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CAPITAL MISALLOCATION AND FINANCIAL DEVELOPMENT: A SECTOR-LEVEL ANALYSIS

by Daniela Marconi* and Christian Upper*

Abstract

This study investigates how financial development affects capital allocation across industries in a panel of countries at different stages of development (China, India, Mexico, Korea, Japan and the US) over the period 1980-2014. Following the approach proposed by Chari et al (2007) and Aoki (2012), we compute wedges for capital and labour inputs for 26 industrial sectors in the six countries and add them up to economy-wide measures of capital and labour misallocation. We find that more developed financial systems allocate capital investment more efficiently than less developed ones. If financial development is low, faster capital accumulation is associated with a worsening of allocative efficiency. This effect reverses for higher levels of financial development. Sectors with high R&D expenditures or high capital investment benefit most from financial development. These effects are not only statistically significant, they are also large in economic terms.

JEL Classification: E22, E23, O16, O47.
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Contents

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1. Introduction

Financial intermediaries perform a number of functions that stimulate growth. First, they channel funds from savers to investors. Banks and other financial intermediaries such as fund managers and insurance firms bundle savings and allocate them to investment projects. This allows them to finance investment projects that would be too large to handle for any individual saver. For savers, financial intermediation provides a degree of diversification that is not available from un-intermediated investments. Second, financial intermediaries screen investment projects and allocate capital to those with sufficiently high payoffs. Third, they monitor these investments and exert corporate governance. Last but not least, they offer payment and liquidity services, which eases the exchange of goods and services and mitigates the transfer problem that arises from imperfectly timed incoming and outgoing payments. Given all these useful functions, one would expect a straightforward positive relationship between financial development and growth. It is thus little surprising that the empirical evidence reviewed in Levine (2005) and in the recent metastudy by Havránek et al. (2015) suggests that countries with more developed banks and financial markets grow faster. That said, there appear to be diminishing returns to financial development and there might be a point beyond which a further expansion of financial intermediation has either no or even an adverse impact on economic growth (Rioja and Valev, 2004; Aizenman et al, 2015; Arcand et al, 2012; Cecchetti and Kharroubi, 2012; Sahay et al, 2015).

A positive relationship between financial development and growth begs the question of what the precise channels are through which finance affects growth. Levine (2005) conjectures that this needs to come primarily through how financial development affects the allocation of resources in an economy rather through higher capital accumulation, as the empirical growth literature has found that the latter per se is not a sufficient determinant of long-term growth. Levine's conjecture is in line with a sizable body of studies that finds that financial frictions result in capital misallocation (Banerjee and Duflo, 2005; Buera et al., 2011; Midrigan and Xu, 2014; Sahay et al., 2015). Their impact could be quite large. For instance, calibrations of the model in Buera et al indicate that differences in financial frictions can explain up to 80% of the difference in output per worker between Mexico and the United States.[1] While established firms may overcome financial frictions through the internal generation of funds, this option is not available to firms newly entering a market or upgrading to a technology requiring investments far in excess of past profits. Self-financing also takes time, which means that sizable misallocations could exist for prolonged periods even if it disappears eventually (Moll, 2014).[2]

[1] The importance of financial frictions for misallocation has been questioned by Gilchrist et al (2013), who find that the dispersion in (observed) borrowing costs in the US manufacturing sector is too small to generate sizable losses in total factor productivity (TFP). That said, their sample consists of firms large enough to issue publicly-traded debt in one of the most financial developed economies in the world. As the authors acknowledge, the impact of financial frictions could be much larger in financially less developed economies.

[2] A large body of literature find that firm investment decisions are highly sensitive to bank credit availability, especially in countries with a large share of small firms (Cingano et al., 2016; Manaresi and Pierri, 2017).

But even if a more developed financial system is conducive to growth, this does not mean that more finance is always good. Unwanted effects of credit growth on resource misallocation could arise for a number of reasons. For instance, credit booms may tilt the composition of investment to projects that are easier to finance and crowd out more productive but riskier projects. Or they may reduce incentives to entry and exit. For instance, Cecchetti and Kharroubi (2017) document in a panel of advanced countries that the output per worker falls if credit grows beyond a certain threshold, especially in industries with high R&D expenditure or many intangible assets. Similarly, the large capital inflows into Portugal after the creation of the euro resulted in a rapid growth in the non-tradable sector (Reis, 2013) and in a reduced exit of low productivity firms (Dias et al., 2016), two factors that help explain the dismal performance of the Portuguese economy in the wake of the global financial crisis. In Spain, the decline in real rates after the creation of the euro appears to have raised the dispersion of the return on capital across firms, a clear sign of capital misallocation (Gopinath et al 2017).[3] More generally, Borio et al (2015) show that rapid credit growth is associated with an inefficient allocation of labour across sectors in a large panel of advanced economies. Such labour misallocations can have long-lasting effects, particularly when the credit boom ends in a financial crisis.

In this paper we analyse how financial development affects capital allocation across industries in a panel of countries at different stages of development. We adopt the wedge-accounting framework of Chari et al (2007), later extended to a multi-sectoral setting by Aoki (2012). In this model, any distortions that lead to a misallocation of resources relative to the frictionless benchmark translate into implicit taxes or subsidies faced by the representative firm in each industry. Unlike most of the previous literature, we measure the misallocation of capital and labour across different sectors rather than across individual firms within one industry.[4] This means, for example, that we are concerned whether physical capital is concentrated in the (less productive) construction or the more productive IT industry, and not whether less productive construction firm A absorbs more capital than the more productive construction firm B. We believe that a sector level analysis is better suited to capture the unwanted effects of financial development discussed above than data on firms within a single industry. Moreover, sector-level data allows us to compute aggregate measures of resource misallocation for a long time span, which would be

[3] This finding is controversial, though. García-Santana et al (2016) also find a sizable misallocation of factors in the Spanish economy during the 1994-2007 expansion, but argue that this did not reflect financial factors as industries heavily dependent on finance did not show a larger degree of misallocation than those less reliant on external funding. Instead, the size of misallocation appears to be correlated with the degree to which a sector is prone to government intervention. García-Santana et al. do not consider capital or labour misallocations across industries. Similarly, using a broader sample of industries than Gopinath et al (2017), Gamberoni et al (2016) find that a reduction in the cost of credit tends to be associated with a reduction, not an increase, in misallocation.

[4] Firm-level studies include Hsieh and Klenow (2009), Bartelsman et al (2013), Dias et al (2016) and Gopinath et al (2017)). They focus on misallocation between different firms within the same industry mainly for methodological reasons, as it reduces the impact of differences in demand across industries.

impossible with a small sample of firms in each given country.[5] To our knowledge, this is the first attempt to relate cross-sector capital misallocation and financial development across countries. The cross-country analysis is crucial to identify the heterogeneity of misallocation patterns in relation to the different level of financial development.

An important contribution of our paper is the use of a broader concept of financial development than just the size of the financial sector. Levine (2005) defines financial development as an improvement of the financial system in performing the functions outlined at the beginning of this section. Of course, this is not observable and only loosely related to often-used proxies such as total credit outstanding or the capitalization of the stock market. More recent work has attempted to tackle the issue by constructing more sophisticated indicators of financial development. In this paper, we use the financial development index constructed by Sahay et al (2015), which is based on previous work by Čihák et al (2013) as well as earlier contributions. The indicator measures the depth, accessibility and efficiency[6] of both financial institutions and markets. Financial institution depth, for instance, is measured by the amount of private sector credit outstanding, pension fund and mutual fund assets and the total volume of insurance premiums; access by the number of bank branches and ATMs per population; and efficiency by net interest margins and bank profitability measures. To be sure, these variables are only loosely related to the ability of the financial system to perform the functions outlined above, but they nonetheless represent a considerable advance over measures exclusively based on size. As it turns out, changes in the index proposed by Sahay et al (2015) are largely uncorrelated with growth in the credit-to-GDP ratio or financial sector employment, two variables often used to capture credit and financial booms, despite their correlation in levels.

Our methodology requires good-quality and comparable industry-level data, which limits both the length of the sample and the number of countries, especially emerging market economies, we are able to consider. We use sector-level data from WORLD KLEMS, which to our knowledge are the most comparable across countries available to the general public.[7] Our sample covers China, India, Korea and Mexico, which are the only emerging market economies for which we have long time series for sector-level and quality-adjusted labour and capital stocks. We complement this with data for Japan and the United States, two economies with a high degree of financial development. We believe that our relatively small sample covering countries at different stages of financial development can teach us much more about how financial development affects the allocation of capital than a broader sample covering primarily advanced economies. Also, the relatively long time-series dimension allow us to compare stages

[5] As emphasized by Restuccia and Rogerson (2017), at firm level, it is very difficult to come up with a quantitative measures of underlying sources of misallocation.

[6] Čihák et al (2013) also include a measure of financial stability.

[7] Alternative industry-level databases, such as the WIOD (SEA) database, are available for a large sample of advanced and emerging and developing countries, however they suffer from lower cross-country comparability, as data are collected from non-harmonized national sources.

of development more clearly. For instance, in China, financial development in 2010 was comparable to US level in 1989.

Our estimates show that more developed financial systems are better able to channel capital to productive sectors than those that are less developed. In countries with underdeveloped financial systems, a rise in capital accumulation tends to be associated with a reduction in allocative efficiency. But this effect reverses in countries with more developed financial systems, where more investment tends to go hand in hand with a better allocation of resources, indicating that financial markets and institutions are key to channel investment towards more productive sectors.

Our results are in line with previous findings in the literature, such as Ciccone and Papaioannou (2010), who conclude that financial development facilitates the reallocation of capital from declining industries to industries with good investment opportunities, and Fisman and Love (2007), who find that industries with good growth opportunities grow more rapidly in countries with well-developed financial markets.

Our methodology provides estimates on the implicit taxes and subsidies in each sector of the economy at every given period, so we are also able to shed light on which sectors are affected most by financial development. It turns out that sectors that are more investment intensive and those that invest more in R&D benefit more from a more developed financial system. These effects could be quite large. For example, bringing Mexico's financial system to the US level would virtually eliminate the differences in the losses owing to misallocation between the two countries. These gains would also be substantial for China and India.

The paper is structured as follows. The next section lays out our analytical framework. Sections 2 and 3 present the data and our estimated allocation measures, respectively. Sections 4 and 5 form the core of our paper, presenting estimates at the country (section 4) and sector (section 5) level. A final section concludes.

2. Measuring misallocation

To measure misallocation, we adopt the framework developed by Aoki (2012). In each country *i*, there are *N* sectors that combine in a Cobb-Douglas fashion to generate aggregate real value added:

$$V_{it} = \prod_{j=1}^{N} V_{ijt}^{\emptyset_{ijt}} , \tag{1}$$

where V_{it} denotes aggregate real value added (or GDP) of country *i* and V_{ijt} sector *j*'s value added in country *i*. The nominal sector shares , $\emptyset_{ijt}$ add up to one, ie $\sum_{J=1}^{N} \emptyset_{ijt} = 1$.

Labour (L_i) and capital (K_i) stocks in country *i* are exogenous (from now on we drop the time index for simplicity). In each country *i*, firms in sector *j* hire capital (K_{ij}) and labor (L_{ij}) inputs to maximize profits, taking the price of output (P_{ij}), the price of capital (P_{ki}), the price of labor (P_{Li}) as given. Firms also face sector-specific frictions on capital (τ_{Kij}) and labour (τ_{Lij}) that make the effective price of factors vary across sectors. Firms have Cobb-Douglas production functions with constant returns to scale: $V_{ij} = A_{ij}{K_{ij}}^{\alpha_j}{L_{ij}}^{1-\alpha_j}$. Capital intensities α_j vary across sectors and total factor productivity (TFP) A_{ij} across both sectors and countries.

The maximization problem of the representative firm in sector *j* and country *i* is:

$$max_{\{K_{ij},L_{ij}\}} P_{ij}A_{ij}{K_{ij}}^{\alpha_j}{L_{ij}}^{1-\alpha_j} - (1+\tau_{Kij})P_{ki}K_{ij} - (1+\tau_{Lij})P_{Li}L_{ij}; j=1,\ldots,n. \quad (2)$$

The first order conditions imply $P_{ij}\frac{\partial V_{ij}}{\partial K_{ij}} = (1+\tau_{Kij})P_{Ki}$ and $P_{ij}\frac{\partial V_{ij}}{\partial L_{ij}} = (1+\tau_{Lij})P_{Li};\ \forall j, j = 1, \ldots N$.

Imposing the market clearing in the factor markets in each country, $\sum_{j=1}^{N} K_{ij} = K_i$ $\sum_{j=1}^{N} L_{ij} = L_i$, and solving for the equilibrium allocations with and without frictions, we can express capital and labour wedges as follows:

$$wedge_{K_{ij}} \equiv K\_GAP_{ij} = \left(\frac{K_{ij}}{K_i}\right)^{*} / \left(\frac{K_{ij}}{K_i}\right) = \frac{(1+\tau_{Kij})}{\sum_s (1+\tau_{Kis})K_{is}/K_i} \quad (3)$$

$$wedge_{L_{ij}} \equiv L\_GAP_{ij} = \left(\frac{L_{ij}}{L_i}\right)^{*} / \left(\frac{L_{ij}}{L_i}\right) = \frac{(1+\tau_{Lij})}{\sum_s (1+\tau_{Lis})L_{is}/L_i} \quad (4)$$

Where $\left(\frac{K_{ij}}{K_i}\right)^{*}$ and $\left(\frac{L_{ij}}{L_i}\right)^{*}$ indicate the shares of labour and capital that would result in the absence of any frictions. In this framework, the wedge represents the ratio between the frictionless and the actual share of sector *j* in the factor market, which depends on the relative productivity of the factor in sector *j*. If the ratio is greater (lower) than one, then the factor is more (less) productive than in the average sector, suggesting that something is holding back the sector from hiring more of that factor (or encouraging it to over-accumulate it).

Capital and labour misallocations translate into aggregate TFP losses that can be computed as follows:[8]

$$TFPL\_K_i = \left| \sum_j \emptyset_{ij} * \alpha_j \left[\underbrace{ln\left(\frac{K_{ij}}{K_i}\right) - ln\left(\frac{K_{ij}}{K_i}\right)^{*}}_{-\ln(K\_GAP_{ij})} \right] \right| \quad (5)$$

$$TFPL\_L_i = \left| \sum_j \emptyset_{ij} * (1-\alpha_j) \left[\underbrace{ln\left(\frac{L_{ij}}{L_i}\right) - ln\left(\frac{L_{ij}}{L_i}\right)^{*}}_{-\ln(L\_GAP_{ij})} \right] \right| \quad (6)$$

where $TFPL\_K_i$ is the fraction of aggregate TFP losses due to the misallocation of the capital in country *i* and $TFPL\_L_i$ is the loss due to the misallocation of labour. The sum of both gives the total productivity loss experienced by economy *i* and corresponds to the amount of real output forgone by not shifting capital and labor inputs from less productive to more productive sectors. This means that at each point in time, the economy could produce more with the same total amount of capital and labor inputs if sectors were to hire capital and labor according to their relative productivity. To the extent that

[8] For the derivation of these expressions, see Di Stefano and Marconi (2016).

differences in the average product of capital and labour may also reflect technological barriers to factor reallocation, or other inefficiencies such as investment costs, this framework provides an upper bound on the losses from misallocation.

A number of issues need to be kept in mind when interpreting the estimated wedges. First, the benchmark capital shares in the frictionless economy are only optimal given the observed technology and market structure at a given point in time. In this regard, we are doing a second-best analysis. For example, imperfect competition in the output market would boost P_{ij} of a particular sector and the optimal response in our world would be to increase the incentives to allocate more resources to it. Of course, this may not be the optimal response in a first best world, where one would address the frictions that lead to imperfect competition in the first place. A similar point arises in the presence of unsustainable price developments, for instance a housing bubble. Rising house prices would boost the output price P_{ij} of the construction and real estate sectors, so the optimal response of firms would be to hire more labour and increase their capital stock. Inefficiencies would only show up if it is not possible to shift this capital and labour to other sectors once the bubble bursts and P_{ij} falls.

Another issue concerns measurement. When calculating wedges, we assume that capital and labour is either homogenous or measured in a way that fully reflects quality differences across sectors, that there is perfect competition in the factor market, and that factors can be reallocated across sectors without any cost. Any violation of these assumptions will show up as an upward bias in our estimated TFP losses. We deal with these issues by focusing on the rate of change rather than absolute levels of TFP losses, and by considering measures of labour and capital adjusted for their composition as provided in WORLD KLEMS data. In particular, the labour input is adjusted to take into account the share of low, medium and high skilled workers employed in each sector, while the capital stock is adjusted for composition effects across different types of capital assets.

Despite the limitations of the model, our evidence points to very reasonable cross-country differences in the allocative efficiency, with the US, generally considered the "frontier" country, proving to be the economy with the lowest level of frictions on both labour and capital markets.

3. Data

We compute wedges and aggregate TFP losses from data on value added, labour input, capital input, and factor payments for 26 sectors for China, India, Korea, Mexico, Japan and the United States. The data is from WORLD KLEMS,[9] which provides harmonised and quality-adjusted information on services flows related to different types of tangible and intangible capital assets and labour of different skills. The sample period varies across countries: 1981-2011 for India and Japan; 1980-2010 for China, 1980-2010 for US,

[9] KLEMS stand for K-capital, L-labor, E-energy, M-materials, and S-purchased services.

1980-2012 for Korea and 1990-2014 for Mexico. Our 26 sectors exclude public administration and cover agriculture, 13 manufacturing sectors, mining, construction, utilities, real estate and 8 service sectors (see appendix Table A1 for a complete list).

Factor intensities are computed from labour and capital compensation, which are provided under the assumption of constant return to scale. As a consequence, they sum up to one in each sector. According to WORLD KLEMS data, less developed countries are more capital intensive than advanced economies, which seems at odds with their relative technological backwardness. We believe that this finding is likely to reflect measurement problems, perhaps because of greater labour market informality. As is standard in the literature[10], we therefore use sectoral factor intensities computed from US data over the entire sample period. Using country-specific factor intensities would yield an even larger degree of misallocation (see Figure A1 in the appendix).

We measure financial development (FD) with the index developed by Sahay et al. (2015). Their FD index is a synthetic measure of the development of institutions (bank and non-banks) and markets along three dimensions: depth, access and efficiency. We consider the broad index as well as the sub-indices for institutions (FI) and markets (FM), to uncover which dimension, if any, affects the allocation of capital across sectors. The main index and the sub-indices range between 0 (no development) and 1 (maximum level of development). Graph A2 in the appendix shows the evolution of the FD index, while table A2 describes its different dimensions and the variables used to compute them.[11]

According to the FD index, the financial systems in all six countries in our sample have become more developed, although at different speeds. In the United States, the index rose rapidly in the first half of our sample, following liberalization measures such as the abolition of interest rate regulations in the 1980s and the repeal of the Glass-Steagall act in the mid and late 1990s. Since the late 1990s, the index hovered around 0.9. The financial sectors of the other two advanced economies of our sample, Japan and Korea, developed more gradually. The index rose from less than 0.4 in the early 1980s to values above 0.8 after 2005. Financial development in the three EMEs falls significantly short of the level seen in the advanced economies. The index for China rose to 0.6 in 2012,[12] with financial intermediation lagging behind market development. India and Mexico started around 0.25 and ended the sample period around 0.4. While the

[10] See e.g. Hsieh and Klenow (2009) and, for further discussion, Di Stefano and Marconi (2016).

[11] A shortcoming of this and the other measures for financial development that we are aware of is that they do not distinguish between genuine financial development and the effects of risk taking. But we believe that this problem is not as severe as it may sound. First, the index contains many variables that are not affected by risk taking, for example the number of bank branches or ATMs. Second, risk-taking may affect different components of the index in the opposite way. For instance, it may push up the FI depth index that contains variables such as the ratio of credit or pension fund assets to GDP but it may push down the FI efficiency index through its effects on margins and spreads.

[12] The example of China also shows the pitfalls of using simple measures of the *size* of financial intermediation to measure development. The ratio of broad measures of money to GDP – a commonly used proxy of financial development – is higher in China than in the United States, in part because households do not have many alternative savings vehicles due to financial underdevelopment.

Indian financial reforms of the 1990s are clearly visible in the series, those in Mexico after the financial crisis of 1994-5 are not. They may have increased the stability of the Mexican financial system (as indicated by the absence of a crisis despite sizable shocks), but apparently did not result in more financial development.

4. Misallocation at a glance

Figure 1 summarises the total TFP losses arising from labour and capital misallocation computed from equations (5) and (6) for the six countries in our sample countries. They correspond to the increase in TFP that could be attained by miraculously reallocating the existing capital and labour stock in the most efficient way. Our estimates suggest substantial TFP losses in all countries of our sample, although especially the less developed ones. During 2005-2009, TFP in India was on average 37% below the maximum attainable given the existing stock of labour and capital. In China, the shortfall was 31%, in Mexico 28%, in South Korea 27%, in Japan 18% and in the United States 9.5%. These numbers are substantial.

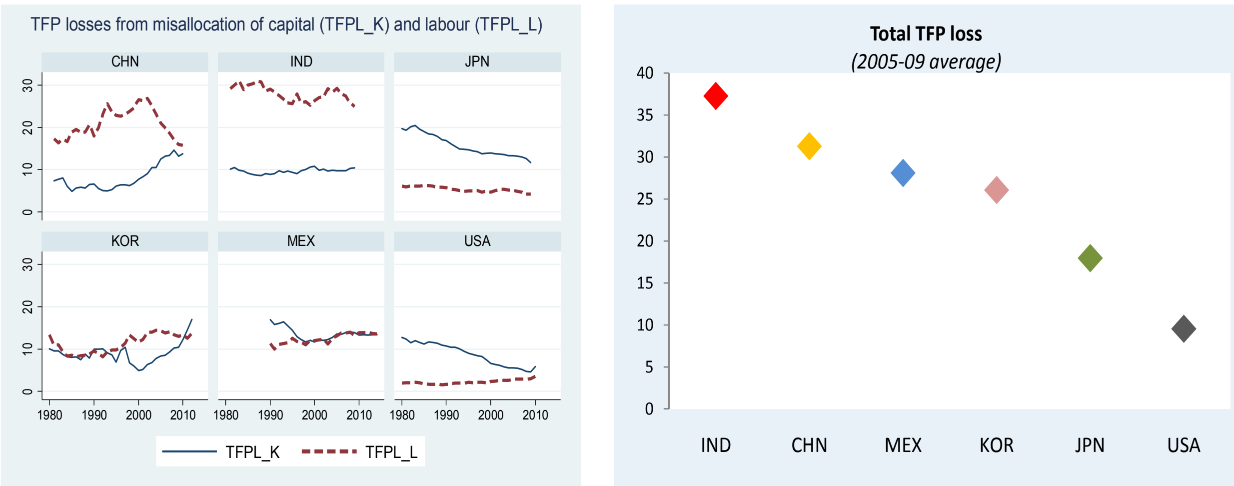


Figure 1. TFP losses from factors' misallocation as % of efficient level

Source: authors' calculations on WORLD KLEMS data

The sources of misallocation differ between advanced and less advanced economies. In China and India, labor misallocation is the main source of aggregate inefficiency, whereas in more advanced economies, such as Japan and the US, capital misallocation is the main driver. This may reflect the relatively large and inefficient agricultural sectors in countries at earlier stages of economic development.[13] But as economies develop and labor shifts to the more productive manufacturing or services sectors, capital misallocation

[13] This is reflected in much lower capital-to-labour ratios of less developed economies. For example, in 1980 the capital-to-labour ratio in China and India was less than 3% of that in the United States, whereas those Korea, Mexico and Japan stood at 15%, 33% and 58% of the US level.

starts playing a larger role. It is interesting to note that both the Japan and the United States displayed a relatively inefficient allocation of capital in the early years of our sample. This could reflect the prevalence of tight regulation and a (still) relatively little developed financial system even in these two economies. In the United States, for example, the 1980s saw a big wave of deregulation in many industries, such as transportation, communication, energy and financial services (Niskanen, 1989).

Across countries there is some evidence that rapid capital accumulation tends to be associated with a increase in capital misallocation. China and Korea, the two countries that saw the largest growth in the capital stock between 1990 and 2010, also have the largest rise in capital misallocation (Table 1). By contrast, capital allocation improved in Mexico, Japan and the United States, which saw a much smaller rise in the capital stock. The odd one out is India, where the capital stock increased almost as much as in Korea but capital misallocation went up my much less. This could be related to the fact that the primary sector (still) plays a much larger role in India than in China or Korea.

TABLE 1. ANNUAL RATE OF GROWTH OF CAPITAL STOCK, ALLOCATIVE INEFFICIENCY AND AVERAGE LEVEL OF FINANCIAL DEVELOPMENT OVER THE PERIOD 1990-2010

	Growth of capital stock	Rate of change of inefficiency	Level of financial development
China	13.40	3.75	0.42
India	7.27	0.82	0.35
Korea	9.36	2.48	0.69
Mexico	2.77	-0.99	0.32
Japan	1.72	-1.95	0.69
USA	2.51	-3.02	0.79

Source: authors' calculations on WORLD KLEMS data and Sahay et al. (2015).

We start from this evidence to conjecture that, in the presence of market frictions, faster capital accumulation may result in growing misallocation. In these instances, capital accumulate faster in "subsidized sectors", which need not be the most productive. Recent works provide evidence for this happening in Southern European countries (Gopinath et al., 2017; Dias et al., 2016; Gamberoni et al., 2016). While there are many frictions that could lead to resource misallocation, the recent theoretical and empirical literature suggests that financial market frictions are important channels though which misallocation is perpetuated (Ciccone and Papaioannou, 2010).[14]

[14] For a comprehensive review on frictions and misallocation see Andrews and Cingano, 2014.

Panel (a) in Figure 2 offers a snapshot of sector-level patterns of misallocation across countries. To improve readability, we aggregate the capital gaps into five macro-sectors (Manufacturing, Services, Construction and Real Estate, Agriculture, and Mining), over the period 2005-09. Positive (negative) values indicate a deficit (surplus) of capital in the sector. In deficit sectors the marginal productivity of capital is above average, hence it would be optimal either to allocate more capital to those sectors, or to increase the productivity of capital in the sectors that have too much of it.

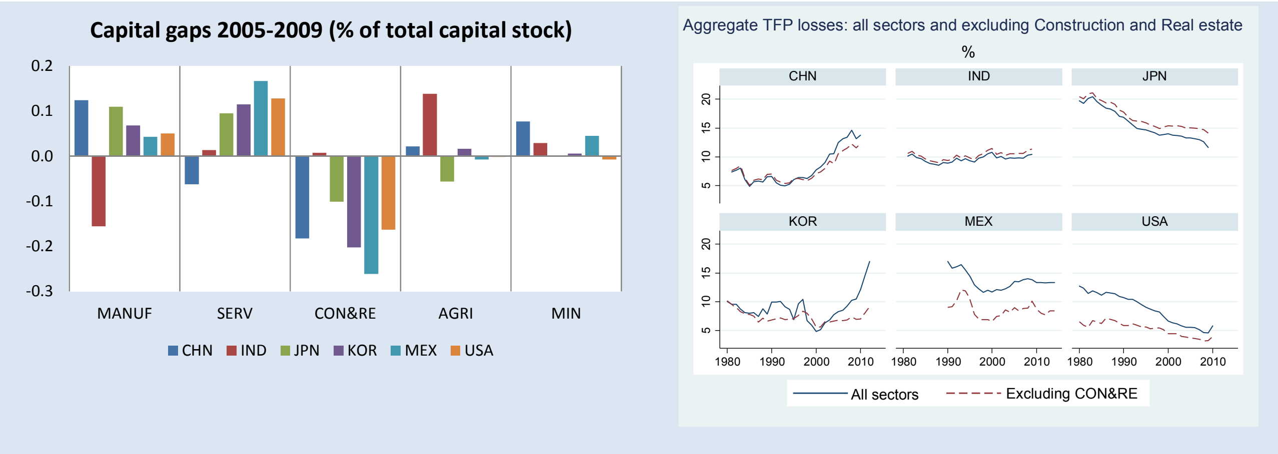


Fig. 2 Capital misallocation at a glance

Source: authors' calculations on WORLD KLEMS data.

Note: The service sector excludes Public Administration.

To clarify the concept further, consider two extreme cases: China and India. In India, the capital gap of the manufacturing sector is negative, showing a surplus of capital, whereas that of agriculture is positive, indicating a lack of capital. Efficient allocation of resources would either require a reallocation of capital from manufacturing to agriculture or reforms to raise the productivity in the manufacturing sector. In China, by contrast, manufacturing has too little capital, as indicated by the large positive capital gap, whereas services have too much of it (for a comparison between the two countries see also Di Stefano and Marconi, 2016). This has obviously important implications for the current rebalancing of the Chinese economy from producing goods to services (e.g. IMF, 2016), suggesting that such a shift requires sizable improvements in the productivity of the services sector.

Construction and Real Estate are the sectors contributing most to capital misallocations in all countries but India. Excluding them and recalculating the gaps according to the new sector shares makes allocative inefficiency appear less severe in all countries but Japan, with particularly large reductions in South Korea, Mexico and the United States (Figure 2, panel (b)). Nonetheless, even taking into account the disproportionate role of the Construction and Real Estate sectors, we still notice different trends in capital misallocation across countries.

5. Misallocation of capital and financial development: evidence on aggregate inefficiency

In this section, we explore whether financial underdevelopment is associated with the deterioration in capital misallocation (or the lack of improvement) that we observe in emerging market economies. In principle, financial development can improve capital allocation by reallocating existing capital or by channeling new investment to the most productive uses. Since much of the capital stock is quite specific to a particular sector, we believe the latter to be more important. That said, our empirical specification allows us to capture both effects.

Financial frictions associated with financial underdevelopment could have two effects on capital accumulation. On the one hand, credit-constrained firms may have very high marginal rates of return on new investment, and thus strong incentives for capital accumulation. On the other hand, an underdeveloped financial sector may curtail the supply of credit and may not be able to channel the credit it does grant to the most productive sectors (Banerjee and Moll (2010)). For instance, financial underdevelopment may bias capital accumulation to sectors that are not competitive, have a larger number of incumbent firms that could generate internal funds (in light with the arguments of Buera et al., 2011 or Gopinath et al., 2017) or are better connected politically (see García-Santana et al., 2016). By reducing the financial frictions that prevent (some) productive sectors from attracting capital, financial development could reduce the degree of capital misallocation in the economy.

In the empirical analysis, we exploit both the aggregate and sector-level variation of capital misallocation across countries and over time to assess to what extent financial development, both in terms of financial institutions and markets, affects the allocative efficiency of capital. In order to appreciate the dynamic mechanism through which financial development affects capital allocation, we consider the effect of financial development on the rate of change of the TFP loss. Working with first differences allows us to overcome problems of spurious correlations that may arise if variables have time trends.[15]

Our specification in first differences then takes the following form:

$$\Delta tfpl\_K_{it} = \alpha_i + \delta_t + \beta_1 \Delta k_{it} + \beta_2 FIN_{it} + \beta_3 \Delta k_{it} * FIN_{it} + \beta_4 FIN_{it}^2 + \beta_5 \Delta k_{it}^2 + \boldsymbol{X}'_{it-1}\gamma + \varepsilon_{it}, \qquad (7)$$

where $\Delta tfpl\_K_{it}$ denotes the log change of *TFPL_K* in country *i* in year *t*, Δk_{it} the log change of the aggregate capital stock and FIN_{it} financial development. The variable $\Delta k_{it} * FIN_{it}$ captures the interaction effects between the growth rate of capital and the level of financial development. To ensure

[15] Unit root tests suggest that TFPL_K is integrated of order one, although this may reflects the relatively short sample period (1980-2010) rather than a unit root in the data generating process. Taken literally, a unit root would imply that $\Delta tfpl\_K_{it}$ would grow without bounds and could even turn negative. We cannot rely on the Arellano-Bond estimator because it is designed for datasets with many cross-sectional units and few time periods.

that the interaction term is not spuriously capturing left-out squared terms arising from the correlation between Δk_{it} and FIN_{it}, we follow Balli and Sørensen (2013) and include the quadratic terms.

Since financial frictions may be correlated with other factors that affect structural transformation and factor allocation, we also include a vector of control variables $\boldsymbol{X}'_{it-1}$, which we lag one period. The controls include the log change of employment in agriculture (to capture the speed of the structural shift from agriculture to other sectors), the GDP deflator (to capture misallocation arising from inflation), the log change in the degree of openness (representing external pressures for structural change), the share of capital accounted for by the construction and real estate sectors (to control for an important source of distortions) and a dummy variable that takes value one if the country experienced a banking crisis.[16] All the control variables are taken from the World Bank's WDI database. We also include country fixed effects α_i to allow for variation in initial conditions across countries and control for other unobserved (and relatively sticky) country-specific factors affecting frictions across sectors, and time fixed effects δ_t to control for global macroeconomic shocks. We do not include the rate of growth of financial indicators and the rate of growth of TFP losses from labor allocation because these variables turned out always non-significant.

Table 2 reports estimates for equation (7) using the broadest measure of financial development (*FD*), that covers both financial institutions and markets. As a robustness check, we run again regression (7) on three different dependent variables. We first consider all sectors, we then exclude the financial services sector from the computation of TFP losses, and lastly we exclude the construction and real estate sectors. The heading of the column indicates the sectors excluded from the computation our dependent variable in each regression. In line with common practice, public administration is always excluded.

Results indicate the presence of a non-linear relationship between capital accumulation and capital misallocation that depends on the level of financial development. The positive coefficient on *fixed capital growth* ($\hat{\beta}_1$) indicates that faster capital accumulation is associated with a deterioration of allocative efficiency. This effect is non-linear and vanishes (and even reverses) at higher levels of financial development, as indicated by the negative coefficient $\hat{\beta}_3$ on the interaction term between *fixed capital growth* and *FD*.[17]

[16] India went through a bank crisis in 1993, Mexico in 1994-96, China in 1998, Korea in 1997-98, Japan in 1997-2001, and the United States in 2007-2011.

[17] The marginal effect of capital accumulation is given by $\frac{\partial \Delta tfpl\_K}{\partial \Delta k} = \beta_1 + \beta_3 FIN + 2 * \beta_5 \Delta k$, hence $FIN_{thres} = -(\beta_1 + 2 * \beta_5 \overline{\Delta k}) / \beta_3$, and $\Delta K_{thres} = -(\beta_1 + \beta_3 \overline{FIN}) / (2 * \beta_5)$. β_2 must be interpreted as the effect of FD when $\Delta k = 0$, and similarly, β_1 must be interpreted as the effect of Δk when FD=0.

TABLE 2. CAPITAL MISALLOCATION GROWTH AND FINANCIAL DEVELOPMENT

Variable	All sectors (1)	Excluding Financial sector (2)	Excluding Construction and Real estate sectors (3)
Fixed capital growth (β1)	4.01**	4.80**	5.79***
	(1.224)	(1.372)	(1.407)
FD (β2)	0.23	0.02	0.16
	(0.339)	(0.356)	(0.123)
FD*Fixed capital growth (β3)	-5.65***	-7.46***	-5.26***
	(0.811)	(1.555)	(1.200)
FD_squared (β4)	-0.2	-0.05	-0.13
	(0.3)	(0.269)	(0.106)
Fixed capital growth_squared (β5)	-11.2	-11.63	-15.84***
	(5.586)	(7.352)	(3.153)
N	166	166	166
r2_a	0.33	0.42	0.20
Threshold for FD	**0.71**	**0.64**	**0.74**
Threshold for investment growth	**n.s.**	**n.s.**	**10%**

Note: *p<0.1; **p<0.05; ***p<0.01. Cluster robust standard errors reported in parentheses. The dependent variable is the log change of TFP losses from capital misallocation computed according to equation (5). The regressions also include: country and time fixed effects, the log change of the share of labour in agriculture; the inflation rate, measured as *log(1+rate of change of GDP deflator)*; the log change of the degree of openness; the log share of capital stock in real estate and construction and a dummy variable to control for banking crises. Thresholds are computed as follows $FD_{thres} = -(\beta_1 + 2 * \beta_5 \overline{\Delta k}) / \beta_3$; $\Delta K_{thres} = -(\beta_1 + \beta_3 \overline{FD}) / (2 * \beta_5)$.

The bottom rows of Table 2 show that the threshold for *FD* above which higher investment rates are associated with an improvement in allocation efficiency (evaluated at the sample mean for fixed capital growth) is quite high (0.64-0.74), lying above the average level for the group of the advanced countries in our sample (0.64), let alone the developing economies.[18]

When we exclude construction and real estate from the computation of the TFP shortfall (column 3), the coefficient on the square of *fixed capital growth* ($\hat{\beta}_5$) becomes statistically significant. The negative coefficient on the squared term implies that at very high levels of capital accumulation, above 18.3% p.a., the degree of capital misallocation declines even for low levels of financial development. It should be noticed, however, that such a high speed of capital accumulation was reached only once in our sample countries, namely by Korea in 1984.

Our next step is to evaluate the relative importance of financial institution (FI) and financial market (FM) development. Tables 3 and 4 show the results for the *FI* and the *FM* indices respectively.

[18] The advanced group is composed of Korea, Japan and US. The developing one is composed of China, India and Mexico.

TABLE 3. CAPITAL MISALLOCATION GROWTH AND DEVELOPMENT OF FINANCIAL INSTITUTIONS

Variable	All sectors (1)	Excluding Financial sector (2)	Excluding Construction and Real estate sectors (3)
Fixed capital growth (β1)	3.70**	3.90*	4.57*
	(1.372)	(1.869)	(1.791)
FI (β2)	0.83	0.83	0.43
	(1.061)	(1.136)	(0.387)
FI*Fixed capital growth (β3)	-5.69***	-6.90**	-3.87
	(1.394)	(2.457)	(1.942)
FI_squared (β4)	-0.63	-0.65	-0.39
	(0.804)	(0.84)	(0.246)
Fixed capital growth_squared (β5)	-10.44	-9.8	-14.53**
	(5.721)	(7.337)	(4.258)
N	166	166	166
r2_a	0.32	0.37	0.18
Threshold for FI	**0.65**	**0.57**	**n.s**
Threshold for investment growth	**n.s.**	**n.s.**	**16%**

Note: *p<0.1; **p<0.05; ***p<0.01. Cluster robust standard errors reported in parentheses. The dependent variable is the log change of TFP losses from capital misallocation computed on all sectors, excluding public administration and financial services. The regressions also include: country and time fixed effects, the log change of the share of labour in agriculture; the inflation rate, measured as *log(1+rate of change of GDP deflator)*; the log change of the degree of openness; the log share of capital stock in real estate and construction the log share of capital stock in real estate and construction (only in regressions (1) and (2)), dummy variable to control for banking crises. Thresholds are computed as follows: $FI_{thres} = -(\beta_1 + 2 * \beta_5\overline{\Delta k})/\ \beta_3$. $\Delta K_{thres} = -(\beta_1 + \beta_3\overline{FI})/\ (2 * \beta_5)$.

The results are broadly in line with those for *FD*, and show that the development of both financial institutions and markets play a significant role in mitigating capital misallocation. The only clear distinction is found in the case of the third regression (column (3) in Table 3 and Table 4), which excludes the construction and real estate sectors, where the mitigating role of financial development can be traced back entirely to financial market development. Tables A3-A5 in the appendix report regression results for all the sub-indices of financial development proposed by Sahay et al. (2015).

TABLE 4. MISALLOCATION OF CAPITAL AND DEVELOPMENT OF FINANCIAL MARKETS

Variable	All sectors (1)	Excluding Financial sector (2)	Excluding Construction and Real estate sectors (3)
Fixed capital growth (β1)	3.07**	3.74**	4.76***
	(1.051)	(0.961)	(1.043)
FM (β2)	0.21	0.17	0.28
	(0.151)	(0.21)	(0.147)
FM*Fixed capital growth (β3)	-4.12***	-6.10***	-4.06***
	(0.945)	(0.719)	(0.616)
FM_squared (β4)	-0.2	-0.16	-0.2
	(0.126)	(0.139)	(0.114)
Fixed capital growth_squared (β5)	-9.75	-9.21	-13.10***
	(5.581)	(7.727)	(2.506)
N	166	166	166
r2_a	0.31	0.40	0.19
Threshold for FM	**0.75**	**0.61**	**0.79**
Threshold for investment growth	**n.s.**	**n.s.**	**11%**

Note: *p<0.1; **p<0.05; ***p<0.01. Cluster robust standard errors reported in parentheses. The dependent variable is the log change of TFP losses from capital misallocation computed on all sectors, excluding public administration, construction and real estate. The regressions also include: country fixed effects, the log change of the share of labour in agriculture; the inflation rate, measured as *log(1+rate of change of GDP deflator)*; the log change of the degree of openness; the log share of capital stock in real estate and construction (only in regressions (1) and (2)) and a dummy variable to control for banking crises. The thresholds are computed as follows: $FM_{thres} = -(\beta_1 + 2 * \beta_5 \overline{\Delta k}) / \beta_3$. $\Delta K_{thres} = -(\beta_1 + \beta_3 \overline{FM}) / (2 * \beta_5)$.

6. Misallocation and financial development: evidence on sector-level data

The results reported in the previous section show that financial development is associated with an improved efficiency in the allocation of new investment. In this section, we exploit cross-country, cross-sector and cross-time variation of the capital wedges to uncover which sectors benefit most from financial development. Our hypothesis is that industries more dependent on external financing, with a higher share of R&D or fewer tangible assets will benefit most from a more sophisticated financial sector as they are less likely to obtain lending based on easy-to-value collateral. We test this hypothesis using the difference-in-difference methodology of Rajan and Zingales (1998). Our dependent variable is the natural log of the wedge on capital in sector *j* in country *i*, as given in (3). Our explanatory variables are the interactions of sector *j*'s characteristics SC (e.g. its exposure to financing needs, R&D intensity, etc.) and country *i*'s financial development, correcting for country and industry effects. If the hypothesis is correct, the estimated coefficients should be negative, which means that the higher industry *j*'s dependence on external financing or R&D intensity, the more its wedge will fall as financial development increases.

Our basic specification is the following:

$$\ln(wedge)_{Kji,t} = c_{ij}+c_i+c_j + d_t + \beta(SC_j * FIN_{i,t}) + \delta_1 FIN_{i,t} + \delta_2 FIN_{i,t}^2 + \boldsymbol{X}_{ij,t-3}{}'\gamma + \varepsilon_{ij,t}\,, \qquad (8)$$

where $ln(wedge)_{Kji,t}$ is the natural log of the wedge on capital in sector *j* and country *i*. A positive value indicates a tax, a negative value a subsidy. We take 3-year averages to reduce the impact of cyclical variations and noise in the data, although the results for annual data are broadly similar. c_{ij} are country-sector fixed effects, intended to capture all the time-invariant country-specific policies and other institutional characteristics that affect sector wedges. d_t are year dummies capturing global macroeconomic shocks. SC_j is a variable that captures the relevant sector *j*'s characteristic to be interacted with country *i*'s financial development (FIN).

In particular, we consider four characteristics: the dependency on external financing of the sector, given by the difference between capital expenditures (CAPEX) and Cash flow from operations (CASH) over capital expenditures, as in Rajan and Zingales (1998); the skill intensity of the sector, the R&D intensity of the sector and the investment intensity. All the variables are measured using US data. We take averages over the period of data availability. Table 5 reports definition and sources of the abovementioned variables; Table 6 show their correlation. To get a correct estimate for β, we also control for FIN and FIN squared. And finally, $\boldsymbol{X}_{ij,t-3}$ is a vector of additional variables that may affect capital wedges. We consider two controls: the wedge on labor (to control for other sector-specific distortions) and the value-added share of the sector (to control for a convergence effect), both taken at time t-3. The sample consists of non-overlapping three-year periods.

TABLE 5. INTERACTED VARIABLES BASED ON US INDUSTRY DATA

Variable	Source
$EDep_j = \frac{CAPEX_j - CASH_j}{CAPEX_j}$	CAPITAL IQ (S&P) 1980-2015
$SkI_j = \frac{HIGH\ SKILL\ LABOUR_j}{TOTAL\ EMPLOYMENT_j}$	WIOD (SEA) database 1995-2009
$R\&D_j = \frac{R\&D\ expenditures_j}{VALUE\ ADDED_j}$	OECD STAN database 2000-2014
$InI_j = \frac{GFCF_j}{VA_j}$	WIOD (SEA) database 1995-2009

TABLE 6. CORRELATION BETWEEN INDUSTRY CHARACTERISTICS

	Dependency from external finance	Skill intensity	R&D intensity	Investment intensity
Dependency from external finance	1			
Skill intensity	-0.48	1		
R&D intensity	-0.23	0.31	1	
Investment intensity	0.37	0.03	-0.2	1

It is worth noting that the approach adopted here relies on the assumption that cross-industry differences do not vary across countries. This assumption could prove too strong. To mitigate this problem we consider additional industry-characteristics other than the "external dependency" variable defined as in Rajan and Zingales (1998), which may not be representative for sector-level financing needs in emerging countries. In particular, investment intensity, by capturing a more general industry characteristic, could better capture a cross-country invariant measure of dependency from external finance.

Table 7 reports estimates of the coefficient of interest β from our basic specification (8). The rows show the different measures of financial development and the columns industry characteristics. For instance, row I shows the coefficient on the interaction between the overall financial development index (FD) and the dependency on external financing (column 1), skill intensity (column 2), R&D intensity (column 3) and investment intensity (column 4).

The results indicate that financial development, either in the form of more developed financial institutions or markets, tends to benefit the sectors that invest more in R&D, which are presumably the most innovative, or that have a higher fraction of investment relative to value added. The results for skill intensity are less strong, whereas the dependency from external finance defined as in Rajan and Zingales (1998) appears not to matter, except when interacted with the FM index.

To gauge the economic significance of our results, we compute how the wedges of sectors with particular industry characteristics would change if FD moved from the 25th percentile to the 75th percentile. We compare the difference in how such a move would affect the wedges for sectors with high readings of the industry characteristics (such as an R&D intensity at the 75th percentile) and those with low readings (at the 25th percentile). For example, the differential in wedge of -0.037 in row I (FD) and column 3 (R&D intensity) shows that a large boost to financial development would reduce the wedge of a sector that is R&D intensive relative to one that is not by 0.037. This is quite small considering that the 75th percentile of the wedge is 0.472. The economic significance for skill and investment intensities is somewhat larger.

TABLE 7. FINANCIAL DEPENDENCY, FINANCIAL DEVELOPMENT AND SECTOR WEDGES: OLS REGRESSIONS WITH RAJAN-ZINGALES TYPE OF VARIABLES

Industry characteristic:	**Dependency from external finance**	**Skill intensity**	**R&D intensity**	**Investment intensity**
I. Industry characteristic*FD	0.15 (0.101)	-0.79* (0.448)	-2.60*** (0.8)	-0.92*** (0.35)
Adj-R2	0.89	0.88	0.88	0.88
Differential in wedge	0.000	-0.039	-0.037	-0.020
II. Industry characteristic*FI	0.09 (0.136)	-0.91 (0.617)	-2.94*** (1.0)	-1.31*** (0.478)
Adj-R2	0.90	0.89	0.89	0.89
Differential in wedge	0.000	0.000	-0.063	-0.043
III. Industry characteristic*FM	0.16** (0.073)	-0.59* (0.34)	-1.95*** (0.6)	-0.62** (0.264)
Adj-R2	0.89	0.88	0.89	0.88
Differential in wedge	0.057	-0.027	-0.025	-0.012
N	1171	1327	1162	1327
Average wedge at 75th percentile	0.092	0.197	0.472	0.153

Note: *p<0.1; **p<0.05; ***p<0.01. Standard errors reported in parentheses. The dependent variable is the 3-year average of the log of sectoral wedges. The variables indicated in each column are interacted with one of the financial development indexes introduced by Sahay et al (2015): overall financial development (FD) in regression I; financial institutions (FI) in regression II; financial markets (FM) in regression III. The regressions also include a complete set of year dummies and country dummies interacted with industry dummies, the lag 3 of the financial indicator considered and its square, the lag 3 of the value-added share of the sector, and the lag 3 of the log wedge on labour. Standard errors are robust to heteroskedasticity. The last row reports the average wedge evaluated at the 75th percentile of the SC variable indicated in the column heading.

But looking at individual industry characteristics in isolation may understate the importance of financial development as industry characteristics may overlap. To overcome this problem we jointly include, in a single regression, those characteristics that turned out to be statistically significant on their own (Table 8).

The results indicate that the interaction terms with FD and FI remain significant for both R&D intensity and investment intensity. For the FM index, instead, the only interaction term that survives is that with R&D intensity, in line with a literature that emphasizes that R&D intensive industries tend to rely more heavily on equity as a source of external finance if their output is harder to collateralize (Gambacorta et al, 2014; Magri, 2014). Skill intensity is not significant regardless of the measure of financial development.

The differential in wedge, reported at the end of the table, becomes larger. For example, moving the FI index from the 25th percentile (low development) to the 75th percentile (high development), implies a reduction in the average wedge of 0.076 for industries at the 75th percentile of R&D intensity (high intensity), or 16% of the average wedge of 0.472. For industries at 75th percentile of investment intensity the reduction in the wedge would also be 0.076, cutting the average wedge (0.153) by half.

TABLE 8. FINANCIAL DEPENDENCY, FINANCIAL MARKETS AND SECTOR WEDGES: OLS REGRESSIONS WITH RAJAN-ZINGALES TYPE OF VARIABLES

FIN:	**FD**	**FI**	**FM**
FIN*Dependency from external finance			-0.03
			(0.10)
FIN*Skill intensity	0.59		-0.69
	(0.896)		(0.71)
FIN*R&D intensity	-3.27***	-3.55***	-1.66**
	(1.10)	(1.1)	(0.80)
FIN*Investment intensity	-1.52**	-2.29**	-0.68
	(0.729)	(0.93)	(0.64)
Adj-R2	0.88	0.89	0.89
N	1162	1162	988
Differential wedge			
R&D intensive sectors	-0.046	-0.076	-0.022
Investment ntensive sectors	-0.033	-0.076	0.000

Note: *p<0.1; **p<0.05; ***p<0.01. Standard errors reported in parentheses. The dependent variable is the 3-year average of the log of sectoral wedges. The variables indicated in rows are introduced all together and are interacted with one of the financial development indexes introduced by Sahay et al. (2015). The heading of the columns indicate the index considered in each regression: overall financial development (FD) in column I; financial institutions (FI) in column II; and financial markets (FM) in column III. The regressions also include a complete set of year dummies and country dummies interacted with industry dummies, the lag 3 of the financial indicator considered and its square, the lag 3 of the value-added share of the sector, and the lag 3 of the log wedge on labour. Standard errors are robust to heteroskedasticity.

Our sector-level results have so far shown that R&D and investment-intensive sectors benefit disproportionately from financial development, but not whether financial development reduces the misallocation of resources in an economy. Following the methodology proposed by Guiso et al. (2004) and Andrews and Cingano (2014), we use the parameter estimates reported in Table 8 to compute the counterfactual TFP losses under the assumption that financial development in each country shifts to the US level. That is, we assume that (log) wedges changes such that:

$$\Delta \ln(\widehat{wedge})_{jc} = \hat{\beta}_{R\&D}\ RandD_j(FIN_{USA} - FIN_c) + \hat{\beta}_{II}\ Invint_j(FIN_{USA} - FIN_c). \quad (9)$$

From these counterfactual wedges we then compute $\widehat{TFPL\_K}_{jc}$ using equation (5) and compare these to the actual TFP losses estimated above. Table 9 reports $\Delta\widehat{TFPL\_K}_{jc}$ for the year 2009.[19] The results show that China, India and, above all, Mexico would benefit greatly from financial development, especially of financial institutions. Most notably, for Mexico bringing financial institutions development to the US-level would completely eliminate the distortions in the allocation of capital.[20] In the case of China and

[19] We assume that the simulated change in financial development would not affect nominal value added shares within a country. This is an extremely simplifying assumption, however we have no basis to conjecture how relative prices would change in response to a change in real output.
[20] This effect is surprisingly large, given that there may be other frictions, such as monopolies or stifling restrictions, that reduce allocative efficiency in Mexico. A similar large impact of eliminating financial frictions in the Mexican economy has been found by Buera et al (2011).

India, distortions would be reduced substantially albeit not eliminated, corroborating the idea that other frictions are at play. Finally, moving to a US-level of financial development would not change TFP losses much in Korea and Japan, where financial markets and institutions are already well developed and yet levels of inefficiency are significantly higher than in the United States. The low effect stemming from the financial markets (FM index) suggests that only R&D intensive sectors would benefit from their development, but on the one hand $\hat{\beta}_{R\&D}$ is lower than that found for FI, and on the other, these sectors still represent only a small share of the economy in emerging countries.

TABLE 9. TFP GAIN FROM IMPROVING FINANCIAL DEVELOPMENT TO US LEVEL (%)

	TFP gain in 2009 under counterfactual scenario			Actual TFP losses
	FD	FI	FM	
China	4.8	7.9	0.5	17.8
India	3.2	5.5	0.4	11.6
Mexico	9.0	11.8	0.7	11.9
Korea	0.6	0.9	0.1	10.5
Japan	0.6	-0.8	0.1	9.6
USA	0.0	0.0	0.0	3.8

Note: Column 1-3 reports the difference expressed in percentage points between TFP losses arising from capital misallocation computed on actual data and those computed under counterfactual scenarios for FD, FI and FM. A positive number indicates a gain under the counterfactual scenario. The last column reports the TFP losses computed from actual data. Computations are based on equation (5) and exclude agriculture and public administration.

7. Conclusions

We investigate the relationship between capital misallocation and financial development in a panel of six countries at different levels of development (China, India, Mexico, Korea, Japan and the United States), exploiting both aggregate and sector-level variation of capital misallocation across both countries and over time. We find that more developed financial systems do a better job at allocating capital investment. When the level of financial development is low, faster capital accumulation is associated with a worsening of allocative efficiency, but this effect reverses for higher levels of financial development. Sectors with high R&D expenditures or high capital investment benefit most from financial development. These effects are not only statistically significant, they are also large in economic terms. For example, our results suggest that bringing Mexico's level of development of financial institutions to that of the United States would almost entirely eliminate the gap in allocative efficiency between the two countries. China and India would also make significant gains. Of course, this does not mean that these economies would become as productive as the United States just by eliminating misallocation. Resource allocation is only one factor explaining differences in productivity, differences in technology and human capital are at least as important, although they remain outside our analysis. Furthermore, financial development may go hand in hand with other institutional changes that improve resource allocation which may be picked up by our financial development measure.

Appendix tables and figures

TABLE A1. SECTOR CLASSIFICATION

Sector	*NACE code*
AGRICULTURE, HUNTING, FORESTRY AND FISHING	AtB
MINING AND QUARRYING	C
FOOD , BEVERAGES AND TOBACCO	15t16
TEXTILES, TEXTILE , LEATHER AND FOOTWEAR	17t19
WOOD AND OF WOOD AND CORK	20
PULP, PAPER, PAPER , PRINTING AND PUBLISHING	21t22
COKE, REFINED PETROLEUM AND NUCLEAR FUEL	23
CHEMICALS AND CHEMICAL PRODUCTS	24
RUBBER AND PLASTICS	25
OTHER NON-METALLIC MINERAL	26
BASIC METALS AND FABRICATED METAL	27t28
MACHINERY, NEC	29
ELECTRICAL AND OPTICAL EQUIPMENT	30t33
TRANSPORT EQUIPMENT	34t35
MANUFACTURING NEC; RECYCLING	36t37
ELECTRICITY, GAS AND WATER SUPPLY	E
CONSTRUCTION	F
WHOLESALE AND RETAIL TRADE	G
HOTELS AND RESTAURANTS	H
TRANSPORT AND STORAGE AND COMMUNICATION	I
FINANCIAL INTERMEDIATION	J
REAL ESTATE SERVICES	70
BUSINESS SERVICES	71t74
PUBLIC ADMIN AND DEFENCE; COMPULSORY SOCIAL SECURITY	L
EDUCATION	M
HEALTH AND SOCIAL WORK	N

FIG. A1 SENSITIVITY ON ALPHAS

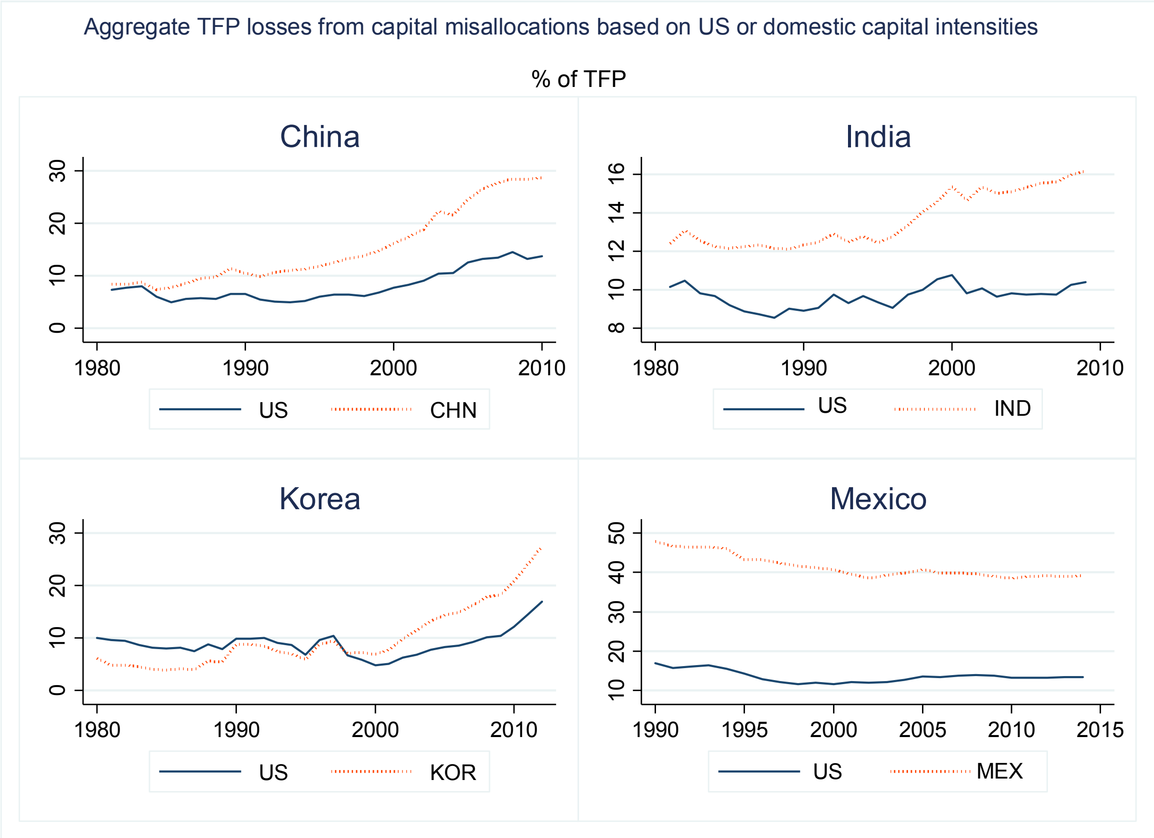
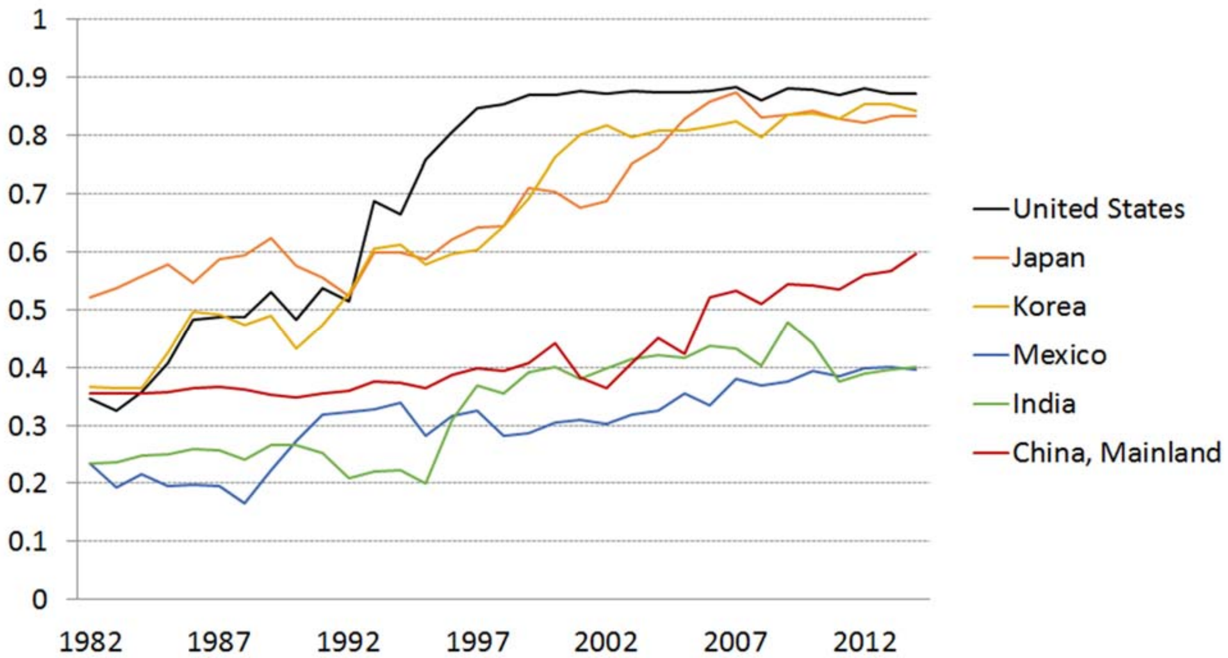


FIG. A2 FINANCIAL DEVELOPMENT INDEX



Source: Sahay et al. (2015)

TABLE A2. COMPONENTS OF THE FINANCIAL DEVELOPMENT INDEX

	FINANCIAL INSTITUTIONS	FINANCIAL MARKETS
DEPTH	1. Private-sector credit (% of GDP) 2. Pension fund assets (% of GDP) 3. Mutual fund assets (% of GDP) 4. Insurance premiums, life and non-life (% of GDP)	1. Stock market capitalization to GDP 2. Stocks traded to GDP 3. International debt securities government (% of GDP) 4. Total debt securities of nonfinancial corporations (% of GDP) 5. Total debt securities of financial corporations (% of GDP)
ACCESS	1. Branches (commercial banks) per 100,000 adults 2. ATMs per 100,000 adults	1. Percent of market capitalization outside of top 10 largest companies 2. Total number of issuers of debt (domestic and external, nonfinancial corporations, and financial corporations)
EFFICIENCY	1. Net interest margin 2. Lending-deposits spread 3. Non-interest income to total income 4. Overhead costs to total assets 5. Return on assets 6. Return on equity	1. Stock market turnover ratio (stocks traded/capitalization)

Source: Sahay et al. (2015)

TABLE A3. CAPITAL MISALLOCATION GROWTH AND FINANCIAL DEVELOPMENT: ALL SECTORS, EXCLUDING PUBLIC ADMINISTRATION.

FIN:	FD	FI	FM	FIA	FMA	FID	FMD	FIE	FME
Fixed capital growth (β1)	4.01**	3.70**	3.07**	5.02***	2.10**	2.01	2.23**	-1.02	1.33
	(1.224)	(1.372)	(1.051)	(1.122)	(0.682)	(1.151)	(0.783)	(1.381)	(1.014)
FIN (β2)	0.23	0.83	0.21	0.63	0.00	0.11	0.08	-0.12	0.18
	(0.339)	(1.061)	(0.151)	(0.773)	(0.208)	(0.353)	(0.176)	(0.093)	(0.092)
FIN*Fixed capital growth (β3)	-5.65***	-5.69***	-4.12***	-6.72***	-3.88***	-3.91**	2.23**	2.63	-0.68
	(0.811)	(1.394)	(0.945)	(1.131)	(0.426)	(1.058)	(0.729)	(1.811)	(0.948)
FIN_squared (β4)	-0.2	-0.63	-0.2	-0.33	0.08	-0.21	0.09	-0.19	-0.19
	(0.3)	(0.804)	(0.126)	(0.5)	(0.182)	(0.324)	(0.114)	(0.205)	(0.11)
Fixed capital growth_squared (β5)	-11.2	-10.44	-9.75	-17.07**	-10.37	-7.54	9.74	-7.84**	-7.89*
	(5.586)	(5.721)	(5.581)	(4.649)	(5.069)	(4.772)	(5.469)	(2.676)	(3.651)
N	166	166	166	166	166	166	166	166	166
r2_a	0.33	0.32	0.31	0.38	0.28	0.3	0.27	0.24	0.25
Threshold for FIN									
	0.71	**0.65**	**0.75**	**0.43**	**0.54**	**n.s.**	**n.s.**	**n.s.**	**n.s.**
Sample means for financial development indicators									
Advanced countries	0.64	0.70	0.58	0.73	0.44	0.60	0.54	0.57	0.75
Developing countries	0.35	0.32	0.38	0.14	0.27	0.21	0.22	0.65	0.68

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors reported in parentheses. The dependent variable is the log change of TFP losses from capital misallocation computed from all sectors exceps public administration. The regressions also include: country and time fixed effects, the log change of the share of labour in agriculture; the inflation rate, measured as *log(1+rate of change of GDP deflator)*; the log change of the degree of openness; the log share of capital stock in real estate and construction and a dummy variable to control for banking crises. Standard errors are robust to serial correlation. $FIN_{thres} = -(\beta_1 + 2 * \beta_5 \overline{\Delta k}) / \beta_3$

TABLE A4. CAPITAL MISALLOCATION GROWTH AND FINANCIAL DEVELOPMENT: EXCLUDING PUBLIC ADMINISTRATION AND FINANCIAL SERVICES.

FIN:	FD	FI	FM	FIA	FMA	FID	FMD	FIE	FME
Fixed capital growth (β_1)	4.80**	3.90*	3.74**	5.33**	2.45**	1.99	2.70*	-2.11	0.9
	(1.372)	(1.869)	(0.961)	(1.442)	(0.862)	(1.502)	(1.089)	(1.396)	(0.869)
FIN (β_2)	0.02	0.83	0.17	0.57	-0.15	0.08	0.02	-0.18	0.25
	(0.356)	(1.136)	(0.21)	(0.575)	(0.229)	(0.421)	(0.262)	(0.134)	(0.168)
FIN*Fixed capital growth (β_3)	-7.46***	-6.90**	-6.10***	-7.95***	-6.02***	-5.29**	-3.56***	3.46	-0.81
	(1.555)	(2.457)	(0.719)	(1.529)	(0.464)	(1.658)	(0.854)	(2.149)	(0.894)
FIN_squared (β_4)	-0.05	-0.65	-0.16	-0.28	0.31	-0.22	-0.06	-0.25	-0.27
	(0.269)	(0.84)	(0.139)	(0.368)	(0.18)	(0.368)	(0.158)	(0.217)	(0.165)
Fixed capital growth_squared (β_5)	-11.63	-9.8	-9.21	-17.32**	-10.18	-6.01	-9.63	-6.32	-6.43
	(7.352)	(7.337)	(7.727)	(5.922)	(5.881)	(6.382)	(8.043)	(4.078)	(5.077)
N	166	166	166	166	166	166	166	166	166
r2_a	0.42	0.37	0.40	0.43	0.36	0.36	0.37	0.30	0.31
Threshold for FIN									
	0.64	**0.57**	**0.61**	**0.40**	**0.41**	**n.s.**	**0.76**	**n.s**	**n.s**
Sample means for financial development indicators									
Advanced countries	0.64	0.70	0.58	0.73	0.44	0.60	0.54	0.57	0.75
Developing countries	0.35	0.32	0.38	0.14	0.27	0.21	0.22	0.65	0.68

Note: *p<0.1; **p<0.05; ***p<0.01. Standard errors reported in parentheses. The dependent variable is the log change of TFP losses from capital misallocation computed on all sectors, excluding public administration and financial services. The regressions also include: country and time fixed effects, the log change of the share of labour in agriculture; the inflation rate, measured as *log(1+rate of change of GDP deflator)*; the log change of the degree of openness; the log share of capital stock in real estate and construction dummy variable to control for banking crises. Standard errors are robust to serial correlation. The threshold for FIN is computed as follows: $FIN_{thres} = -(\beta_1 + 2 * \beta_5\overline{\Delta k}) / \beta_3$

TABLE A5. CAPITAL MISALLOCATION GROWTH AND FINANCIAL DEVELOPMENT: ALL SECTORS, EXCLUDING PUBLIC ADMINISTRATION, CONSTRUCTION AND REAL ESTATE

FIN:	FD	FI	FM	FIA	FMA	FID	FMD	FIE	FME
Fixed capital growth (β1)	5.79***	4.57*	4.76***	3.99**	3.87**	2.81*	3.10***	1.71	2.95*
	(1.407)	(1.791)	(1.043)	(1.34)	(0.995)	(1.129)	(0.751)	(1.12)	(1.316)
FIN (β2)	0.16	0.43	0.28	0.01	0.00	0.49	0.29*	-0.36*	0.15
	(0.123)	(0.387)	(0.147)	(0.106)	(0.103)	(0.376)	(0.14)	(0.161)	(0.152)
FIN*Fixed capital growth (β3)	-5.26***	-3.87	-4.06***	-2.86	-3.57**	-2.15*	-2.27***	0.28	-1.20*
	(1.2)	(1.942)	(0.616)	(1.459)	(1.059)	(0.937)	(0.396)	(1.157)	(0.565)
FIN_squared (β4)	-0.13	-0.39	-0.2	-0.1	0.05	-0.41	-0.22*	0.28	-0.1
	(0.106)	(0.246)	(0.114)	(0.108)	(0.112)	(0.256)	(0.107)	(0.335)	(0.105)
Fixed capital growth_squared (β5)	-15.84***	-14.53**	-13.10***	-15.36**	-14.76***	-10.69**	-10.86***	-9.04*	-9.28*
	(3.153)	(4.258)	(2.506)	(4.457)	(3.435)	(3.452)	(2.253)	(3.746)	(3.98)
N	166	166	166	166	166	166	166	166	166
r2_a	0.20	0.18	0.19	0.20	0.17	0.16	0.17	0.14	0.15
Threshold for FIN									
	0.74	**n.s.**	**0.79**	**n.s.**	**0.59**	**0.71**	**0.80**	**n.s.**	**1.54**
Sample means for financial development indicators									
Advanced countries	0.64	0.70	0.58	0.73	0.44	0.60	0.54	0.57	0.75
Developing countries	0.35	0.32	0.38	0.14	0.27	0.21	0.22	0.65	0.68

Note: *p<0.1; **p<0.05; ***p<0.01. Standard errors reported in parentheses. The dependent variable is the log change of TFP losses from capital misallocation computed on all sectors, excluding public administration, construction and real estate. The regressions also include: country fixed effects, the log change of the share of labour in agriculture; the inflation rate, measured as *log(1+rate of change of GDP deflator)*; the log change of the degree of openness and a dummy variable to control for banking crises. Standard errors are robust to serial correlation. $FIN_{thres} = -(\beta_1 + 2 * \beta_5\overline{\Delta k}) / \beta_3$

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