation component represents 3.1 percentage points on average. Aggregate real productivity growth hence splits between a common component representing 65% and an allocation component representing 35% of the total. Using 3-year growth rates, figures are relatively similar: Aggregate real labour productivity grows on average 1.9 percent per year, the common component representing 60% and an allocation component 40% of the total.

Looking at standard deviations, the volatility of the allocation component approximately ranges between 45 and 55% of aggregate productivity growth volatility depending on whether total or within country volatility is considered and depending on whether growth rates are computed using 3-year or 5-year windows. Moreover, it is interesting to note that the common component of aggregate productivity growth is roughly as volatile as aggregate productivity growth, which implies that the common and the allocation components are negatively correlated. Fluctuations in the common component hence systematically come hand-in-hand with opposite fluctuations in the allocation component and vice-versa. For example, an economy-wide shock that raises productivity growth across all sectors, therefore tends to be partly offset by labor reallocation towards sectors with lower productivity gains.

Table 2 provides the correlation matrix for aggregate productivity growth, the allocation and the common component of aggregate productivity growth, focusing on within-country correlations. Correlations in the upper left matrix are computed using 5-year windows while those in lower right matrix are computed using 3-year windows.

Insert Table 2 here

Unsurprisingly, aggregate productivity growth and its common component are very strongly positively correlated: fast productivity growth across all sectors translates into high productivity growth at the aggregate level. Moreover, the negative correlation between the allocation and the common components was already suggested by the summary statistics described above. The more surprising finding is the correlation between aggregate productivity growth and the allocation component which is positive and significant. Hence when employment grows faster in high productivity gain sectors, -the allocation component is positive- this tends to coincide with higher aggregate productivity growth. This is somewhat surprising since changes in the allocation component are mirrored by changes in the common component in the opposite direction. Hence the strong positive correlation between aggregate productivity growth and its common component, would suggest expect that the the allocation component would not be significantly correlated with aggregate productivity growth. Yet the positive and significant correlation suggests that labor reallocation across sectors does affect aggregate productivity growth in a meaningful way. Moreover, it is interesting to note that all these conclusions hold irrespective of the length of the window used to compute growth rates.

3.3 Credit booms and labor reallocations.

Having established that labor reallocations account for a sizeable part of aggregate productivity growth and that changes in the direction of labor reallocations (towards high or low productivity gains sectors) correlate significantly aggregate productivity growth, we now investigate the drivers of aggregate productivity growth and its components (common and allocation) focusing on credit booms. Let us start with aggregate productivity growth and estimate the following regression:

$$\frac{y^r_{i,t+5}/n_{i,t+5}}{y^r_{i,t}/n_{i,t}} = \alpha_i + \alpha_t + \beta X_{i,t,t+5} + \delta \ln\left(\frac{y^r_{i,t}}{n_{i,t}}\right) + \theta F_{i,t,t+5} + \varepsilon_{i,t} \tag{12}$$

In this specification, α_i is a set of country dummies, α_t is a set of time dummies and $X_{i,t,t+5}$ is a set of control variables. The log of aggregate real productivity in country i on year t, $\ln\left(y^r_{i,t}/n_{i,t}\right)$, controls for standard catch-up effects, $F_{i,t,t+5}$ is a variable measuring the intensity of the credit boom in country i between year t and year $t+5$ and finally ε is a residual. We consider two variables to measure financial booms: average private credit to GDP growth and average private credit to GDP deviation from trend. Higher values for each of these variables indicate a more intense credit boom.[11] Data on private credit comes primarily from the BIS dataset "Long series on credit to the private non-financial sector". The other macroeconomic data included in controls are drawn from the EOCD Economic Outlook dataset.

Computing growth rates using 5-year windows, we observe a significant and negative correlation between aggregate productivity growth and each of the measures of credit booms, i.e. private credit to GDP growth or private credit to GDP deviation from trend (negative and significant θ parameter represented by the slope of the regression lines in Graph 1).

Insert Graph 1 here

To get a sense of the magnitudes involved, an increase in private credit to GDP growth equal to the inter-quartile difference is associated with a 2.35 percentage points cut in productivity growth over five years (0.47 percentage point every year). This corresponds to a one third drop in average productivity growth rater over a five-year period. Similarly, an increase in the growth rate of financial intermediation employment share equal to the inter-quartile difference is associated with a 1.6 percentage point drop in productivity growth over five years (0.31 percentage point every year).

In the previous section describing the correlation matrix, we saw that aggregate productivity growth exhibits positive and significant (unconditional) correlation with both its common and its allocation component. Understanding the negative relationship between productivity growth and financial booms therefore requires uncovering how each of the two components of productivity growth reacts to financial booms and in particular, whether the negative correlation between productivity growth and financial booms is driven by

[11] The results derived below are still valid when using the growth rate in the financial sector employment share as a measure of the intensity of financial booms.

the common component, the allocation component or both. The remainder of this section is therefore dedicated to explore this issue and shed light on the channel(s) through which financial booms affect aggregate productivity growth.

The main finding in this respect is summarized in Graph 2. The left hand panel plots the results from regressing the allocation component of productivity growth against the growth rate in private credit to GDP, taking deviations from country means for both variables. Following our previous notation, the estimated equation is

$$(ALLOC)_{i,t,t+5} = \alpha_i + \alpha_t + \theta_a F_{i,t,t+5} + \varepsilon_{i,t} \tag{13}$$

Here θ_a is the parameter of interest. It measures whether stronger credit booms are associated with labor reallocation towards higher or lower productivity gain sectors.[12] Similarly, the right hand panel in Graph 2 plots the common component of productivity growth against the growth rate in private credit to GDP, taking deviations from country means for both variables. It represents the regression

$$(COM)_{i,t,t+5} = \alpha_i + \alpha_t + \theta_c F_{i,t,t+5} + \varepsilon_{i,t} \tag{14}$$

θ_c being now the parameter of interest measuring whether stronger credit booms are associated with stronger or weaker productivity growth across all sectors. Graph 2 provides a simple conclusion: There is a negative and significant correlation between private credit to GDP growth and the allocation component of productivity growth (θ_a negative and significant), but not between private credit to GDP growth and the common component of productivity growth (θ_c not statistically significant). Hence the negative correlation between aggregate productivity growth and private credit to GDP growth is driven by the allocation component not to the common component. In other words, aggregate labour productivity slows down when credit outgrows GDP because employment gets reallocated *into* low productivity gain sectors and *away* from high productivity gain sectors, not because labour productivity slows down across all sectors of the economy.[13]

[12] Note here that causality is more likely to run from the credit boom to labor reallocation rather than the other way round.

[13] Graph 2a runs similar estimations but using 3-year windows to compute productivity growth and introducing time dummies on the right hand side in estimations (13) and (14). The results are qualitatively similar: the allocation of productivity growth correlates negatively with credit to GDP growth while the common component does not.

Insert Graph 2 here

Does this qualitative result survive to the inclusion of controls? This is the question we now turn to. Sticking to previous notation, we estimate the following set of regressions:

$$\begin{aligned}
\frac{y^r_{i,t+5}/n_{i,t+5}}{y^r_{i,t}/n_{i,t}} &= \alpha_i + \alpha_t + \beta X_{i,t,t+5} + \delta \ln\left(\frac{y^r_{i,t}}{n_{i,t}}\right) + \theta F_{i,t,t+5} + \varepsilon_{i,t} \\
(ALLOC)_{i,t,t+5} &= \alpha_{a,i} + \alpha_{a,t} + \beta_a X_{i,t,t+5} + \delta_a \ln\left(\frac{y^r_{i,t}}{n_{i,t}}\right) + \theta_a F_{i,t,t+5} + \varepsilon_{i,t} \\
(COM)_{i,t,t+5} &= \alpha_{c,i} + \alpha_{c,t} + \beta_c X_{i,t,t+5} + \delta_c \ln\left(\frac{y^r_{i,t}}{n_{i,t}}\right) + \theta_c F_{i,t,t+5} + \varepsilon_{i,t}
\end{aligned} \tag{15}$$

To be comprehensive, we will estimate equations (15) using the two alternative measures of credit booms and the two alternative window length to compute growth rates. But before describing the results, let us first highlight some of the different reasons why credit booms may affect labor reallocations across sectors. The first reason one could thing about would be that credit booms are more likely or stronger in economies which start with a lower financial development level. As a result, if financial development improves labor reallocation across sectors then we may end up with a negative correlation between financial booms and the allocation component of productivity growth. Second, the negative correlation highlighted above could simply reflect that financial booms lead to large employment creations at the aggregate level which makes it easier for low productivity gains sectors to create employment compared to times of moderate or weak employment growth. A third explanation may be related to the government. During financial booms, the government enjoys significantly larger revenues than in normal times and can as a result, raise expenditures, for instance through expanding the number of people it employs. Given that the government sector exhibits low productivity gains by construction (*ref. needed here*), financial booms may be detrimental to the allocation component of productivity growth just because of how financial booms affect government policies. Fourth, inflation may be playing an important role. One of the drawbacks/costs that has been attributed to inflation relates specifically to reallocation: by introducing noise in the signals agents get about relative prices, inflation can lead to reallocations that reduce efficiency. In our case, inflation could lead to stronger labour reallocations into sectors with low productivity gains as agents over-estimate productivity in such sectors as a result of high inflation. And in case financial booms create higher inflation, the negative correlation between the allocation component of productivity and financial booms may just be reflecting the mechanism described above. Fifth and last, we need to control for the occurrence of financial crises.[14] Indeed financial booms are a very good predictor of financial crises. Hence, it could be that following financial crises, sectors faced with a need for structural adjustment actually cut employment so aggressively that they end showing large productivity gains. In this case, financial crises would lead to a more negative allocation component of productivity growth as higher productivity gains would be associated with larger employment destructions. This could account for the negative relationship between financial booms and the allocation component of productivity growth.

Insert Table 3 here

Let us start with regressions where credit booms are measured with the growth rate in private credit to GDP. In Table 3, columns (i)-(iii) provide the estimations for regressions (15) using growth rates computed over 5-years, while columns (vi)-(vi) provides the estimation results for regressions (15) using growth rates computed over 3-years. Consistent with evidence presented above, column (i) shows that aggregate productivity growth correlates negatively with private credit to GDP growth, this result holding irrespective of the specific set of controls included. Regression results in column (ii) & (iii) are also consistent with the main claim of this section: Productivity growth and private credit to GDP growth correlate negatively because labor gets reallocated more strongly into low productivity gains sectors to the detriment of high productivity gains sectors, not because productivity growth get depressed across all sectors. The picture is somewhat different when growth rate variables are computed using a shorter window: Columns (v) and (vi) indeed show that the negative correlation between productivity growth and credit to GDP growth comes not only from labor reallocations which drag productivity growth down but also from a generalized slow-down in productivity which takes place across all sectors. And if anything a significant part of the overall effect (65-70%) of credit booms on productivity growth is actually coming from a generalized productivity slow-

[14] Data on financial crises comes from Borio and Drehman (2009) and is used as a dummy variable which is equal to one if a financial crisis hits during the period considered and is equal to zero otherwise.

down. The most likely explanation for this qualitative difference in the results relates to the positive effect of credit booms on aggregate demand. In the short-run, an economy which goes through a credit boom undergoes a positive demand shock which affects all sectors in the economy. This leads firms to increase employment significantly in expectation on strong demand in the years to come which leads to a slow-down in productivity. Yet, as the credit boom develops over time, a smaller set of sectors keep facing strong demand which leads to labor reallocations into those sectors and mechanically reduces any generalized productivity slow-down across all sectors.

Let us now turn to the results on control variables. Here, a couple of interesting patterns emerge. First, the level of private credit to GDP does not play any role, neither on aggregate productivity growth nor on any of its components. Second, the negative correlation between aggregate employment growth and aggregate productivity growth hides opposite effects on the allocation and the common components: The allocation component responds positively to higher employment growth while the common component reacts negatively, the latter effect dominating the former. The evidence is therefore that labor gets reallocated more strongly towards high productivity gains sectors during periods of large employment creation. By contrast during periods of low or negative employment growth, labor gets reallocated towards low productivity gains. One explanation may be that aggregate employment growth mirrors the evolution of labor costs. As a result, during periods of low employment growth, employment gets disproportionately created in labor intensive sectors, which usually exhibit low productivity gains as these sectors benefit disproportionately from weak or moderate labor cost increases. On the contrary, during periods of high employment growth, labor costs likely also grow quickly to that capital intensive sectors - which are also high productivity gains sectors- are in a better position to create jobs as they can more easily keep pace with fast growing labor costs compared with labour intensive sectors. Turning to government consumption, it seems to affect aggregate productivity growth, but only through the common component, the allocation component being uncorrelated with government consumption to GDP. Based on this evidence, we can therefore discard the view that labor reallocations are driven by changes in government expenditures.[15]

[15] This hypothesis can be formally tested by computing productivity growth and its components, excluding the government sector. See appendix for more details.

The fourth control variable of interest is CPI inflation. Confirming previously established evidence, inflation is bad for growth, particularly over shorter time periods. The data however does not have enough identification power to find out whether the negative correlation comes essentially from the common or the allocation effect, although in quantative terms, the effect on the common component is larger. Last, financial crises do not seem to affect neither productivity growth nor any of its components in a significant way. Before turning to the evidence using the alternative measure of credit booms, it is worth saying a few words on the intensity of the catch-up effect. As is shown in column (i), there is a negative relationship between the initial level and the subsequent growth rate of productivity. However, this negative relationship comes almost exclusively from the common component. In other words, labour reallocation as a source of productivity growth does not diminish mechanically as a result of a higher productivity level, contrary to the common component of productivity growth which does face convergence to a steady-state level determined by fundamentals of the economy. Hence as aggregate productivity increases, the common component of productivity growth tends to become relatively less important while the allocation component becomes relatively more important for aggregate productivity growth. Financial booms are therefore more costly for advanced economies whose productivity is already relatively high as in such economies, aggregate productivity growth is essentially coming from the allocation component.[16]

Turning to the regressions using the average deviation of private credit to GDP from trend as a measure of financial boom, conclusions are very similar with those we have obtained up to now with some qualifications. First, contrary to the case where credit booms were measured with private credit to GDP growth, credit booms measured as large deviations of credit to GDP from trend are found to have no significant effect on the common component of productivity growth, even over short periods. This difference is likely due to the fact that measuring credit booms as deviations in credit to GDP from trend is more relevant as this excludes episodes where strong growth in credit to GDP relates to genuine financial deepening. Second, the effect of some control variables is also slightly different: the level of private credit to GDP has a weakly positive effect on aggregate productivity growth.

[16] This may be a reason why such results may actually not extend to emerging market economies where producitivity growth is more linked to common developments across sectors.

Another finding worth noting is that irrespective of the specific measure of credit booms, inflation affects negatively aggregate productivity growth essentially through the allocation component, thereby confirming that the growth cost of inflation comes first and foremost from labour reallocations which are less growth-enhancing with higher inflation.

Insert Table 4 here

The last robustness check we carry out in this section consists in re-estimating the first regression of equations (15) but adding on the right hand side either the allocation or the common component to productivity growth as an additional control variable. For example when the common component of productivity growth is included on the right hand side, we actually can estimate the effect of credit booms on the allocation component of productivity growth component while at the same time controlling for the effect of the common component on the allocation component. This is important as we showed earlier that there is a significant (negative) correlation between productivity growth components. Results using credit to GDP growth are wrapped-up in Table 5.

Insert Table 5 here

The first three columns (i)-(iii) provide estimation results using growth rate variables computed over 5 years, while the first last columns (iv)-(vi) provide estimation results using growth rate variables computed over 3 years. The estimations show that credit booms affect negatively productivity growth irrespective of which productivity growth component is included on the right hand side. Hence this would suggest that credit booms are detrimental to both the allocation and the common component of productivity growth. Yet, the effect of credit booms on the allocation component of productivity growth (column (ii) and (v)) tends to be more significant than the effect of credit booms on the common component. This table therefore suggests that credit booms affect productivity growth equally through the allocation and the common components. Yet the effect on the former is more clear-cut (precisely estimated) than the effect on the latter. Estimations results using credit to GDP average deviation from trend are provided in Table 6. As previously, the first three columns (i)-(iii) provide estimation results using growth rate variables computed over 5 years, while the first last columns (iv)-(vi) provide estimation results using growth rate variables computed over 3 years. The table confirms previous results, although some differences exist. Similarly to results of Table 5, credit booms affect negatively productivity growth through the allocation component which productivity growth component (columns (iii) and (vi)). However, the effect of credit booms on the common component tends to disappear and in any case is much weaker considering standard confidence levels. These results therefore confirm that credit booms tend to be detrimental to productivity growth and that labor reallocations towards low productivity gains sectors are the main -although not unique- channel through which this negative effect takes place.

Insert Table 6 here

4 Labor reallocations and the dynamics of productivity

Up to now, we have investigated factors that may influence labor reallocations and found out that during credit booms, labor tends to be reallocated more strongly into low productivity gains sectors. In this section we move to a different question asking what are the implications of a given labor reallocation pattern. In particular, we are interested in finding out whether labor reallocations towards low or high productivity gains sectors actually affects the subsequent dynamics of productivity. For example, if labor is reallocated into low productivity gains sectors, does that lead to a subsequent slow-down in productivity or does it have insignificant implications? In other words, we want to test not only whether current productivity growth drives future productivity growth – the standard time dependence – but also whether the nature of current productivity growth, i.e. how much of it is due to the allocation component as opposed to the common component, bears any implication on the path of future productivity.

4.1 Data and methodology

For this sake, we start by identifying turning points in real GDP to working population for OECD economies starting in 1960.[17] Having identified for each country such local peaks, we end up with a panel of countries

[17] As a restriction in identifying local peaks, we require that xxx. *explain quickly the methodology.*

and dates for turning points in real GDP to working population. Our dataset gathers 81 different turning points for 22 different advanced economies, the first turning point being in 1969 for the United States. In what follows, we will denote Y_{i,t_p} GDP in country i in year t_p (N_{i,t_p} the number of persons employed in country i in year t_p), t_p being the year of the p-th turning point in country i real GDP to working population. Then for each country, turning point pair $(i;t_p)$, we consider the path of labor productivity following the peak, i.e. $\left\{y^r_{i,t_p+h}/n_{i,t_p+h}; h > 0\right\}$, where Y_{i,t_p+h} denotes GDP in country i, h years after the n-th turning point and n_{i,t_p+h} the number of persons employed in country i, h years after the n-th turning point. Our dependent variable will hence be the percentage deviation in labour productivity relative to the peak considering time horizons h running from 1 to 8 years, i.e. $\left\{\frac{y^r_{i,t_p+h}/n_{i,t_p+h}}{y^r_{i,t_p}/n_{i,t_p}}; h = 0, 1, ..., 7, 8\right\}$.

On the right hand side, we consider two main explanatory variables, which will be our variables of interest. These are the allocation component and the common component of productivity growth, these variables being defined as previously. In our baseline specification we measure these components over the 3-year period prior to the peak, i.e. over $[t_p - 3; t_p]$. However for robustness checks, we will also consider longer periods (4-year or even 5-year period prior to the peak). In addition to these two variables of interest we also include a set of control variables. We first consider as a control variable, the growth rate of credit to GDP in the period prior to the peak. As we do for the explanatory variables of interest, we consider periods of different length to compute the growth rate of credit to GDP (3-year, 4-year or 5-year period). In addition, whenever the data is available we consider alternative measures to credit to GDP growth like financial sector employment growth or deviation of credit to GDP from trend. The motivation for including credit to GDP growth as a control variable is relatively straightforward. Given that financial booms are associated with labor reallocation towards low-productivity gains sectors, it could well be that any effect of past labor reallocations on the dynamics of subsequent productivity actually captures the effect of financial booms. It is therefore critical given the tight association between financial booms and labor reallocation towards low-productivity gains sectors to understand if the effect of labor reallocation on future productivity if any, still holds for given credit to GDP growth. Second, we include as control variables, the growth rate in real GDP and growth rate in employment up to 3 years prior to the peak.[18] Here the idea is to have a detailed set of macroeconomic controls for the period which precedes the turning point as to eliminate any possible alternative explanation for the results related to differences in the macroeconomic environment. Last we construct a financial crisis dummy which, for each country/peak pair $(i; t_p)$, equals one if a financial crisis hits during the period running from 3 years before the peak up to two years after the peak, i.e. $[t_p - 3; t_p + 2]$. If no financial crisis hits during this period, the dummy takes value zero. Among the 82 turning points identified in our dataset -for which all data described above is actually available-, 22 turning points happen to be associated with a financial crisis while 59 are not. Unsurprisingly, the vast majority of the turning points associated with a financial crisis are related to the Global Financial Crisis which hit in 2007-2008.[19] With this financial crisis dummy, we can test whether the effect of labor reallocation on productivity if any, is related to the occurrence of financial crises. Given that financial booms are a good predictor of financial crises, financial crisis may be accounting for the possible effects of labor reallocations on the path of subsequent productivity. Moreover, we can also test with this financial crisis dummy variable if the effect of labor reallocations on productivity actually depends on the occurrence of a financial crisis. Here the idea would be that on top of financial crisis being detrimental to productivity in their own respect, they may also affect the ability of the economy to correct for past reallocations hindering productivity growth. Labor reallocations towards low productivity gains sectors may hence be more costly with a financial crisis than without.

Insert Table 7 here

[18] We consider here two variants. In the first set of regressions, we include as control variables the 3-year growth rates for real GDP and employment prior to the peak, respectively denoted $Y_{i,t_p}/Y_{i,t_p-3}$ and $N_{i,t_p}/N_{i,t_p-3}$. In the second set of regressions, the control variables are the year-on-year growth rates up to 3 years prior the peak for output $\left\{Y_{i,t_p-j}/Y_{i,t_p-j-1}\right\}_{0\leq j\leq 2}$ and employment $\left\{N_{i,t_p-j}/N_{i,t_p-j-1}\right\}_{0\leq j\leq 2}$.

[19] In table 8, the code 1 indicates a turning point in GDP to working population *without* any financial crisis occurring between 3 years before the turning point and 2 years after the turning point, for the country whose name is the corresponding row and the year in the corresponding column. The code 1c indicates a turning point in GDP to working population *with* any financial crisis occurring between 3 years before the turning point and 2 years after the turning point, for the country whose name is the corresponding row and the year in the corresponding column. The presence of a star * indicates that the corresponding turning point was not included in the regressions where past employment growth is included as a control variable, for lack of data availability.

4.2 The empirical specifications

In the first set of regressions we estimate how the allocation and the common components of productivity growth prior to the peak in real GDP to working population affect the subsequent dynamics of labour productivity. Specifically we estimate productivity growth at a given horizon h following the peak as a function of the allocation and the common component of productivity growth computed over the 3-year period which precedes the peak. Denoting country fixed effects as $\alpha_{i,.}$ we estimate the regression

$$\frac{y^r_{i,t_p+h}/n_{i,t_p+h}}{y^r_{i,t_p}/n_{i,t_p}} = \alpha_{i,h} + \beta_h X_{i,t_p} + \theta_{a,h}\left(ALLOC\right)_{i,t_p} + \theta_{c,h}\left(COM\right)_{i,t_p} + \varepsilon_{i,t_p,h} \tag{16}$$

where X is a column-vector of control variables X , β_h is a row-vector of coefficients to be estimated, $(\theta_{a,h}; \theta_{c,h})$ are parameters to be estimated and $\varepsilon_{i,t_p,h}$ is a residual. We estimate different versions of regression (16) which differ in the control variables included in the vector X. Results presented below are those where the vector of control variables X, includes credit to GDP growth prior to the peak and a financial crisis dummy variable as well as the full set of year-on-year growth rates in output and employment up to three years prior to the peak.[20] Since we consider horizons h running from 1 to 8 years, we estimate each version of equation (16) 8 times, one for each different horizon h.

Next, we estimate an extended regression by allowing the coefficients $\{\theta_{a,h}; \theta_{c,h}\}_h$ to differ depending on whether the turning point in real GDP to working population is associated with a financial crisis. As noted above, we are now interested not only in how labor reallocation affects the subsequent dynamics of productivity but also in whether this effect differs depending on the occurrence of a financial crisis. For example labor reallocation towards low-productivity gains sectors may be more costly for subsequent productivity dynamics when a financial crisis hit. One argument for this could be that correcting such reallocations requires credit which is difficult following a financial crisis. Alternatively, labor reallocation

[20] It is important to keep in mind that the allocation and the common component of productivity growth sum up to aggregate productivity growth. As a result, the first version of (16) de facto controls for productivity growth prior to the peak, assuming that estimated coefficients for output and employment should be opposite. The second version of regression (16) is precisely there to relax this assumption and allow the effect of past output and employment growth to differ in absolute value while the third and last version is there to allow for year-on-year growth rates to have different effects.

towards low-productivity gains sectors may be less costly for subsequent productivity dynamics when a financial crisis hit if low productivity gains sectors have to go through structural adjustment. To test for these different possibilities, we estimate the following regression:

$$\begin{aligned}\frac{y^r_{i,t_p+h}/n_{i,t_p+h}}{y^r_{i,t_p}/n_{i,t_p}} &= \alpha_{i,h} + \beta_h X_{i,t_p} + \left[\left(1 - FC_{i,t_p}\right)\theta^0_{a,h} + FC_{i,t_p}\theta^1_{a,h}\right](ALLOC)_{i,t_p} \\ &+ \left[\left(1 - FC_{i,t_p}\right)\theta^0_{c,h} + FC_{i,t_p}\theta^1_{c,h}\right](COM)_{i,t_p} + \varepsilon_{i,t_p,h}\end{aligned} \tag{17}$$

where FC_{i,t_p} -the financial dummy variable- is equal to one if the turning point in real GDP to working population taking place in country i on year t_p is associated with a financial crisis and zero otherwise; and $\left(\theta^0_{a,h};\theta^1_{a,h};\theta^0_{c,h};\theta^1_{c,h}\right)$ are parameters to estimate, other notation being unchanged. Last, we allow estimated coefficients for the control variables β_h to differ depending on whether the turning point in real GDP to working population is associated with a financial crisis. The idea here is to test whether possible differences in the coefficients $\left(\theta^0_{a,h};\theta^1_{a,h};\theta^0_{c,h};\theta^1_{c,h}\right)$ are robust to relaxing the assumption that the other control variables affect the productivity path independently of whether a financial crisis hits or not. To test for this possibility, we estimate the following regression:

$$\begin{aligned}\frac{y^r_{i,t_p+h}/n_{i,t_p+h}}{y^r_{i,t_p}/n_{i,t_p}} &= \alpha_{i,h} + \left[\left(1 - FC_{i,t_p}\right)\beta^0_h + FC_{i,t_p}\beta^1_h\right]X_{i,t_p} + \left[\left(1 - FC_{i,t_p}\right)\theta^0_{a,h} + FC_{i,t_p}\theta^1_{a,h}\right](ALLOC)_{i,t_p} \\ &+ \left[\left(1 - FC_{i,t_p}\right)\theta^0_{c,h} + FC_{i,t_p}\theta^1_{c,h}\right](COM)_{i,t_p} + \varepsilon_{i,t_p,h}\end{aligned} \tag{18}$$

where β^0_h and β^1_h are row–vectors of coefficients to estimate, other notation being unchanged. In practice, we will focus on credit to GDP growth and credit to GDP deviation from trend and check whether allowing coefficients to differ depending on the occurrence of a financial crisis actually affects our main results.

4.3 Labor reallocation and the dynamics of productivity: the empirical results.

We start with estimation results for specification (16) which can be found in table 8. There are three main conclusions: First, looking at control variables, the occurrence of a financial crisis has some negative effect on the subsequent path of aggregate labour productivity. However, it fades out pretty quickly as it is not significant anymore 2 years after the peak. Moreover, differences in credit to GDP growth prior to the peak do not have any significant implication for the path of subsequent labour productivity. This is true irrespective of the considered horizon. Second looking at the effect of the allocation and the common component of productivity growth, it seems that the common component has some positive but insignificant effect on the dynamics of productivity. However, the allocation component does has a positive and significant effect on the productivity path. Productivity following the peak grows more rapidly when labor reallocation has had a larger contribution to productivity growth prior to the peak. To give a sense o the magnitude involved, consider a one-standard-deviation increase in the allocation component of productivity growth prior to the peak. This corresponds roughly to a 2 percentage point increase. Then this lifts productivity 5 years after the peak by roughly 1.5 percentage points, i.e. 0.3 percentage point every year. Finally, the last row in table 9 shows that the null hypothesis that the estimated coefficient for the common and the allocation effects can never be rejected at any horizon. This is likely related to the large standard errors of the estimated coefficients particulary those of the common effect. However, this result also implies that what matters for the path of productivity is not the source but the overall amount of past productivity growth.

Insert Table 8 here

To push the investigation further, we allow estimated coefficients for the allocation and the common components of productivity growth prior to the peak to differ depending on the occurrence of a financial crisis. The idea is therefore to figure out whether the results highlighted in the previous table may actually be due to differences in how past productivity growth components affect subsequent productivity depending on whether a financial crisis hits the economy or not. And indeed, this hypothesis seems to be supported by the data (see Table 9). For example, the allocation component of labour productivity growth prior to the peak has a positive and significant effect on the subsequent path of labour productivity when a financial crisis hits the economy. But in the absence of a financial crisis, past labour reallocations do not seem to have a consistently significant effect on productivity going forward. This difference is also confirmed by the results of F-test which show that the null hypothesis that the effect of the allocation component is the same in the presence and in the absence of a financial crisis can be rejected at standard confidence levels. The

p. value for the F-test indeed suggests that the allocation component has a statistically larger effect on the subsequent path of productivity starting from 2 years after the peak. This result therefore highlights that labour reallocations towards low productivity gains sectors can prove to be particularly detrimental for subsequent productivity when a financial crisis hits the economy. To give a sense of economic magnitudes, we can compute the effect on productivity of a one-standard-deviation drop in the allocation component of past productivity growth depending on whether the economy is hit with a financial crisis or not. When a financial crisis hits, a one-standard-deviation drop in the allocation component leads to an 8 percentage point drop in productivity five years after the peak which corresponds to a 1.5 percentage point loss in productivity every year. By contrast, in the absence of a financial crisis, a one-standard-deviation drop in the allocation component leads to a 1 percentage point drop in productivity five years after the peak, i.e. a 0.2 percentage point loss in productivity every year. Moreover, it is important to bear in mind that this last effect is not significantly different from zero. Turning now to the common component of productivity growth, a similar type of result holds: differences in the common component of productivity growth have a larger effect on the subsequent path of productivity when a financial crisis hits, a stronger common component leading to stronger subsequent productivity. This is visible both in the estimated coefficients as well as in the F-test which shows that the null hypothesis that the common component has the same effect on subsequent productivity in the presence and in the absence of a financial crisis can be rejected at standard confidence levels starting 4 years after the peak onwards. Yet, the two last F-tests (last and before last row) show that there is an another important remark to be made: In the absence of a financial crisis, the null hypothesis that the allocation and the common components have a similar effect on subsequent productivity cannot be rejected at standard confidence levels. However, when it comes to the case where a financial crisis hits the economy, then the null hypothesis that the allocation and the common components have a similar effect on subsequent productivity can be rejected at standard confidence levels, starting from the second year after the peak onwards.

The bottom line is hence twofold. First, the occurrence of a financial crisis draws a sharp difference in how the allocation and the common of productivity growth affect the subsequent path of labour productivity:

When a crisis hits, the economy's productivity performance display much stronger time dependence than in the absence of a crisis. Current productivity growth is therefore much more sensitive to the allocation and the common components of past productivity growth in the presence of a financial crisis. Second, the occurrence of a financial crisis draws a sharp difference in how the productivity growth sources affect the subsequent path of labour productivity. In the absence of a crisis, the economy's productivity depends equally on the allocation and the common component of productivity growth; the source of growth does not make a difference. But when a crisis hits, the economy's productivity performance is much more sensitive to past labour reallocations than to past average sector-level productivity growth.

Insert Table 9 here

Last, we extend the analysis running a few robustness exercises to check whether these conclusions are still valid. The first robustness check consists in allowing other variables and in particular credit to GDP growth, to affect differently the path of subsequent productivity depending on the occurrence of a financial crisis. Table 10 provide regression results when the effect of credit to GDP growth as well as the effects of the allocation and the common of productivity growth can differ depending on whether a financial crisis hits the economy or not. The empirical evidence shows that previous conclusions are broadly unchanged and in particular the two main results developed in the last paragraph. First, when a financial crisis hits, the productivity path become significantly more sensitive to past labour reallocations and to past average sector-level productivity growth. Second, conditional on a financial crisis hitting the economy, past labour reallocations have a much larger effect on the subsequent productivity path than past average sector-level productivity growth. Besides these two results, it is striking to note that past credit to GDP growth actually has very little impact of the path of subsequent productivity. This is particularly true in the absence of any financial crisis. In this case, there is no horizon between 1 and 8 years for which, past credit to GDP growth has a significant effect on future labour productivity. Things are marginally different in the case of episodes associated with a financial crisis. In this case, strong credit to GDP growth in the past seems to have some positive effect on labour productivity, but this is restricted to 5 and 6 years after the turning point. At other horizons, there is no significant effect.

Insert Table 10 here

In the second robustness check, we re-run estimation (18) using independent variables computed over a 4-year window prior to the peak while previous estimations were using 3-year windows for explanatory variables. Results reported in Table 11 are qualitatively identical to those drawn from Table 9 and Table 10. In particular, when a financial crisis hits, the allocation and the common component of productivity growth have a much larger effect on subsequent labour productivity with the sensitivity to the allocation component increasing disproportionately more. By contrast, credit to GDP growth -also computed over a 4-year window- does not have any consistently significant effect on subsequent labour productivity.

Insert Table 11 here

The third and last robustness check consists in re-estimating regression (18) using the average deviation of private credit to GDP from trend rather than the private credit to GDP growth as an indicator of the credit boom prior to the peak. Results presented in Table 12 show that the main conclusions are unchanged. First, labour productivity following the peak depends significantly on the allocation and the common component of productivity growth prior to the peak when a financial crisis hits. In the absence of a financial crisis, there is no consistently significant relationship. Second, the effect of the allocation component increases disproportionately more relative to the effect of the common component when a financial crisis occurs. Interestingly, the estimated coefficients for the allocation and the common components are very similar in this last set of regressions to those estimated previously.

Insert Table 12 here

To wrap-up these results, we simulate the estimated path for productivity. To do so we consider four alternative scenarios. In the first two scenarios, the economy does not face any financial crisis, while in the last two, a financial crisis hits the economy. Moreover In the first and the third scenarios, the allocation component of productivity growth prior to the peak is relatively high (solid blue and sold red lines respectively), i.e. equal to the third quartile of the sample distribution of the allocation component of productivity growth. Conversely, in the second and the fourth scenario, the allocation component of productivity growth prior to the peak is relatively low (dashed blue and dashed red lines respectively), i.e. equal to the first quartile of the sample distribution of the allocation component of productivity growth. Graph 3 shows the simulated paths for productivity and provides three main conclusions. The first one is that differences in the allocation component of past productivity growth do not make any difference for countries which do not face any financial crisis. Eight years after the peak, the difference betwen the solid and the dashed blue lines culminates at 2 percentage points and up to 6 years after the peak it is always below one percentage point. The second conclusion is that on the contrary, when a financial crisis hits the economy, differences in the allocation component actually greatly affect the path of productivity: the difference between the red solid and the red dashed lines is around 5 percentage points 3 years after the peak and reaches more than 11 percentage points after 6 years. The third and last conclusion is that the drag on productivity stemming from the occurence of a financial crisis is "roughly" compensated with the lift on productivity coming from a strong contribution of labor reallocation to past productivity growth. It is striking to note that the dashed red line drawing the path of productivity when a financial crisis hits the economy and the allocation component of past productivity growth has been relatively low, follows a very different dynamics compared with the three alternative scenarios. This shows that neither the occurence of a financial crisis nor past reallocations that have been a drag on productivity growth have significant negative implications for subsequent productivity. It is the *combination* of these two elements which has significant and long-lasting negative effects on productivity.

Insert Graph 3 here

5 Conclusion

This paper is an investigation into the causes and consequences of labor reallocation across sectors. It delivers three contributions. First, we have developed a simple methodology to isolate the contribution of labor reallocations across sectors to aggregate productivity growth building on the output decomposition used in the literature on labor misallocation. Second, we have shown that labor reallocation contribution tends to be lower the stronger the growth in credit to GDP, implying that credit booms tend to come with labour reallocations across sectors which hurt productivity growth. This result which we have established for a panel of advanced economies holds after controlling for a large set of factors including the common of productivity growth, i.e. productivity growth which is common to the whole set of sectors in the economy. We have also provided evidence that this result does not depend on the specific measure of credit booms since it still holds using the deviation of credit to GDP from trend rather than the growth in credit to GDP. Last, looking at the implications, we have shown that in general, labour reallocation patterns have no large effect on the subsequent path of productivity. However, conditional on a financial crisis hitting the economy, past labour reallocations have been found to have dramatic implications for future productivity as the latter keeps dropping for more than 5 years after peak before it starts recovering while not coming back to the previous peak level more than 8 years after the peak.

These results raise two important questions. The first relates to the reasons which may account for the relationship between credit booms and labour reallocation. This is an open question and the specific mechanisms trough which credit booms lead the labor force to be reallocation to low productivity gains sectors are still to establish. The second relates to the effect of past labour reallocations on the subsequent productivity and why financial crisis amplify the effect of the former on the latter. Here a couple of conjectures can be made. The most obvious is that following financial crises, credit becomes very scarce. So correcting for past reallocations can prove to be very difficult and long lasting so that past developments can weigh significantly on productivity for a long time. These questions deserve deep scrutiny and will be the focus of future research.

References

[1] Acharya, V. Imbs, J. and Sturgess, J. (2010) Finance and Efficiency: Do Bank Branching Regulations Matter? Review of Finance, 15(1), pp. 135-172.

[2] Baily, M. Bartelsman, E. and Haltiwanger, J. (1996) Downsizing and Productivity Growth: Myth or Reality? Small Business Economics, 8, pp. 259-278.

[3] Baily, M. Bartelsman, E. and Haltiwanger, J. (2001) Labor Productivity: Structural Change and Cyclical Dynamics. The Review of Economics and Statistics, 83(3), pp. 420-433.

[4] Blanchard, O. and Katz, L. (1992) Regional Evolutions. Brookings Papers on Economic Activity, pp. 1-75.

[5] Borio, C. and Drehman, M. (2009) Assessing the risk of banking crises – revisited. BIS Quarterly Review, March 2009.

[6] Caballero, R. Engel, E. and Haltiwanger, J. (1997) Aggregate Employment Dynamics: Building from Microeconomic Evidence. The American Economic Review. 87(1), pp. 115-137

[7] Campbell, J. and Kuttner, K. (1996) Macroeconomic Effects of Employment Reallocation. Carnegie-Rochester Conference Series on Public Policy, 44, pp. 87-116.

[8] Cecchetti, S. Kohler, M. and Upper, C. (2009) Financial Crises and Economic Activity. NBER Working Paper 15379.

[9] Cecchetti, S. and Kharroubi, E. (2015) Why Does Financial Sector Growth Crowd Out Real Economic Growth? BIS Working Paper 498.

[10] Davis, S. and Haltiwanger, J. (1992) Gross Job Creation, Gross Job Destruction, and Employment Reallocation. Quarterly Journal of Economics, 107(3), pp. 819-863.

[11] Dias, D. Robalo Marques, C. and Richmond C. (2014) Misallocation and productivity in the lead up to the Eurozone crisis. Banco do Portugal Working Paper 11.

[12] Drehmann, M. and Juselius, M. (2015) Leverage Dynamics and the Real Burden of Debt. BIS Working Paper 501.

[13] Drehmann, M, C Borio, and K Tsatsaronis (2011): "Anchoring countercyclical capital buffers: The role of credit aggregates", International Journal of Central Banking, 7(4).

[14] Hsieh, C.-T. Klenow, P. (2009) Misallocation and Manufacturing TFP in China and India. Quarterly Journal of Economics 124(4), pp: 1403-1448.

[15] Foster, L. Grim, C. and Haltiwanger, J. (2014) Reallocation in the Great Recession: Cleansing or Not? NBER Working Paper 20427.

[16] Jorda, O. Schularik, M and Taylor, A (2013) When Credit Bites Back. Journal of Credit Money and Banking, 45(2), pp. 3-28.

[17] Olley, S. and Pakes, A. (1996) The Dynamics of Productivity in the Telecommunications Industry. Econometrica, 64(6), pp. 1263-1298.

[18] Bartelsman, E. Haltiwanger, J. and Scarpetta, S (2013) Cross-Country Differences in Productivity: The Role of Allocation and Selection. American Economic Reviw, 103(1), pp. 305-334.

[19] Krüger, J. (2008) Productivity and Structural Change: A reviw of the Literature. Journal of Economic Surveys, 22(2), pp. 330-363.

[20] Walker, R. (2013) The Transitional Costs of Sectoral Reallocation: Evidence from the Clean Air Act and the Workforce. Quarterly Journal of Economics, 128(4), pp. 1797-1835.

6 Appendix

6.1 Alternative productivity growth decompositions

Baily et al. (1996) proposes an alternative decomposition for productivity growth: Following similar notation to that used in section 2, aggregate real productivity y^r/n writes as the sum of unweighted average productivity and the covariance between sector-level productivity and sector-level relative employment size:

$$\frac{y^r}{n} = \overline{y_s^r/n_s} + cov\left(\frac{y_s^r}{n_s}; \alpha_{n,s}\right) \tag{19}$$

Now differentiating this decompostion, the change in aggregate productivity writes as a sum of four different terms:

$$\Delta\left(y^r/n\right) = \overline{\Delta\left(y_s^r/n_s\right)} + cov\left(\Delta\left(y_s^r/n_s\right); \alpha_{n,s}\right) + cov\left(\frac{y_s^r}{n_s}; \Delta\alpha_{n,s}\right) + cov\left(\Delta\left(y_s^r/n_s\right); \Delta\alpha_{n,s}\right) \tag{20}$$

The first is the unconditional average change in productivity across all sectors. The second term measures whether the change in productivity is larger in sectors accounting for a large share of total employment. Similarly the third term measures whether the change in employment share is larger in sectors display higher initial productivity while the last term indicates whether sectors with high employment expansion did experience high productivity gains.

$$\frac{\Delta\left(y^r/n\right)}{y^r/n} = \frac{\overline{\Delta\left(y_s^r/n_s\right)}}{y^r/n} + cov\left(\frac{\Delta\left(y_s^r/n_s\right)}{y^r/n}; \alpha_{n,s}\right) + cov\left(\frac{y_s^r/n_s}{y^r/n}; \Delta\alpha_{n,s}\right) + cov\left(\frac{\Delta\left(y_s^r/n_s\right)}{y^r/n}; \Delta\alpha_{n,s}\right) \tag{21}$$

There is a key difference between this approach and the decomposition laid down in section 2: The former uses industry-level *changes* for employment and labour productivity -scaled by the level of aggregate productivity-. By contrast, the latter is computed using industry level *growth rates* for employment and labour productivity. In practise, this means that this decomposition makes no difference whether a sector's output per worker increases from 1000 to 2000 - a 50 per cent increase- or from 10000 to 11000 -a 10 per cent increase-.

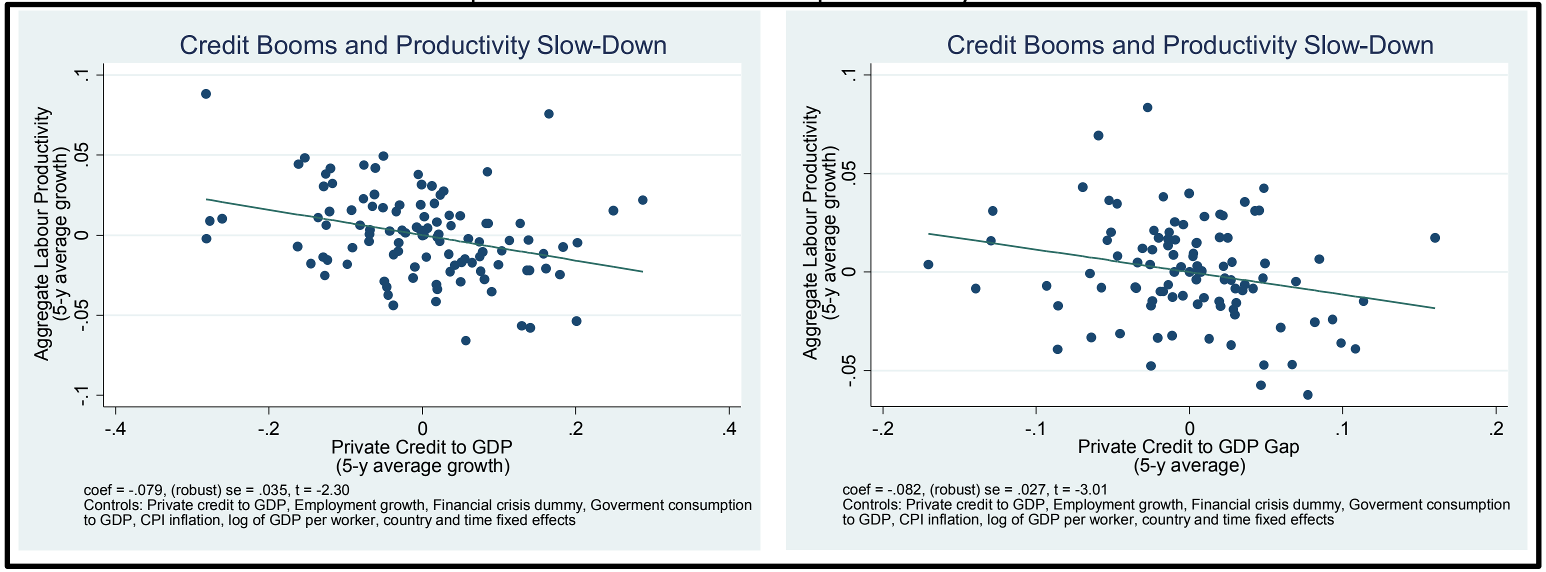
Table 1: Summary Statistics

	Productivity growth	Allocation component	Common component	Productivity growth	Allocation component	Common component
	5-year growth			3-year growth		
Average	**8.77**	**3.13**	**5.64**	**5.09**	**2.05**	**3.04**
Median	**8.23**	**3.21**	**4.55**	**5.11**	**2.02**	**2.67**
Standard deviation	**6.57**	**2.91**	**7.29**	**4.43**	**2.13**	**4.57**
Standard deviation (within)	**4.75**	**2.52**	**4.95**	**3.85**	**1.92**	**3.88**
Observations	**122**	**122**	**122**	**208**	**208**	**208**

Table 2: Correlation Matrix

		Productivity growth	Allocation component	Common component	Productivity growth	Allocation component	Common component
		5-year growth rates			3-year growth rates		
Productivity growth	**5-year growth rates**	**1**					
Allocation component	**5-year growth rates**	**0.186****	**1**				
Common component	**5-year growth rates**	**0.866*****	**-0.330*****	**1**			
Productivity growth	**3-year growth rates**				**1**		
Allocation component	**3-year growth rates**				**0.233*****	**1**	
Common component	**3-year growth rates**				**0.877*****	**-0.264*****	**1**

Graph 1: Financial booms and productivity slow-down



Graph 2: Financial booms and productivity growth components.

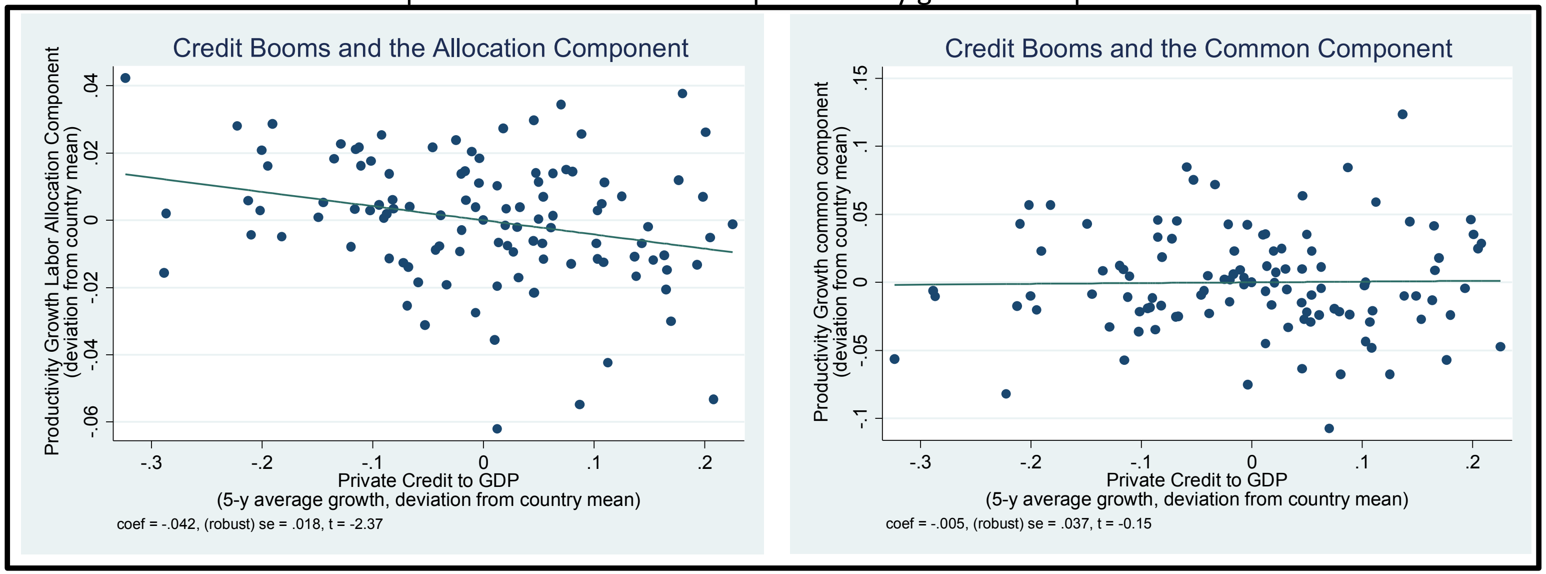


Table 3: Private credit to GDP growth, productivity growth and its components

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	Productivity Growth	Allocation component	Common component	Productivity Growth	Allocation component	Common component
Growth in private credit to GDP	**-0.0795**** *(0.0346)*	**-0.0522**** *(0.0205)*	**-0.0272** *(0.0394)*	**-0.0973***** *(0.0246)*	**-0.0305***** *(0.0113)*	**-0.0668**** *(0.0271)*
Initial private credit to GDP	0.0281 *(0.0361)*	-0.0164 *(0.0229)*	0.0445 *(0.0372)*	0.00915 *(0.0183)*	-0.00253 *(0.00871)*	0.0117 *(0.0197)*
Employment growth	-0.407*** *(0.0730)*	0.152*** *(0.0491)*	-0.559*** *(0.0874)*	-0.294*** *(0.0782)*	0.0852** *(0.0385)*	-0.379*** *(0.0847)*
Government consumption to GDP	-2.511*** *(0.733)*	0.228 *(0.423)*	-2.739*** *(0.718)*	-1.760*** *(0.423)*	0.110 *(0.216)*	-1.870*** *(0.461)*
CPI Inflation	-0.0316 *(0.0247)*	-0.0140 *(0.0143)*	-0.0176 *(0.0301)*	-0.0840** *(0.0352)*	-0.0179 *(0.0164)*	-0.0662 *(0.0424)*
Dummy for financial crisis	-0.0106 *(0.0116)*	0.0117 *(0.00786)*	-0.0223 *(0.0145)*	-0.00674 *(0.00740)*	0.00266 *(0.00461)*	-0.00940 *(0.00867)*
initial GDP per person employed (log of)	-0.362*** *(0.0543)*	-0.0197 *(0.0491)*	-0.343*** *(0.0884)*	-0.195*** *(0.0412)*	-0.0431* *(0.0230)*	-0.151*** *(0.0530)*
Observations	103	103	103	186	186	186
R-squared	0.837	0.555	0.848	0.706	0.343	0.665

Note: This table reports the estimated coefficient for independent variables reported in the first column, the dependent variable being aggregate productivity growth (columns (i) & (iv)), the allocation component (columns (ii) & (v)), the common component (columns (iii) & (vi)). Growth rates are computed using 5-year windows in estimations (i)-(iii), 3-year windows in estimations (iv)-(vi). All estimations include country and time fixed effects. Robust standard errors are in parentheses. Statistical significance at the 1%/5%/10% respectively indicated with ***/**/*.

Table 4: Private credit to GDP gap, productivity growth and its components

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	Productivity Growth	Allocation component	Common component	Productivity Growth	Allocation component	Common component
Average private credit to GDP gap	**-0.0753**** *(0.0211)*	**-0.0408*** *(0.0235)*	**-0.0344** *(0.0514)*	**-0.0819***** *(0.0254)*	**-0.0393***** *(0.0127)*	**-0.0427** *(0.0264)*
Initial private credit to GDP	0.0712 *(0.0465)*	0.0110 *(0.0200)*	0.0602 *(0.0368)*	0.0215 *(0.0143)*	-0.00262 *(0.00989)*	0.0241 *(0.0171)*
Employment growth	-0.433*** *(0.102)*	0.138** *(0.0530)*	-0.572*** *(0.0917)*	-0.176* *(0.0896)*	0.0883** *(0.0439)*	-0.264*** *(0.0944)*
Government consumption to GDP	-2.592** *(0.772)*	0.179 *(0.439)*	-2.770*** *(0.732)*	-2.293*** *(0.477)*	-0.0242 *(0.246)*	-2.269*** *(0.484)*
CPI Inflation	-0.0514** *(0.0174)*	-0.0178 *(0.0150)*	-0.0336 *(0.0303)*	-0.158*** *(0.0309)*	-0.0725*** *(0.0167)*	-0.0860** *(0.0366)*
Dummy for financial crisis	-0.0166 *(0.0182)*	0.00766 *(0.00784)*	-0.0243 *(0.0146)*	0.00228 *(0.00819)*	0.00999** *(0.00476)*	-0.00771 *(0.00760)*
initial GDP per person employed (log of)	-0.358*** *(0.0288)*	-0.0144 *(0.0547)*	-0.343*** *(0.0872)*	-0.244*** *(0.0373)*	-0.0299 *(0.0215)*	-0.214*** *(0.0455)*
Observations	100	100	100	154	154	154
R-squared	0.877	0.653	0.864	0.620	0.417	0.566

Note: This table reports the estimated coefficient for independent variables reported in the first column, the dependent variable being aggregate productivity growth (columns (i) & (iv)), the allocation component (columns (ii) & (v)), the common component (columns (iii) & (vi)). Growth rates are computed using 5-year windows in estimations (i)-(iii), 3-year windows in estimations (iv)-(vi). Private credit to GDP gap is the percentage deviation of private credit to GDP from trend (see Borio et al. 2011). All estimations include country and time fixed effects. Robust standard errors are in parentheses. Statistical significance at the 1%/5%/10% respectively indicated with ***/**/*.

Table 5: Productivity slow-down and private credit to GDP growth

Dependent variable: Aggregate Productivity Growth						
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Growth in Private Credit to GDP	**-0.0795****	**-0.0767****	**-0.0603*****	**-0.0973*****	**-0.0964*****	**-0.0459*****
	(0.0346)	*(0.0368)*	*(0.0184)*	*(0.0246)*	*(0.0242)*	*(0.0109)*
Allocation Component		0.0525			0.0295	
		(0.188)			*(0.153)*	
Common Component			0.704***			0.770***
			(0.0619)			*(0.0341)*
Observations	108	108	108	183	183	183
R-squared	0.878	0.878	0.962	0.727	0.727	0.935

Note: This table reports the estimated coefficients for independent variables reported in the first column, controlling for initial private credit to GDP, employment growth, government consumption to GDP, CPI Inflation, dummy for the occurrence of financial crises and initial log of GDP per person employed. Growth rates are computed using 5-year windows in estimations (i)-(iii), 3-year windows in estimations (iv)-(vi). All estimations include country and time fixed effects. Robust standard errors are in parentheses. Statistical significance at the 1%/5%/10% respectively indicated with ***/**/*.

Table 6: Productivity slow-down and private credit to GDP gap

Dependent variable: Aggregate Productivity Growth						
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Average Private Credit to GDP gap	**-0.0753****	**-0.0692**	**-0.0509****	**-0.0641****	**-0.0596***	**-0.0356*****
	(0.0211)	*(0.0488)*	*(0.0229)*	*(0.0315)*	*(0.0308)*	*(0.0126)*
Allocation Component		0.148			0.160	
		(0.179)			*(0.169)*	
Common Component			0.707***			0.789***
			(0.0716)			*(0.0376)*
Observations	100	100	100	154	154	154
R-squared	0.877	0.878	0.958	0.663	0.665	0.916

Note: This table reports the estimated coefficients for independent variables reported in the first column, controlling for initial private credit to GDP, employment growth, government consumption to GDP, CPI Inflation, dummy for the occurrence of financial crises and initial log of GDP per person employed. Private credit to GDP gap is the percentage deviation of private credit to GDP from trend (see Borio et al. 2011). Growth rates are computed using 5-year windows in estimations (i)-(iii), 3-year windows in estimations (iv)-(vi). All estimations include country and time fixed effects. Robust standard errors are in parentheses. Statistical significance at the 1%/5%/10% respectively indicated with ***/**/*.

Table 7: Dates for turning points in GDP to working population

	1969	**1973**	**1974**	**1975**	**1976**	**1977**	**1979**	**1980**	**1981**	**1982**	**1983**	**1985**	**1986**	**1987**	**1989**	**1990**	**1991**	**1992**	**1997**	**2000**	**2001**	**2002**	**2004**	**2007**	**2008**	**Total**
country																										
Australia		1			1				1			1				1										**5**
Austria						1		1			1							1							1c	**5**
Belgium			1		1			1										1							1c	**5**
Canada			1				1		1						1											**4**
Switzerland																					1				1c	**2**
Czech Republic																									1c	**1**
Germany																					1				1c	**2**
Denmark		1					1						1					1						1c		**5**
Spain			1			1c											1							1c		**4**
Finland				1											1c										1	**3**
France			1					1		1								1				1		1c		**6**
United Kingdom		1					1									1								1c		**4**
Greece																								1c		**1**
Ireland																								1c		**1**
Italy			1					1c									1					1	1	1c		**6**
Japan		1															1		1c					1		**4**
Luxembourg																								1		**1**
Netherlands			1					1													1				1c	**4**
Norway									1					1										1		**3**
Portugal			1					1		1c								1			1					**5**
Sweden					1			1							1c									1c		**4**
USA	1	1					1									1c				1				1c		**6**
Total	**1**	**5**	**7**	**1**	**3**	**2**	**4**	**7**	**3**	**2**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**5**	**1**	**1**	**4**	**2**	**1**	**12**	**7**	**81**

Table 8: Labour reallocation, sector-level productivity growth and credit expansion

Dependent variable: Aggregate Productivity Growth								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Allocation component	**35.03*** **	**49.33*** **	**46.93**	**51.89**	**73.44***	**94.14** **	**114.8*** **	**134.7*** **
	(10.58)	*(17.88)*	*(31.50)*	*(39.55)*	*(40.89)*	*(43.05)*	*(41.77)*	*(46.33)*
Common component	**4.516**	**20.93**	**20.52**	**24.88**	**33.04**	**45.32**	**61.18***	**76.78** **
	(12.03)	*(18.39)*	*(21.37)*	*(26.82)*	*(30.04)*	*(30.58)*	*(31.16)*	*(36.23)*
FC dummy	-0.683	-1.938**	-1.423	-1.560	-1.255	-1.221	-0.324	0.492
	(0.602)	*(0.767)*	*(0.940)*	*(1.361)*	*(1.638)*	*(1.782)*	*(1.916)*	*(2.131)*
Credit to GDP growth	-0.339	0.113	1.299	1.336	3.911	4.086	0.172	-0.300
	(2.542)	*(3.449)*	*(4.721)*	*(6.478)*	*(7.318)*	*(7.988)*	*(9.015)*	*(9.925)*
Observations	79	79	79	79	79	79	79	79
R-squared	0.563	0.690	0.691	0.665	0.650	0.636	0.643	0.654
H0: Allocation = Common	*0.0415*	*0.215*	*0.475*	*0.561*	*0.402*	*0.317*	*0.259*	*0.266*

Note: This table reports the estimated coefficients for each of the independent variables reported in the first column in the regression using as dependent variable aggregate labour productivity growth between peak and peak+n years, n being reported in parentheses in the second row of the table. Allocation (Common) refers to the allocation (common) component of labour productivity growth measured between peak-3 and peak as defined in equation (8) in section 2. FC dummy is equal to one if a financial crisis hits between peak-3 years and peak+2 years and equal to zero otherwise. Credit to GDP growth is measured from peak-3 years to peak. All regressions include the following unreported control variables: all real GDP and employment y-o-y growth rates between peak-3 and peak as well as country fixed effects. Robust standard errors are in parentheses. Statistical significance at the 1%/5%/10% respectively indicated with ***/**/*. The last row reports the p. value attached to the F-test where the null hypothesis is that the estimated coefficients for the two reported variable names are identical.

Table 9: Labour reallocation, sector-level productivity growth, credit expansion and financial crises

Dependent variable: Aggregate Productivity Growth								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Allocation component × FC	**85.67****	**204.1*****	**207.5****	**285.2****	**396.2*****	**466.6*****	**528.6*****	**615.5*****
	(40.09)	*(61.37)*	*(78.61)*	*(115.8)*	*(134.6)*	*(145.6)*	*(152.5)*	*(170.3)*
Allocation component × NFC	**31.30*****	**41.70****	**37.82**	**37.23**	**52.23**	**69.82***	**88.37****	**105.6****
	(11.06)	*(18.18)*	*(33.48)*	*(41.14)*	*(38.79)*	*(38.94)*	*(36.65)*	*(40.59)*
Common component × FC	**28.49**	**64.15***	**74.84***	**115.2****	**165.3*****	**196.8*****	**224.9*****	**254.1*****
	(24.12)	*(34.53)*	*(43.73)*	*(56.54)*	*(56.27)*	*(58.78)*	*(61.99)*	*(69.28)*
Common component × NFC	**8.021**	**37.37****	**35.77**	**44.86**	**59.30***	**75.84****	**95.95*****	**119.6*****
	(12.41)	*(18.36)*	*(22.95)*	*(28.78)*	*(30.58)*	*(31.17)*	*(32.75)*	*(37.06)*
FC dummy	-2.307**	-5.643**	-5.664*	-8.201**	-10.75***	-12.13***	-12.25***	-12.82**
	(1.098)	*(2.132)*	*(2.848)*	*(3.747)*	*(3.965)*	*(4.180)*	*(4.314)*	*(4.777)*
Credit to GDP growth	0.707	2.117	3.754	5.359	9.766	10.80	7.445	7.638
	(2.459)	*(3.515)*	*(5.148)*	*(6.686)*	*(6.632)*	*(7.046)*	*(8.134)*	*(8.811)*
Observations	79	79	79	79	79	79	79	79
R-squared	0.582	0.732	0.719	0.702	0.706	0.697	0.704	0.718
H0: Alloc × FC = Alloc × NFC	*0.207*	*0.019*	*0.059*	*0.047*	*0.018*	*0.011*	*0.007*	*0.004*
H0: Com × FC = Com × NFC	*0.296*	*0.309*	*0.196*	*0.080*	*0.014*	*0.008*	*0.007*	*0.011*
H0: Alloc × FC = Com × FC	*0.121*	*0.003*	*0.025*	*0.046*	*0.029*	*0.020*	*0.012*	*0.009*
H0: Alloc × NFC = Com × NFC	*0.153*	*0.856*	*0.960*	*0.875*	*0.877*	*0.895*	*0.867*	*0.765*

Note: This table reports the estimated coefficients for each of the independent variables reported in the first column in the regression using as dependent variable aggregate labour productivity growth between peak and peak+n years, n being reported in parentheses in the second row of the table. Allocation (Common) refers to the allocation (common) component of labour productivity growth measured between peak-3 and peak as defined in equation (8) in section 2. FC dummy is equal to one if a financial crisis hits between peak-3 years and peak+2 years and equal to zero otherwise. Credit to GDP growth is measured from peak-3 years to peak. A variable name followed by the sign × FC (× NFC) indicates an interaction term which is equal to the variable when the financial crisis dummy is equal to one (equal to zero) and equal to zero (equal to the variable) otherwise. All regressions include the following unreported control variables: all real GDP and employment y-o-y growth rates between peak-3 and peak as well as country fixed effects. Robust standard errors are in parentheses. Statistical significance at the 1%/5%/10% respectively indicated with ***/**/*. The four last rows report the p. value attached to the F-test where the null hypothesis H0 is that the estimated coefficients for the two reported variables are identical.

Table 10: Labour reallocation, sector-level productivity growth, credit expansion and financial crises

Dependent variable: Aggregate Labour Productivity Growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Allocation × FC	**77.57***	**183.3*****	**214.6*****	**322.7*****	**474.7*****	**546.6*****	**594.4*****	**663.1*****
	(41.48)	*(63.73)*	*(77.83)*	*(111.7)*	*(123.9)*	*(138.2)*	*(149.2)*	*(170.3)*
Allocation × NFC	**32.76*****	**45.47****	**36.53**	**30.44**	**38.01**	**55.32**	**76.44****	**97.00****
	(10.84)	*(18.16)*	*(34.14)*	*(42.28)*	*(39.36)*	*(39.27)*	*(36.97)*	*(41.83)*
Common × FC	**22.63**	**49.08**	**80.00***	**142.4****	**222.2*****	**254.8*****	**272.6*****	**288.6*****
	(28.87)	*(34.17)*	*(44.41)*	*(57.55)*	*(54.81)*	*(55.48)*	*(59.32)*	*(66.91)*
Common × NFC	**8.169**	**37.75****	**35.64**	**44.18**	**57.86***	**74.38****	**94.74*****	**118.8*****
	(12.40)	*(18.60)*	*(23.20)*	*(28.66)*	*(28.84)*	*(29.18)*	*(31.33)*	*(36.34)*
FC dummy	-1.669	-4.003	-6.226**	-11.16***	-16.94***	-18.44***	-17.44***	-16.58***
	(1.518)	*(2.463)*	*(3.061)*	*(3.866)*	*(4.071)*	*(4.390)*	*(4.783)*	*(5.434)*
Credit to GDP growth × FC	-1.373	-3.228	5.586	14.98	29.93***	31.35***	24.36*	19.87
	(5.199)	*(5.955)*	*(7.018)*	*(9.338)*	*(9.572)*	*(10.54)*	*(12.18)*	*(13.60)*
Credit to GDP growth × NFC	1.557	4.299	3.006	1.430	1.534	2.406	0.539	2.642
	(2.580)	*(4.060)*	*(5.875)*	*(7.387)*	*(7.392)*	*(7.949)*	*(9.344)*	*(10.32)*
Observations	79	79	79	79	79	79	79	79
R-squared	0.585	0.738	0.719	0.709	0.731	0.719	0.716	0.723
H0: Alloc × FC = Alloc × NFC	*0.312*	*0.054*	*0.047*	*0.018*	*0.002*	*0.001*	*0.002*	*0.002*
H0: Com × FC = Com × NFC	*0.559*	*0.674*	*0.180*	*0.025*	*0.000*	*0.000*	*0.000*	*0.002*
H0: Alloc × FC = Com × FC	*0.118*	*0.005*	*0.023*	*0.030*	*0.009*	*0.007*	*0.005*	*0.005*
H0: Alloc × NFC = Com × NFC	*0.138*	*0.744*	*0.983*	*0.782*	*0.668*	*0.678*	*0.683*	*0.645*

Note: This table reports the estimated coefficients for each of the independent variables reported in the first column in the regression using as dependent variable aggregate labour productivity growth between peak and peak+n years, n being reported in parentheses in the second row of the table. Allocation (Common) refers to the allocation (common) component of labour productivity growth measured between peak-3 and peak as defined in equation (8) in section 2. FC dummy is equal to one if a financial crisis hits between peak-3 years and peak+2 years and equal to zero otherwise. Credit to GDP growth is measured from peak-3 years to peak. A variable name followed by the sign × FC (× NFC) indicates an interaction term which is equal to the variable when the financial crisis dummy is equal to one (equal to zero) and equal to zero (equal to the variable) otherwise. All regressions include the following unreported control variables: all real GDP and employment y-o-y growth rates between peak-3 and peak as well as country fixed effects. Robust standard errors are in parentheses. Statistical significance at the 1%/5%/10% respectively indicated with ***/**/*. The four last rows report the p. value attached to the F-test where the null hypothesis H0 is that the estimated coefficients for the two reported variables are identical.

Table 11: Labour reallocation, sector-level productivity growth, credit expansion and financial crises

Dependent variable: Aggregate Labour Productivity Growth								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Allocation × FC	**73.58**	**111.0***	**136.7***	**215.6****	**306.0****	**345.1****	**372.5****	**418.2****
	(44.89)	*(64.66)*	*(74.43)*	*(102.8)*	*(125.2)*	*(141.2)*	*(156.8)*	*(178.4)*
Allocation × NFC	**23.86***	**33.98**	**24.99**	**18.90**	**24.86**	**38.51**	**54.86**	**71.02**
	(11.83)	*(20.53)*	*(33.16)*	*(38.95)*	*(37.27)*	*(37.26)*	*(37.75)*	*(45.17)*
Common × FC	**26.30**	**33.37**	**63.26**	**108.6***	**155.9****	**174.6****	**175.6****	**185.3****
	(21.72)	*(34.20)*	*(42.72)*	*(55.18)*	*(58.62)*	*(65.17)*	*(72.69)*	*(82.42)*
Common × NFC	**8.905**	**30.46**	**30.52**	**34.88**	**43.16**	**54.81***	**61.59***	**77.26***
	(10.60)	*(18.40)*	*(23.82)*	*(30.12)*	*(30.75)*	*(31.76)*	*(33.96)*	*(40.27)*
FC dummy	-2.795	-3.240	-5.833	-11.17**	-16.14***	-17.18***	-16.10**	-15.24*
	(2.008)	*(3.228)*	*(3.737)*	*(4.744)*	*(5.620)*	*(6.344)*	*(7.100)*	*(7.768)*
Credit to GDP growth × FC	0.924	-2.526	5.121	13.31	24.07**	24.93*	18.31	14.60
	(4.801)	*(5.854)*	*(6.694)*	*(9.573)*	*(11.63)*	*(13.41)*	*(15.76)*	*(17.63)*
Credit to GDP growth × NFC	0.566	3.478	2.341	0.247	0.286	0.145	-2.838	-1.461
	(2.249)	*(3.569)*	*(5.165)*	*(6.581)*	*(6.728)*	*(6.931)*	*(7.753)*	*(8.595)*
Observations	77	77	77	77	77	77	77	77
R-squared	0.598	0.713	0.713	0.695	0.694	0.674	0.667	0.672
H0: Alloc × FC = Alloc × NFC	*0.287*	*0.255*	*0.172*	*0.075*	*0.0357*	*0.038*	*0.049*	*0.057*
H0: Com × FC = Com × NFC	*0.323*	*0.911*	*0.278*	*0.063*	*0.015*	*0.022*	*0.049*	*0.093*
H0: Alloc × FC = Com × FC	*0.213*	*0.066*	*0.137*	*0.123*	*0.082*	*0.077*	*0.061*	*0.058*
H0: Alloc × NFC = Com × NFC	*0.261*	*0.857*	*0.873*	*0.709*	*0.651*	*0.677*	*0.866*	*0.889*

Note: This table reports the estimated coefficients for each of the independent variables reported in the first column in the regression using as dependent variable aggregate labour productivity growth between peak and peak+n years, n being reported in parentheses in the second row of the table. Allocation (Common) refers to the allocation (common) component of labour productivity growth measured between **peak-4 and peak** as defined in equation (8) in section 2. FC dummy is equal to one if a financial crisis hits between peak-3 years and peak+2 years and equal to zero otherwise. Credit to GDP growth is measured from **peak-4 years to peak**. A variable name followed by the sign × FC (× NFC) indicates an interaction term which is equal to the variable when the financial crisis dummy is equal to one (equal to zero) and equal to zero (equal to the variable) otherwise. All regressions include the following unreported control variables: all real GDP and employment y-o-y growth rates between **peak-4 and peak** as well as country fixed effects. Robust standard errors are in parentheses. Statistical significance at the 1%/5%/10% respectively indicated with ***/**/*. The four last rows report the p. value attached to the F-test where the null hypothesis H0 is that the estimated coefficients for the two reported variables are identical.

Table 12: Labour reallocation, sector-level productivity growth, credit expansion and financial crises

Dependent variable: Aggregate Labour Productivity Growth								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Allocation × FC	**112.4****	**222.4*****	**246.4*****	**363.1*****	**504.0*****	**579.8*****	**626.6*****	**697.5*****
	(42.94)	*(67.43)*	*(76.35)*	*(96.11)*	*(109.1)*	*(120.3)*	*(130.1)*	*(149.6)*
Allocation × NFC	**28.02****	**41.36****	**29.22**	**21.11**	**27.60**	**44.85**	**67.00***	**84.58****
	(11.41)	*(19.98)*	*(33.43)*	*(39.15)*	*(34.53)*	*(34.97)*	*(34.87)*	*(39.88)*
Common × FC	**51.39***	**79.32***	**111.4****	**186.9*****	**266.6*****	**302.9*****	**316.0*****	**332.6*****
	(28.68)	*(42.06)*	*(51.96)*	*(59.82)*	*(55.22)*	*(55.80)*	*(60.87)*	*(70.82)*
Common × NFC	**11.67**	**41.42****	**37.88***	**50.02***	**64.46****	**82.01*****	**101.5*****	**121.7*****
	(11.87)	*(17.64)*	*(20.97)*	*(25.02)*	*(25.20)*	*(26.26)*	*(28.65)*	*(33.69)*
FC dummy	-3.742***	-6.467**	-8.156**	-13.05***	-17.71***	-19.37***	-18.47***	-18.34***
	(1.362)	*(2.734)*	*(3.392)*	*(3.719)*	*(3.655)*	*(3.743)*	*(4.020)*	*(4.635)*
Credit to GDP gap × FC	0.0677	0.0540	0.138	0.253**	0.380***	0.401***	0.329**	0.300**
	(0.0405)	*(0.0698)*	*(0.0837)*	*(0.104)*	*(0.0972)*	*(0.104)*	*(0.123)*	*(0.145)*
Credit to GDP gap × NFC	0.00436	0.0410	-0.00376	-0.0199	-0.0261	-0.0119	-0.0287	-0.0418
	(0.0217)	*(0.0427)*	*(0.0559)*	*(0.0709)*	*(0.0639)*	*(0.0663)*	*(0.0698)*	*(0.0789)*
Observations	79	79	79	79	79	79	79	79
R-squared	0.602	0.739	0.731	0.731	0.751	0.737	0.729	0.734
H0: Alloc × FC = Alloc × NFC	*0.069*	*0.020*	*0.020*	*0.002*	*0.000*	*0.000*	*0.000*	*0.000*
H0: Com × FC = Com × NFC	*0.104*	*0.274*	*0.064*	*0.003*	*0.000*	*0.000*	*0.000*	*0.000*
H0: Alloc × FC = Com × FC	*0.103*	*0.002*	*0.012*	*0.013*	*0.006*	*0.004*	*0.002*	*0.003*
H0: Alloc × NFC = Com × NFC	*0.308*	*0.998*	*0.837*	*0.547*	*0.388*	*0.386*	*0.423*	*0.413*

Note: This table reports the estimated coefficients for each of the independent variables reported in the first column in the regression using as dependent variable aggregate labour productivity growth between peak and peak+n years, n being reported in parentheses in the second row of the table. Allocation (Common) refers to the allocation (common) component of labour productivity growth measured between peak-3 and peak as defined in equation (8) in section 2. FC dummy is equal to one if a financial crisis hits between peak-3 years and peak+2 years and equal to zero otherwise. Credit to GDP gap is the average percentage deviation of credit to GDP from trend measured between peak-3 and peak. A variable name followed by the sign × FC (× NFC) indicates an interaction term which is equal to the variable when the financial crisis dummy is equal to one (equal to zero) and equal to zero (equal to the variable) otherwise. All regressions include the following unreported control variables: real GDP and employment y-o-y growth rates between peak-3 and peak as well as country fixed effects. Robust standard errors are in parentheses. Statistical significance at the 1%/5%/10% respectively indicated with ***/**/*. The four last rows report the p. value attached to the F-test where the null hypothesis H0 is that the estimated coefficients for the two reported variables are identical.

Graph 3: The effect of labour reallocation and financial crises on the productivity path