

Credit constraints and taxes: misallocation in a two-sector economy

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Effects of misallocation in a two sector economy with different capital intensity technologies can be particularly large. This article proposes a model of occupational choice based on wealth and entrepreneurial talent in which individuals are subject to credit constraints and different tax-rates. Agents must choose between opening a business in a more, or less, capital intensive sector or being a wage worker. The model is calibrated to the Brazilian economy between 2000-2013. Regarding the effects of financial frictions, limiting credit availability to a less capital intensive sector can be worse in terms of efficiency, but less distortive in terms of income inequality. Taxation over a more capital intensive sector worsens aggregate productivity, although it can improve income distribution. Taxing wage workers have a lower impact on efficiency, but will be severely worse on equality.

Keywords: Capital intensity; credit frictions; taxation; entrepreneurship; misallocation.

JEL Codes: L26; O11; O14; O41

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RESUMO

Distorções geradas pela má alocação de recursos podem ser particularmente grandes. Este artigo propõe um modelo de escolha ocupacional baseado em riqueza e talento empresarial no qual indivíduos estão sujeitos a restrições de crédito e diferentes alíquotas de impostos. Agentes devem escolher entre abrir um empreendimento em um setor mais, ou menos, intensivo em capital ou ser um trabalhador assalariado. O modelo é calibrado para a economia brasileira entre os anos de 2000 e 2013. Sobre os efeitos de restrições financeiras, limitar crédito para o setor menos intensivo em capital pode ser pior em termos de eficiência, mas pode gerar menos desigualdade de renda. Tributos sobre um setor mais intensivo em capital piora a produtividade agregada na economia, mas melhora sua distribuição de renda. Por fim, impostos sobre ganhos dos trabalhadores possuem menor efeito sobre eficiência, mas impactam severamente a desigualdade de renda.

Palavras-chave: Intensidade de capital, restrições de crédito, impostos, empreendedorismo

JEL CLASSIFICATION: L26, O11, O14, O41

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1 Introduction

Countries with less developed financial markets may be particularly unproductive because credit constraints exclude talented entrepreneurs from opening a business at profitable scales. Financial frictions distort investments allocations, affecting entry and exit decisions of high ability but poor individuals. Taxation constitutes another possible disturbance in first-best decisions. The effect of misallocation can be specially large in developing countries.

A quantitatively-oriented framework is developed to understand how sectors that differ primarily in their capital intensity may affect aggregate efficiency. More specifically, the focus is on a two sector economy where individuals can choose to be entrepreneurs on a more, or less, capital intensive sector (service *vs.* manufacturing, for instance) or to be a wage worker. The M-sector is more capital intensive than the S-sector. The selection of entrepreneurs is based on the individuals' wealth, which affect their self-financing or borrowing capability, as well as their entrepreneurial talent. Both credit and tax-specific policies are considered.

To shed light on how market imperfections misallocate capital and labor, comparative statics with respect to a credit constraint parameter and different tax-rates are performed. Financial frictions over a less capital intensive sector may affect aggregate economic efficiency in a larger scale than credit constraints over business that requires more capital to be profitable. Individuals at the S-sector are poorer and constraining access to credit for these entrepreneurs worsens the aggregate productivity. They are also the majority of entrepreneurs in the population. Individuals cannot afford to migrate to the M-sector since credit necessities are even higher there.

Based on this quantitative framework, it is also possible to demonstrate a set of combinations of credit constraints between sectors that ensure a constant efficiency gap at a desired level - with stability, losses or gains in terms of output. Other exercises investigating the effects on structural transformations on the share of each sector resulting from various credit simulations are also performed. Regarding income inequality, measured by an income Gini coefficient, both credit constraints are relevant, with a higher impact arising from relaxing financial frictions on the more capital intensive sector.

The effect of borrowing constraints in sector S is more relevant to efficiency. On the other hand, when considering taxes, the effect goes at the opposite direction. Taxing entrepreneurs on a more capital intensive sector is highly unproductive, adversely affecting efficiency. Finally, while taxing wage workers generates relatively low efficiency losses, the effect on income distribution can be particularly distortive. Taxation on output worsens a Gini coefficient of income distribution if the taxes are in a less capital intensive sector, but can actually improve income equality if on the other sector, where the richer and more talented entrepreneurs are.

An important distinction among sectors can also be their average establishment size. Bigger enterprises may have more financing needs and therefore are potentially more affected by financial frictions. This affects the aggregate productivity by distorting the allocation of capital between firms. There are three sources of misallocation here: agents operate in their desired sector, but with less than optimal capital, agents migrate to another sector which is less capital intensive, or they can no longer open a business and become a wage work.

This article relates to a recent literature focused on misallocation and credit imperfections. Financial frictions are often viewed as a central issue on economic development. This area is approached by constructing a model and then empirically analysing its implications. Jeong and Townsend (2007), Hsieh and Klenow (2007), Restuccia and Rogerson (2008) and Banerjee and Moll (2010) are some of the works that also have this related interest.

There is a large group of studies on macro-implications of credit market imperfections [Banerjee and Newman (1993), Blanchflower and Oswald (1998), Townsend and Ueda (2006) and Buera, Kaboski and Shin (2011), for instance]. Also, a growing literature is interested in the effects of misallocation on aggregate output, Total Factor Productivity and inequality (see Paulson and Townsend (2004), Banerjee and Duflo (2005), Restuccia and Rogerson (2008) and Hsieh and Klenow (2007) for instance). Regarding the effect on inequality, our work relates particularly to Cagetti and De Nardi (2006).

Some empirical facts motivate our study. The Brazilian service sector corresponds for more than two thirds of its GDP, yet the literature for this subject is still very incipient. The share of the service sector in value-added terms has grown persistently in the last 50 years. Between 1950 and 2013 its share went from 53.3% to 69.3% of the total GDP (IBGE data). Earlier discussions on structure of production and growth of the service sector can be found in Stigler (1956), Baumol (1967) and Maddison (1987). A more recent literature includes Ngai and Pissarides (2007), Acemoglu and Guerrieri (2008) and Buera and Kaboski (2012).

This article focus on labor and capital reallocation between sectors facing different constraints and different technological production functions. Ferreira and da Silva (2015) show the importance of labor reallocation and the persistence of low productivity in countries facing a structural transformation. According to them, the poor performance of the traditional and less productive service sector may explain the slowdown in productivity growth observed in Latin America after the mid-1970s. Buera and Kaboski (2012) also highlight the importance of the service economy in order to understand certain aspects of economic development.

Imperfections in the credit market are quantitatively very important, particularly for poor people living in developing countries. A country's Total Factor Productivity may be low not only because it is low at the individual level but mainly because inputs are misallocated across heterogeneous production units. This paper relies

heavily on numerical simulations. The main methodological contribution is to provide non-intuitive analytic results in a simple model with two sectors, different capital use and different credit and tax policies.

The rest of the paper is organized as follows: Section 2 describes the model; Section 3 is dedicated to the calibration procedure; Section 4 presents simulations regarding the credit parameters; Section 5 extends the model allowing sector-specific tax rates; Section 6 concludes.

2 Model

A simple model can be very useful to illustrate the concept of misallocation. The economy is modelled with two coexisting sectors: M (more capital intensive - manufacturing) and S (less capital intensive - services). They differ in technology and access to external financing. Individuals are constrained by their available wealth. Financial frictions appear in the form of collateral constraints on capital rental (imperfect enforceability of contracts). A more capital intensive sector will be more affected by the degree of the credit constraint.

The model is static. Individuals are heterogeneous in two endowment dimensions: entrepreneurial ability, θ , and wealth, z . They may choose either to be an entrepreneur or a wage worker. If they decide to open a business, it can be in a sector more or less capital intensive. Entrepreneurs hire workers in a competitive labor market.

The entrepreneurial ability will affect the individual's capacity to run a business. Also to become an entrepreneur, the individual may need to borrow resources. The possibility of heterogeneous access to external financing is allowed. Different sectors will face different levels of financial constraints. The interest relies on how sector-specific credit policies may affect efficiency and inequality. Later, the introduction of heterogeneous sector related taxes will be briefly approached.

2.1 Preferences

There is a representative household in this economy populated by a continuum of mass 1 of individuals heterogeneous in two dimensions: entrepreneurial ability - $\theta \in [0; \infty)$ - and wealth - $z \in [0; \infty)$. They are deterministic and distributed across the population according to the pdf $f(\theta; z)$. The occupational decision is based on both ability and capital resources¹.

If one decides to be an entrepreneur all her labor endowment must be devoted to

¹Due to heterogeneous individuals and credit market imperfections, the representative agent framework is invalid. See Banerjee and Duflo (2005) for a review of this literature.

run a business, i.e. occupations are indivisible (specializing in one activity is more productive). In a risk neutrality environment, the decision is towards the more profitable occupation. Entrepreneurs in both sectors demand workers. Wage will be endogenous and set according to a market clearing condition.

2.2 Technology

There are two sectors (j) in which the individual can open a business, $j = M, S$. An entrepreneur with inherent ability θ combines capital (K_j) and labor (L_j) to generate output using a sector-specific technology. At the M-sector, more capital intensive, as follows:

$$Y_M = \theta(K_M^\alpha L_M^{1-\alpha})^\gamma$$

$\gamma \in (0; 1)$ is a span of control parameter, as in Lucas (1978), that ensure the coexistence of sectors by a decreasing returns to scale function. For this same entrepreneur, production in the S-sector is given by:

$$Y_S = \theta(K_S^\beta L_S^{1-\beta})^\gamma$$

The crucial assumption is that $\beta < \alpha$, i.e., production in the S-sector is less capital intensive. As argued, one can think about M-sector as an industrial and more sophisticated kind of production. The S-sector turns out to be more similar to the services sector.

2.3 Credit market

The credit market, due to imperfections such as limited enforceability of contracts, is set as follows: in a sector $j = M, S$ individuals can only borrow up to a multiple λ_j [as in Evans and Jovanovic (1989), Paulson and Townsend (2004) and Buera, Kaboski and Shin (2011)]. The amount of capital invested in a business is constrained by the owner's wealth. More specifically, an individual with wealth z is able to borrow up to $(\lambda_j - 1)z$, where $\lambda_j \in [1; \infty)$ is a parameter that measures how lax is the borrowing constraint in a j -sector.

That said, the amount available for investment is given by this amount added to the agent's own wealth: $(\lambda_j - 1)z + z = \lambda_j z$. The capital stock employed by a firm in sector M (K_M) cannot exceed $\lambda_M z$, and in sector S (K_S) the restriction is up to $\lambda_S z$. Intuitively, agents of a given entrepreneurial ability choose to open a business if they are wealthy enough to run it at a profitable scale.

Sector-specific credit policies might be implemented by governments wishing to foment asymmetrically different activities. The credit parameter on sector M - λ_M - is potentially different for the one on sector S - λ_S . The interest rate is exogenously determined, as in a small open economy hypothesis. Financial frictions will have different impacts on sectors because the capital intensity (establishment size) translates directly into financing needs.

2.4 M - The more capital intensive sector

Net earnings of an entrepreneur operating in the M-sector with wealth z and talent θ is set as follows:

$$\pi_M(\theta, z) = \max_{K_M, L_M} \{ \theta(K_M^\alpha L_M^{1-\alpha})^\gamma - wL_M - r(K_M - z) : 0 \leq K_M \leq \lambda_M z \}$$

Where w is the endogenous wage rate and $(r - 1)$ is the real interest rate (assumed to be exogenous and equal between sectors). If the amount required to finance the desired business capital optimum is less than the individual's wealth, the remaining of it will be invested at the same rate r . If the borrowing constraint does not bind (i.e. unconstrained entrepreneur), optimality conditions imply that:

$$K_{Mu}^* = \left[\frac{\gamma\theta}{\left(\frac{r}{\alpha}\right)^{1-(1-\alpha)\gamma} \left(\frac{w}{1-\alpha}\right)^{(1-\alpha)\gamma}} \right]^{\frac{1}{1-\gamma}} ; L_{Mu}^* = \left[\frac{\gamma\theta}{\left(\frac{r}{\alpha}\right)^{\alpha\gamma} \left(\frac{w}{1-\alpha}\right)^{1-\alpha\gamma}} \right]^{\frac{1}{1-\gamma}}$$

Where the amounts of capital (K_{Mu}^*) and labor (L_{Mu}^*) do not depend on wealth. Quantities are efficient and the credit constraint is irrelevant. No missallocation in this scenario. On the other hand, if the entrepreneur wishes to invest more than $\lambda_M z$ (i.e. constrained entrepreneur):

$$K_{Mc}^* = \lambda_M z ; L_{Mc}^* = \left[\frac{\gamma\theta(1-\alpha)(\lambda_M z)^{\alpha\gamma}}{w} \right]^{\frac{1}{1-\alpha(1-\gamma)}}$$

The optimal choice of inputs by an entrepreneur in the more capital intensive sector can then be expressed as:

$$K_M^* = \begin{cases} \lambda_M z, & \text{if } K_{Mu}^* > \lambda_M z \\ K_{Mu}^*, & \text{otherwise} \end{cases}$$

$$L_M^* = \begin{cases} L_{Mc}^*, & \text{if } K_{Mu}^* > \lambda_M z \\ L_{Mu}^*, & \text{otherwise} \end{cases}$$

2.5 S - The less capital intensive sector

The entrepreneur in the less capital intensive sector faces an analogous problem, with two key differences: she is credit constrained in a potentially different degree and operates with a different technology. Entrepreneurs also hire workers in a competitive labor market at the same wage w . Net earnings are therefore given by:

$$\pi_S(\theta, z) = \max_{K_S, L_S} \{ \theta (K_S^\beta L_S^{1-\beta})^\gamma - wL_S - r(K_S - z) : 0 \leq K_S \leq \lambda_S z \}$$

Individuals can operate credit unconstrained (optimum inputs quantities that do not depend on their wealth) or constrained. The optimal decision of an entrepreneur in this sector can be summarized by:

$$K_S^* = \begin{cases} \lambda_S z, & \text{if } K_{Su}^* > \lambda_S z \\ K_{Su}^*, & \text{otherwise} \end{cases}$$

$$L_S^* = \begin{cases} L_{Sc}^*, & \text{if } K_{Su}^* > \lambda_S z \\ L_{Su}^*, & \text{otherwise} \end{cases}$$

Where:

$$K_{Su}^* = \left[\frac{\gamma \theta}{\left(\frac{r}{\beta}\right)^{1-(1-\beta)\gamma} \left(\frac{w}{1-\beta}\right)^{(1-\beta)\gamma}} \right]^{\frac{1}{1-\gamma}} ; L_{Su}^* = \left[\frac{\gamma \theta}{\left(\frac{r}{\beta}\right)^{\beta\gamma} \left(\frac{w}{1-\beta}\right)^{1-\beta\gamma}} \right]^{\frac{1}{1-\gamma}}$$

$$K_{Sc}^* = \lambda_S z ; L_{Sc}^* = \left[\frac{\gamma \theta (1-\beta) (\lambda_S z)^{\beta\gamma}}{w} \right]^{\frac{1}{1-\beta(1-\gamma)}}$$

2.6 Wage worker

Individuals with less entrepreneurial ability will chose to be a wage worker. Each one of them supplies 1 unit of time inelastically. She will receive a wage set by a market clearing condition: work supply must be equal to its demand. Labor income does not depend on entrepreneurial talent. Therefore, net earnings of a wage worker with wealth z are then:

$$\pi_W(z) = w + rz$$

Individuals also receive interest on their wealth, which is lent to an entrepreneur (M or S sector) that need external financing. For simplicity, wages equalized across sectors, so there is no segmentation in the labor market.

2.7 Market clearing and equilibrium

An equilibrium in this economy follows an usual way. The occupational decision is a static one. Given talent and wealth, an individual chooses the occupation which gives her the highest net income: wage worker, entrepreneur in the manufacturing (M) sector, or entrepreneur in the service (S) sector. This can be seen in a simple policy function, as follows:

$$\pi(\theta, z) = \max [\pi_M(\theta, z), \pi_S(\theta, z), \pi_W(z)]$$

The share of agents opting for each form of occupation $n \in \{M; S; W\}$ is:

$$O_n = \int \int 1\{\pi(\theta, z) = \pi_n(\theta, z)\} f(\theta, z) d\theta dz$$

Where the subscripts M , S and W stand for entrepreneur in the M or S-sector and wage worker, respectively. The equilibrium wage is such that the supply of labor from wage workers is equal to its demand from entrepreneurs in both sectors.

$$O_M + O_S + O_W = 1$$

Equivalently:

$$O_W = \int \int 1\{\pi(\theta, z) = \pi_M(\theta, z)\} L_M^* f(\theta, z) d\theta dz + \int \int 1\{\pi(\theta, z) = \pi_S(\theta, z)\} L_S^* f(\theta, z) d\theta dz$$

An equilibrium for this model, given the factor prices $[w_t; r_t]$ and credit constraints parameters $[\lambda_K; \lambda_L]$, is such that every agent solves its problem, chooses a occupation and the labor market clears.

3 Calibration

Our main goal is to understand the effects of borrowing constraints, and later, taxation, on occupation choices, aggregate efficiency and inequality. The model is calibrated to mimic some features of the Brazilian economy, also according to the related literature. Functional forms for the distributions of wealth and entrepreneurial talent also need to be assumed.

3.1 Parameters values

In order to quantify our theoretical model, a set of parameters values $[\theta, z, \lambda_M, \lambda_S, \alpha, \beta, \gamma]$ need to be assigned. Table 1 presents the baseline calibration. The starting point assumes $\lambda_i = 2$, with $i = M, S$, i.e. the amount borrowed by entrepreneurs in both sectors cannot be larger than the value of her own wealth. This value is used in Paulson, Townsend and Karaivanov (2006) on the Thai economy. Also, Buera (2008) and Evans and Jovanovic (1989) use a similar value for the U.S. economy. This hypothesis will be relaxed later.

Table 1: Parameters values

Parameter	Description	Value	Source
$\lambda_{M,S}$	Borrowing constraint	2.0	Paulson et al. (2006)
r	Real interest rate (plus 1)	1.072	Average for Brazil (2000–2013)
γ	Span of control	0.65	Hsieh and Klenow (2007)
α	M-sector technology	0.4	Data on labor share and manufacturing output
β	S-sector technology	0.2	Data on labor share and service output

Regarding the interest rate, r will be given by the average Brazilian real interest rate (Short-term nominal interest rate - SELIC - minus the annual rate of CPI inflation -IPCA) between 2000 and 2013 ($r = 1.072$). The span of control parameter, γ , is set to be 0.65, which is the value used in Hsieh and Klenow (2007). As for the production parameters, $\alpha = 0.4$ and $\beta = 0.2$. In this particular model, the labor share is given by:

$$\gamma(1 - \alpha)Y_{M\%} + \gamma(1 - \beta)Y_{S\%}$$

Where $Y_{M\%}$ is the share of manufacturing output on total output (27.6% on average between 2000-2013) and $Y_{S\%}$ is the share of the service sector (66.4% on average for the same period. Both suppressing the agricultural sector (6% of total GDP) for the simplicity of the model). The weighted average of sectorial labor shares gives the economy wide labor share. According to Brazil's National Accounts, between 2000 and 2013, compensation of employees is 49% of GDP. α and β , therefore, were set to match this amount.

3.2 Distribution of wealth and entrepreneurial talent

The model is calibrated to reproduce two statistics of the Brazilian economy: (i) the share of service output in total GDP – 69.4% according to Brazil's National Accounts (excluding agricultural output, as said); and (ii) the share of wage workers

in total employment – 72% according the Brazilian Household Survey (average for the 2000–2013 period).

Wealth and talent are independently distributed and follow a log-normal distribution, i.e. $\log z \sim (\mu_z, \sigma_z)$ and $\log \theta \sim (\mu_\theta, \sigma_\theta)$. The standard deviation of the wealth distribution can be mapped into the Gini coefficient through the following formula: $Gini = 2\Phi(\sigma_z/\sqrt{2}) - 1$. Where $\Phi(\cdot)$ is the cdf of the normal distribution. Davies et al. (2011) provide an estimation of the Brazilian wealth Gini coefficient (0.784), which is used to calibrate σ_z in 1.75. The same dispersion in entrepreneurial ability is assumed, i.e. $\sigma_\theta = 1.75$ as well.

For each pair $[z; \theta]$ we simulate the model following the market clearing condition at the labor market and compute (i) and (ii). We choose the pair which minimizes the sum of the squared difference between each of these statistics and their corresponding values in the Brazilian data. Specifically, $\mu_z = 0.005$ and $\mu_\theta = 0.1$, which approximate properly the observed data. The simulations are based on a random draw of 100,000 individuals. See Figure 1 for the occupational choices in a wealth and entrepreneurial talent diagram.

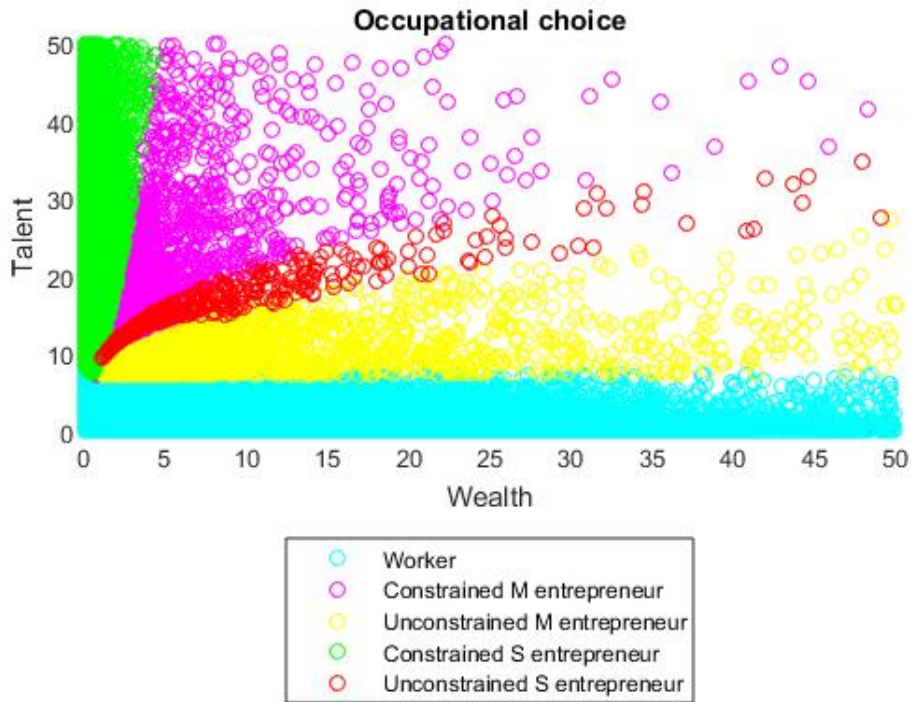


Figure 1: Occupational choice

As can be seen, if the entrepreneurial ability is sufficiently high, the individual becomes an entrepreneur. Under a value of, approximately, $\theta = 8$ she always choose to be a wage worker. For low levels of wealth, the credit constraint will be binding. Talented but poor agents will opt to be constrained at the less capital intensive

sector S. Increases in wealth will shift their choice to the M sector. Entrepreneurs in sector M are slightly more talented than others. Above a certain level of wealth agents are free from financing frictions and will be able to fully invest their desire capital: unconstrained entrepreneurs. The combination of entrepreneurial ability and wealth will determine the individual's occupation choice, given the market clearing condition at the labor market.

4 Simulations

The presented model will be used to provide a quantitative analysis of misallocation of capital and labor in this simplified two sector economy. The process of choosing occupational choices allows for an endogenous mechanism of entry and exit from the production sector. This is an important channel for resources reallocation and structural transformation. First, the impacts of changing borrowing constraints parameters on efficiency and sectorial allocation will be addressed.

4.1 Efficiency

To measure efficiency, the model's total output in both sectors is compared to that of the calibrated economy. The starting point is a perfect-credit benchmark environment. With no financial frictions and no other distortion, sectorial and occupational choices result uniquely from comparative advantage: the more talented become entrepreneurs and the marginal product of capital equalizes between sectors and firms. To measure efficiency, the model's total output in both sectors is compared to that of an economy with no credit distortions.

The initial efficiency gap is given by $1 - Y(\lambda_M, \lambda_S)/Y(\infty, \infty)$. The total output in this scenario is 32% higher than in the calibrated economy where $\lambda_M = \lambda_S = 2$. Our starting point is already inefficient. It is also possible to measure the effect of each credit constraint individually. The effect of λ_S is deeper. The efficiency gap when $\lambda_S = 2$ and $\lambda_M = \infty$ is 9%, meanwhile the efficiency gap when $\lambda_S = \infty$ and $\lambda_M = 2$ is 23%.

Figure 2 displays the efficiency gap for combinations of the borrowing constraints parameters: $[(\lambda_M), (\lambda_S)] = [(1 : 5), (1 : 5)]$. In this 3D graphic, point $(\lambda_S; \lambda_M) = (2; 2)$ is equivalent to our benchmark output, with zero efficiency gap. The starting point is the case where only the agent's wealth is available for investment, with no access to credit markets ($\lambda_M = \lambda_S = 1$). The output is 8.4% lower in this scenario than in our baseline economy ($\lambda_M = \lambda_S = 2$).

Increasing λ_i , $i = M, S$, implies that individuals at the i-sector have more access to credit and can, therefore, invest in a more profitable scale. The sector becomes

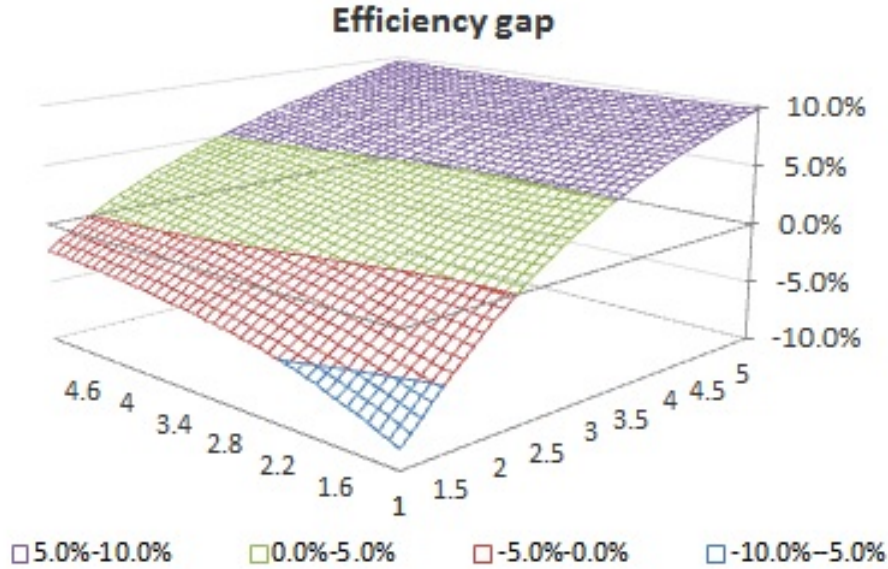


Figure 2: Efficiency gap

more attractive, leading to an increase in their share on aggregate production. Total output may increase due to two complementary channels: (i) intensive margin (agents maintain their chosen sector but will expand in scale), and (ii) extensive margin (individuals switch sectors). Both effects are relevant and have different implications in efficiency and economic structural composition.

In this model, more credit always induces higher levels of output, but the effect is quantitatively different depending on the boosted sector. Relaxing the credit constraint over sector S is significantly more efficient in terms of increasing the aggregate output. Increasing λ_S from one to five can improve the efficiency gap from a loss of 8.4% to a gain of 9.7%, holding $\lambda_M = 1$. On the other hand, the same exercise generates losses from 8.4% to 2.3% varying λ_M , but fixing $\lambda_S = 1$. Therefore, if the less capital intensive S sector is completely credit constrained, not even an increase in the credit availability to five times the agent's wealth in sector M will be enough to at least generate the same output level as in the calibrated economy. A talented but poor individual will not find it worthwhile to migrate to the M sector and we experience losses.

This result is somewhat non intuitive. Since the M sector is more capital intensive, one might expect a higher output loss due to tightening financial frictions over this choice. But sector S is larger in this economy and the following effect will dominate in aggregate terms: is better for some poor individuals to remain at the S sector completely credit constrained than to migrate to a more capital intensive. They are poor and even with a higher λ_M the necessities of capital in this sector are so relatively high that they cannot afford to open a business there. There are some migrations (extensive margin) since higher λ_M generates lower efficiency gaps, but the effect of remaining in a sector more credit constrained ($\lambda_S = 1$) dominates.

It is interesting to see that the mechanism exposed above changes when the possibility of sector-specific taxes rates are added in the next section. In this case, distorting the decision towards the S sector will cause a larger impact in terms of output losses. In a nutshell, different combinations of λ_i , $i = M, S$, will result in different levels of output losses or gains. This will have important implications in terms of credit policies that desire to boost a sector by penalizing another, since resources are scarce.

In this framework, a set of combinations $(\lambda_M; \lambda_S)$ that generates the same efficiency gap can be computed. For example: if we increase the credit constraint parameter in sector M (λ_M), how much we need to decrease the credit available for sector S (λ_S) to produce the same output as in baseline scenario? A selection of certain combinations is displayed in Figure 3. For instance, to achieve the same output as in our baseline scenario of $\lambda_S = \lambda_M = 2$ (a 0% efficiency gap) the following pairs of $(\lambda_S; \lambda_M)$ are possible: (1.5;4.2); (1.6;3.8); (1.8;3.0); (2.1;1.3). Combinations with positive and negative efficiency gaps are displayed. The credit constraint sensitive differ in both sectors, having different implications in terms of public policies aiming economic efficiency. Sectors demand for credit and their shares in total output will affect the final results.

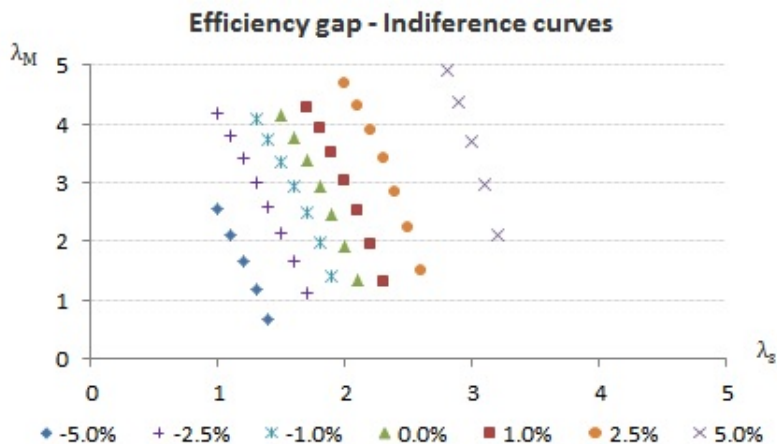


Figure 3: Credit constraints - indifference curves

An important part of the model mechanism is the structural transformation induced by credit policies. In the calibrated economy, sector S responds for 69.6% of total output, very close to the Brazilian economy (64.4%). Reducing completely the credit availability ($\lambda_S = \lambda_M = 1$) shrinks sector S to 54.9% of the GDP and inflates sector M to 45.1%. On the other hand, with more credit available, for instance with ($\lambda_S = \lambda_M = 5$), sector S is up to 82.3% of the total GDP and sector M falls to the remaining 17.7%.

Relaxing the credit constraint in sector S increases its share on the total output up to 92% if $\lambda_S = 5$ and $\lambda_M = 1$. At the opposite way, if there is no credit to sector S, i.e. $\lambda_S = 1$, and investments in sector M can go up to five times the entrepreneur's wealth,

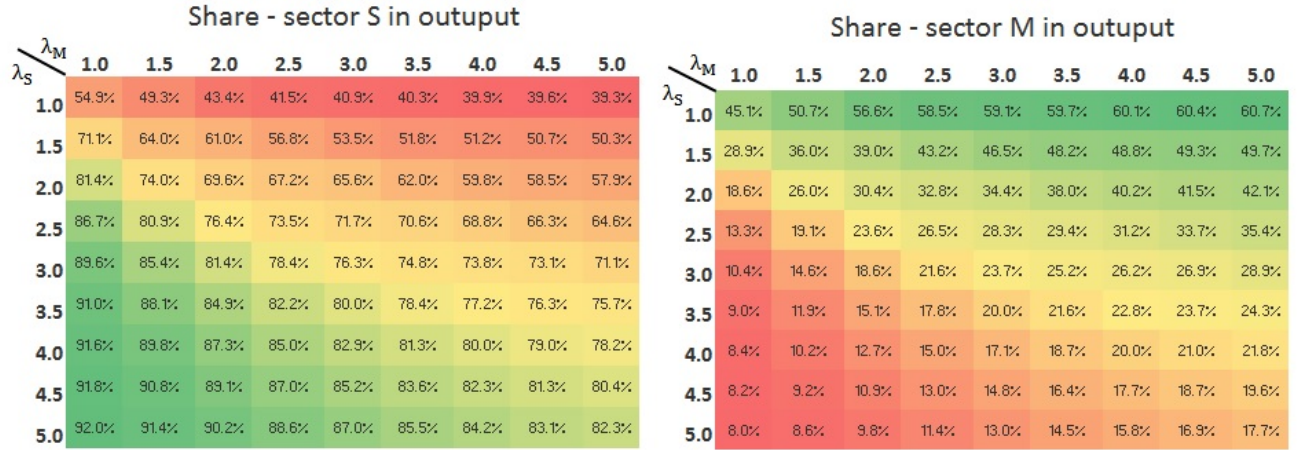


Figure 4: Shares (a) Sector S; (b) Sector M

i.e. $\lambda_M = 5$, the share of sector M in total output grows in a smaller magnitude, to 60.7%. Finally, it is interesting to see that when the credit constraint is completely relaxed at the S sector, $\lambda_S = \infty$, holding $\lambda_M = 2$ still guarantees the coexistence of sectors. Some individuals continue to find it profitable to open a business in the more capital intensive sector. The opposite happens when $\lambda_M = \infty$ and $\lambda_S = 2$. The service sector disappears at this case.

4.2 Inequality

After measuring the effects in efficiency, we shall see how the distribution of wealth will be affected based on different credit scarcity scenarios. To measure inequality, we compute the income Gini coefficient, which is equal to 0.445 in our baseline economy. The model reproduces considerable inequality. In the data, the average Brazilian Gini is equal to 0.559 during the 2000-2013 period.

Eliminating both credit constraints in the model ($\lambda_S = \lambda_M = \infty$) generates a Gini coefficient of 0.403. Dropping each distortion separately would also reduce inequality: Gini = 0.418 when $\lambda_S = 2$ and $\lambda_M = \infty$; Gini = 0.421 when $\lambda_S = \infty$ and $\lambda_M = 2$. Figure 5 plots different levels of the Gini coefficient computed for the same simulation, $[(\lambda_M), (\lambda_S)] = [(1 : 5), (1 : 5)]$. Lower credit availability implies a worse income distribution. When $\lambda_S = \lambda_M = 1$, Gini=0.458. When $\lambda_S = \lambda_M = 5$, Gini=0.429.

The relationship is not linear. Holding $\lambda_S = 1$, the Gini ranges from 0.458 to 0.433 by relaxing λ_M from one to five. At the same time, with $\lambda_M = 1$, the Gini ranges from 0.458 to 0.436. Both distortions are important in income distribution, but the credit parameter in sector M (λ_M) have a marginal larger effect.

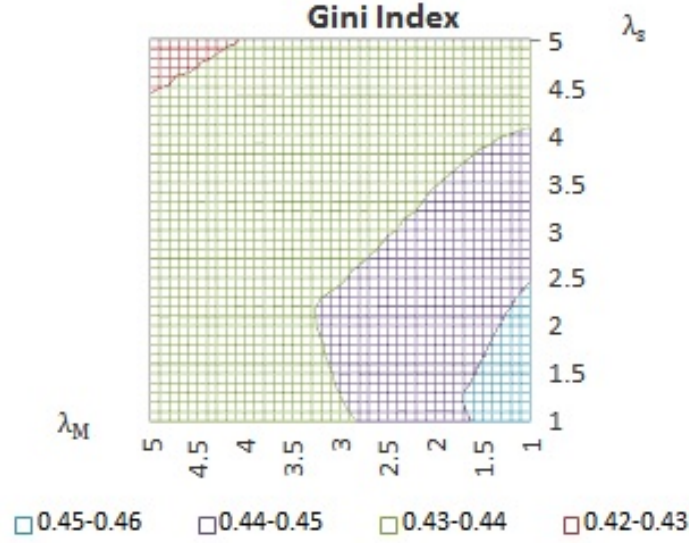


Figure 5: Gini coefficient

5 Taxes

This section includes the possibility of taxation in both sectors. Workers will also pay taxes. Now there is another source of misallocation, with different final effects on efficiency and inequality. Entrepreneurs in the M-sector will pay a τ_M tax rate on output. Analogously, in the S-sector, the tax rate will be τ_S . Wage workers pay a τ_W tax rate.

Net earnings of an individual operating in the M-sector and S-sector are respectively:

$$\pi_M(\theta, z) = \max_{K_M, L_M} \{ \theta(1 - \tau_M)(K_M^\alpha L_M^{1-\alpha})^\gamma - wL_M - r(K_M - z) : 0 \leq K_M \leq \lambda_M z \}$$

$$\pi_S(\theta, z) = \max_{K_S, L_S} \{ \theta(1 - \tau_S)(K_S^\beta L_S^{1-\beta})^\gamma - wL_S - r(K_S - z) : 0 \leq K_S \leq \lambda_S z \}$$

Net earnings of a wage worker with wealth z are:

$$\pi_W(z) = (1 - \tau_W)w + rz$$

Sector-specific tax rates can also be viewed as a source of heterogeneous productivity levels between sectors. Increasing a tax-rate may be seen as reducing a sector total productivity, a negative shock. Taken together, credit constraints and taxes can generate substantial inefficiency. Note that in this case the efficiency gap is given by $1 - Y(\lambda_M, \lambda_S, \tau_W, \tau_M, \tau_S)/Y(2, 2, 0, 0, 0)$. The effects on efficiency and inequality

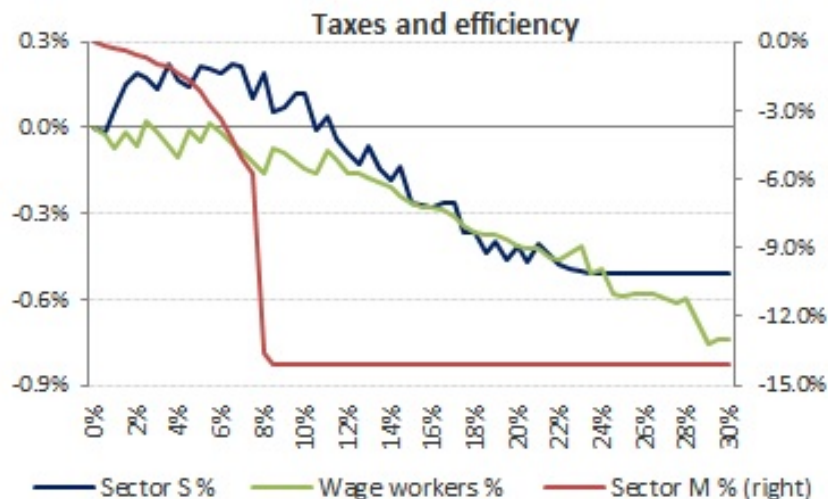


Figure 6: Taxes and efficiency

from individual simulations in tax-rates are computed holding the credit constraint $\lambda_i = 2$, for $i = M, S$.

A 0 to 30% range is simulated for all tax-rates. Regarding the efficiency gap, τ_M has a larger effect. Increasing τ_M from 0% to 1% generates a loss of 0.3% in total output. The impact is monotonically decreasing until $\tau_M = 8.0\%$, when this occupation is no longer profitable and no one chooses to open a business at the M-sector.

A smaller, but also significant effect, comes from variations on τ_S . When τ_S goes from 0% to 5% the efficiency gap oscillates around 0.1%, with no clear direction. It is only at 6% that the impact turns out to be significantly negative. When $\tau_S = 21.0\%$ the S-sector disappears. In summary, τ_M has a larger adverse impact on efficiency than τ_S .

Taxing wage workers generates less output losses. Workers are poorer and less talented. The decision towards this occupation is less sensitive to taxation in terms of efficiency gap, but the opposite conclusion is arrived in terms of inequality, when τ_W will be highly distortive. Taxing wages monotonically worsens income distribution. See Figure 7.

Taxes on production go different ways. Increasing τ_M can actually improve income distribution. Entrepreneurs at M-sector are richer and, therefore, taxing this sector makes the Gini coefficient more equal across the population. The income disparity is reduced. On the other hand, higher taxes in Sector S amplify inequalities, although not as much as increasing τ_W .



Figure 7: Taxes and inequality

6 Concluding remarks

A large literature investigates the relationship between credit frictions and entrepreneurship to development and aggregate productivity. We model an economy with two sectors - M and S - where the former is more capital intensive. Individuals must choose an occupation: whether to work for a wage or to open a business in one of either sectors. They decide based on entrepreneurial ability, wealth and access to capital. Imperfections at the financial market are modeled with a collateral constraint on capital rental. Constrained individuals are limited to borrow up by a multiple of their own wealth. This rental limit is potentially different between sectors. Different tax-rates across sector M and S, as well as in labor income, are also included.

The model is calibrated to approximate features of the Brazilian economy between 2000-2013. the main goal is to quantify the role of financial frictions and taxes as a source of misallocation in economic development. Financial frictions in a less capital intensive sector (S) may have a larger impact on economic efficiency. This happens because poor entrepreneurs are constrained in this sector and reducing credit availability worsens their productivity. They cannot migrate to the M-sector since credit necessities are even higher there.

More broadly, our quantitative framework is also able to demonstrate a set of combinations of credit constraints that hold the efficiency gap constant, as well as investigate the structural transformation resulting from various credit simulations. The effect of borrowing constraints in sector S is more relevant. On the other hand, when considering taxes, the effect is at the opposite direction.

Increasing taxation on sector M can be highly distortive. This affects the richer and more talented individuals on this economy, with a non-negligible impact on total

productivity and output. Albeit very inefficient, this can improve income inequality by generating a more equal distribution, measured by an income Gini coefficient. Taxing wage workers has a lower impact on efficiency, but will be severely worse for equality. Finally, these effects can be larger than in a model with a single sector, since changes in parameters may induce individuals to switch sectors with different technologies and constraints.

The present framework enables us to determine the loss of efficiency associate with different levels of credit constraint and sector-specific tax-rates. It is also possible to investigate impacts on income distribution and, therefore, inequality and poverty reduction. This structure can be expanded to consider multiples periods incorporating intertemporal investment decisions and the possibility of agents saving their way to entrepreneurship.

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