

Decline in Wage Inequality in Brazil

A Survey

Sergio Firpo
Alysson Portella



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Abstract

In the last decades, Brazil experienced a historical decline in its wage inequality level, particularly in the first decade of the 21st century. This paper reviews the literature that attempted to explain the observed pattern. It considers mechanisms related to the supply and demand for labor, as well as institutional factors. The paper argues that the favorable economic environment in the period, combined with increases in the minimum wage, higher formalization,

and a larger supply of skilled workers led to a compression in wages. However, some aspects of the decline in wage inequality are still unanswered, such as the causes behind a reduction in the experience premium and interfirm payment heterogeneity, as well as the exact role of technological changes. The paper concludes by discussing future trends in wage inequality in Brazil.

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Decline in Wage Inequality in Brazil: A Survey*

Sergio Firpo †

Inspere Institute of Education and Research, Brazil

Alysson Portella ‡

Inspere Institute of Education and Research, Brazil

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†firmo@insper.edu.br

‡alyssonlp@al.insper.edu.br

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1 Introduction

The rising inequality in high-income countries has received attention from the public recently, although academic circles have discussed this subject for many decades. Among the explanations for this trend, the most prominent one is perhaps the deceleration in the growth of the supply of college-educated workers coupled with an increase in demand for skilled labor due to skill-biased technological changes (Autor, 2014; Van Reenen, 2011). Advances in technology, especially computers and automation, also contributed to the polarization in employment and wages across occupations in most developed countries after the 1980s, by displacing workers in routine, codifiable jobs to service occupations at the same time that these advances complemented non-routine, cognitive-intensive jobs (Autor and Dorn, 2013). Offshoring of some jobs may also have played a role in increasing polarization (Firpo et al., 2011). Studies have also looked at the contribution of the workplace-specific wage premium and noticed that an important share of the increasing inequality was due to its increasing dispersion together with assortativeness of high-paying firms and high-productivity workers (Card et al., 2013). Finally, institutional factors

such as the diminishing real value of the minimum wage are also partially responsible for increasing inequality in the lower tail of the wage distribution (Autor et al., 2016).

While inequality has risen in the developed world, Latin America experienced a much welcomed decline in inequality during the 2000s, at the same time that growth rates were high. In the period, household income inequality decreased in 16 of 17 countries in the region, and the bulk of the decrease was due to reduction in wage inequality (Messina and Silva, 2017). This decrease was concomitant to large increases in the relative supply of skilled workers and a reduction in skill premia. At the same time, the region, particularly South America, was hit by a large commodity boom, leading to increased demand, better terms of trade, and currency appreciation. Real minimum wage also increased in most of the countries in the region, which may have contributed to declines in wage dispersion. Many studies have tried to make sense of this phenomenon, pointing to all of these factors as contributing to the overall decline in the region (López-Calva and Lustig, 2010; Gasparini et al., 2011; Lustig et al., 2013; de La Torre et al., 2015; Messina and Silva, 2017).

The trends observed in Latin America also took place in Brazil, although in different levels and periods. The country once labeled by the historian Eric Hobsbawm as “the world contender for the championship of economic inequality” (Hobsbawm, 1995, page 407) experienced an unambiguous and continuous reduction in inequality in the first decade of the 21st century. The Gini coefficient for household income *per capita* was stable around 0.6 between 1993 and 2001, when it started to decline steadily, reaching 0.527 in 2013 (Messina and Silva, 2017). According to Rodríguez-Castelán et al. (2016), in contrast with overall trends in Latin America, both labor and nonlabor income contributed equally to this drop. During this period, Brazil experienced a fast increase in coverage and volume of public social spending, via conditional cash transfers (the *Bolsa Família*), pensions, and other social security benefits, which were highly inequality-reducing (Barros et al., 2010).

Reductions in wage inequality in Brazil started earlier than the overall decrease in household income inequality, and earlier than the decrease in wage inequality observed in other Latin American countries, beginning soon after the inflation stabilization in 1994 and continuing after that, with an acceleration in the 2000s. In fact, between 1993 and 2003 Brazil experienced the fastest annualized reduction in wage inequality among Latin American countries, going from a Gini coefficient of 0.544 in 1993 to 0.52 in 2001, while the majority of the region was experiencing rising or stable inequality (Messina and Silva, 2017). When other countries in the region started to exhibit declining inequality, Brazil experienced an acceleration in its trend. The Gini coefficient for the wage distribution in Brazil went from 0.50 in 1995 to 0.41 in 2012, an impressive decrease of 18% (Ferreira

et al., 2017).

What explains this large and continuous wage inequality reduction in the 1990s and 2000s? The Brazilian economy experienced several changes in labor supply, labor demand, and institutional factors that likely contributed to this positive development. On the labor supply side, Brazil has been benefiting from a demographic bonus, with a decline in birth rates leading to a rise in the share of population of working age. Unemployment rates in Brazil decreased considerably in the 2000s, going from around 12% in 2002, to a historical low rate of around 5% in 2012.¹ Similarly, real average earnings increased by around 15% in the same period.² Average years of schooling of its working population increased fast, from 6.31 in 1995 to 7.41 in 2003 and 8.92 in 2012 (Ferreira et al., 2017), similar to overall trends in Latin America, where average years of education increased from 5.9 in 1990 to 7.13 in 2000 and 8.2 in 2010 (Barro and Lee, 2013). Analogously, the ratio of workers with completed tertiary education to complete primary and complete secondary school experienced an annualized rate of increase of respectively 1.4% and 0.1% between 1995 and 2013, with a faster rate between 2003 and 2012, of 1.9% and 0.6%, respectively. These rates were relatively low compared to most South American countries. As a benchmark for the latter period, these annualized rates of increase were 4.6% and 0.9% for Chile.

At the same time, changes in labor institutions and external conditions increased labor demand and wages, especially for the least qualified workers. Minimum wage had a real growth of more than 100% in the period, rising from 234 reais in 1994 to 555 reais in 2013.³ The increase was faster in the 2000s, with a 62% rise between 2003 and 2012. Labor formalization increased fast in the 2000s, with the share of informal workers going from around half of the working population in 2002 to 38.3% by 2012. At the same time, the wage gap between formal and informal workers reduced by 12.6p.p., from 27.9% to 15.3%. The change in formalization was particularly high in the lower tail of the distribution, which potentially had a considerable impact on wage inequality, specially when coupled with the increase in real minimum wage in the period. Brazil also undertook a broad trade reform that dramatically reduced tariffs on imported goods in the early 1990s, with effective tariffs on imports decreasing from around 55% to 20%, while during the 2000s the commodity boom raised the terms of trade by around 35% between 2005 and 2011 in Brazil (de La Torre et al., 2015), whereas the real exchange

¹Data from IPEA, [available here](#), accessed in April 28, 2019.

²Data from IPEA/PME. Only for the metropolitan areas of Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo and Porto Alegre.

³Using 2011 Brazilian reais. In nominal terms, these values are respectively 70 and 622 reais. Using 2011 PPP, they are respectively 240 and 377 dollars. To compute real values, we use price data from IPCA, provided by IPEA [here](#). For data on PPP, we use data from the World Bank, provided [here](#). Both were accessed on June 6, 2019.

rate increased by an annualized rate of 5.9% (Messina and Silva, 2017).

As we can see, many things have happened in Brazil that could help account for the reduction in wage inequality. The average worker became more educated and experienced, which affected the composition of labor supply while labor demand also changed, in part due to trade liberalization and international prices. At the same time that market forces acted, changes in institutional factors also took place, such as a rapid increase in the real minimum wage and formality. Here, we review research investigating these possible causes, evaluating possible points of agreement and disagreement in the literature, while identifying areas that demand further research. Due to its geographic size, regional diversity, good availability of data, and exposure to diverse shocks, Brazil has been the recent subject of many works that are difficult to replicate in other countries in the region. Therefore, the results of research conducted for this country may be relevant to inform policy in many others. Based on a review of this literature, our main conclusion is that the decline in inequality observed in the period was the result of a favorable economic environment combined with a set of policies that allowed workers in the lower tail of the distribution to benefit from the economic growth. Even though recent research suggests that international trade had a limited direct impact on inequality, it contributed to a reduction in regional, racial, and gender wage gaps. More importantly, an improved international situation boosted growth rates and allowed policies such as the increase in minimum wage to compress the distribution of wages without increasing unemployment or informality, at the same time that increased supply of better educated workers resulted in lower relative returns to skills.

However, some unanswered questions still remain. Research shows that a considerable reduction in returns to experience and a large compression in firms' payment heterogeneity were important in accounting for the decline in inequality, but the causes behind them are not yet clear. Although strong evidence suggests that changes in the relative supply of skilled labor explain almost all the reduction in the skill premium, changes in the supply of potential experience explain only a limited amount of the variation in the experience premium, meaning that changes in demand must have played a role (Fernández and Messina, 2018). As for now, the literature has not investigated possible changes in the economy that favored younger workers in the period. Some tentative answers may include age-biased technical change, skill obsolescence, differences in bindingness of minimum wage across age groups, and changes in the selection of young workers into and older workers out of the labor market.⁴ Firms' payment heterogeneity is a topic that received more attention recently, but a consensus is yet to be formed. Possible explana-

⁴For instance, given increases in college attendance, the new generation of workers start their participation in labor markets with higher wages than previous cohorts, while changes in retirement favor older workers with higher wages.

tions for the compression in firms' pay premia are increases in minimum wage (Engbom and Moser, 2018), decline in racial and gender gaps (Gerard et al., 2018; Morchio and Moser, 2019), changes in international commerce (Helpman et al., 2010; Messina and Silva, 2017), reduction in monopsony power of firms (Card et al., 2018; Tucker, 2017), and shocks in productivity and entry costs (Haanwinckel, 2018).

Finally, the relationship between technological change and inequality, both in Brazil and Latin American, is far from clear. Some evidence for Brazil suggests that advances in technology promoted the demand for skilled labor, polarized wages, and increased inequality, just as it did in rich countries (Maloney and Molina, 2016; Corseuil et al., 2018; Haanwinckel, 2018). Nonetheless, more work needs to be done to isolate its impact on inequality from other concomitant changes in the relative supply and demand for skilled labor. These are areas in which future research is important to close these knowledge gaps.

This review is organized as follows. In the next section, we discuss the importance of changes in relative supply of qualified work in the reduction of skill premium and wage inequality. In section 3 we assess the many channels by which demand shock may have affected Brazil, particularly those deriving from trade liberalization and the commodity boom. In section 4 we evaluate the impact that changes in the minimum wage had on wage inequality, together with changes in formalization status and unionization. Section 5 concludes.

2 Returns to Schooling and Experience and the Role of Relative Supply in Inequality Reduction

In this section, we discuss the contribution of changes in the relative supply of more skilled and experienced workers and the reduction in returns to schooling and experience to the observed decline in wage inequality in Brazil. Previous research has highlighted the role of increased average years of schooling of the labor force and the concomitant drop in its return as the main factor behind the decreasing inequality (Barros et al., 2010). The first subsection discuss this hypothesis and subsequent papers that challenged it and proposed alternative explanations, in particular the important role of declining returns to experience during the 1990s and 2000s. In the second subsection we investigate the causes of the decline in returns to education and experience related to changes in the supply of these attributes, which include relative supply as well as changes in the quality of supply. Finally, the last subsection discusses the possible impact that increased education of the labor force may have had on inequality through the occupational structure. As the relative share of highly educated workers increase, growing competition for complex

occupations decreases high wages while a reduction in the relative supply of low-skilled workers leads to wage increases for simple occupations, thus reducing inequality. As we argue, such models are interesting contributions to the literature, but further research that includes other characteristics of the labor force, such as experience, is still needed on this subject.

2.1 Education and experience: Composition vs. price effects

Educational attainment has expanded greatly in Brazil since the 1990s, at a much faster pace than in the previous decades. This has motivated many authors to argue that education expansion was behind the decrease in wage inequality, both through a reduction in inequality of education itself, since it is an important wage determinant, and through the consequent reduction in its return due to the rising supply of qualified labor. [Barros et al. \(2010\)](#) estimated that changes in education were responsible for half of the decline in wage inequality between 2001 and 2007. They further break down this change in a quantity and price effect. The quantity effect brought about by a compression on the distribution of years of schooling at the turn of the century was responsible for only 11% of the whole reduction, while the reduction in the returns to education (price effect) accounted for another 35%. They argue that such reduction in inequality was an “expected” outcome of expansion in average schooling, resulting from the Kuznets curve, which related both variables through an inverted U-shaped curve.

More recently, some authors have challenged the conclusion that education expansion was the main driver of declining inequality in Brazil, especially the relationship between increased average years of schooling and wage inequality. In fact, [Ferreira et al. \(2007a\)](#) were among the first to notice that the increase in schooling was acting in favor of increased inequality, what is now known as the “paradox of progress”. This arises because of the convexity of returns to schooling, that is, the marginal benefit of an extra year of education on wages is increasing. Therefore, as education expands, even though the dispersion in years of schooling decreases, wage inequality may increase because workers are now in a steeper region of the return’s curve. The inequality-enhancing character of schooling was confirmed by [Ferreira et al. \(2017\)](#). In their decomposition of changes in both the Gini index and percentile ratios, they find that education endowments were responsible for an increase in inequality of 4.11 Gini points between 1995 and 2012, a movement intensified in the period between 2003 and 2012. This increase in the Gini brought about by increases in educational attainment was only partially attenuated by decreases in the returns to schooling.

[Ferreira et al. \(2017\)](#) also find that, contrary to what happened with education, changes on the returns of potential experience unambiguously predict reductions in in-

equality, especially between 2003 and 2012. Average years of potential experience barely changed in the period, accounting only for a small drop in the Gini of .13 point. However, changes in its return accounted for a 3.75 drop in the Gini coefficient, a larger effect than the drop attributed to returns in education, which was of 2.91, whereas the increase in the Gini coefficient due to average years of schooling was 3.1. Changes in the return to schooling seem to be more relevant in explaining reduction in inequality in the bottom of the distribution, while changes in the returns to potential experience are more relevant in the upper tail.

The results of [Ferreira et al. \(2017\)](#) are similar to the ones reported by [Fernández and Messina \(2018\)](#) and [Alvarez et al. \(2018\)](#). The first conducts a similar decomposition as [Ferreira et al. \(2017\)](#), but uses a more restricted set of covariates. Nonetheless, they too conclude of educational endowments being inequality-enhancing, while returns to education and potential experience reduce inequality. [Alvarez et al. \(2018\)](#) uses a completely different approach, by first computing the share of the variance in log wages that is attributable to workers and firms fixed-effects. Next, they regress the estimated worker effects on age and education, showing that these characteristics explain around 40% of the variance in workers effects. More importantly, they observe that these two factors predict nearly half of the decline in the dispersion of workers effects. Going further in their analysis, they find that in a counterfactual scenario in which only the distribution of endowments is allowed to change while returns are kept constant, the predicted variance remains practically the same across years. However, when only returns are allowed to change, the predicted variance decreases, following closely the observed trend and fully explaining the reduction in the dispersion of worker effects predicted by education and potential experience.

Based on the above discussion, we conclude that returns to both education and potential experience were relevant factors in explaining the observed reduction in wage inequality in Brazil in the last decades. However, especially for years of schooling, endowment effects contributed to increase wage inequality due to the convexity of returns, counter-acting the full impact of declining returns. Next, we discuss the possible causes behind this reduction in school and experience premia.

2.2 Relative supply, quality of education, skill obsolescence and the reduction in skill and experience premia

Were changes in education and experience premium due to changes only in the relative supply of skills, or were they the result of other economy-wide changes in demand? The impact of changes in relative supply of skilled labor on wage inequality depends on

the elasticity of substitution between skill groups, apart from simultaneous changes in demand that may enhance or counter-act these underlying supply trends. [Manacorda et al. \(2010\)](#) and [Gasparini et al. \(2011\)](#) are among the first to estimate these elasticities for Brazil and other Latin American countries. [Fernández and Messina \(2018\)](#) upgrade the work of [Manacorda et al. \(2010\)](#) for the 2000s, by estimating elasticities of substitution between skilled and unskilled workers and workers with secondary and primary school, as well as elasticities of substitution across experience groups within these education groups. This is one of the departures from [Manacorda et al. \(2010\)](#), as they assumed a constant elasticity of substitution across these education groups. Moreover, they extend the previous framework by allowing for differential demand trends across experience groups. This turns out to be significant, since all changes in the experience premium were accounted for by changes in relative supply in the previous framework.

Concerning the substitution between skilled and unskilled workers, [Fernández and Messina \(2018\)](#) estimate the elasticity of substitution between workers with high school and primary school to be 2.3, but only 1.25 between college-educated and unskilled workers. This means that skilled and unskilled labor are not easily replaced, especially college-educated workers. Based on these estimates and the observed changes in relative supply of skilled workers, the predicted changes for the premia for both skill groups are very close to those observed in Brazil, although for Argentina and Chile they are unable to replicate some movements.⁵ Therefore, the conclusion is that the changes in relative supply played a much more important role in explaining changes in the returns to education in Brazil than changes in relative demand.

The elasticities of substitution between experience groups estimated by [Fernández and Messina \(2018\)](#) are larger than the elasticities between educational groups. Among unskilled workers (high school or less), the estimated elasticity was 3.6, while for skilled workers (college) it was 5.5.⁶ Hence, experienced workers are more easily replaceable among the more skilled workers. In Brazil, observed changes in the relative supply of experience groups account for only a 11.3 log points reduction in experience premium⁷ for unskilled workers, compared to an observed reduction of 26.6. Meanwhile, for college-

⁵In Brazil, the predicted change in the high school premium due to labor supply changes is -68.4 log points, quite close to the observed reduction of -71.9. For Argentina these figures were -12.7 and -31.9, while in Chile they were -31.1 and -51.1. With respect to the college premium, the observed decline in Brazil was -56.6 log points, whereas the reduction predicted by changes in labor supply was -67.1 log points. For Argentina and Chile the observed decline was -46.8 and -32.8 log points, while the predicted decline was -35.1 and -23.1.

⁶It is important to notice that the results for elasticity among skilled groups may be biased by the Brazilian pension system, as argued by [Fernández and Messina \(2018\)](#). Early retirement is somewhat common in Brazil, particularly among highly educated workers. Therefore, the experience premium is probably overstated for college graduates with 30 years or more of experience.

⁷Here we are considering estimations for the experience premium for workers with 20-29 years of experience over the workers with only 0-9 years.

graduates in Brazil, the observed decline in experience premium was 26.6 log points, whereas the predicted drop based only on changes in supply results in -6.9 log points. These figures are similar for Argentina and Chile. These results point out to a prominent role of changes in relative demand in explaining changes in the return to experience.

A complementary explanation to the observed reduction in the premium to skills in Latin America is that the increase in the supply of workers with higher education was followed by a reduction in the quality of education received by the new generations. Based on this “degraded tertiary hypothesis”, the lower quality of schooling is the reason behind skilled workers’ lower relative remuneration, since they are less productive than their previous counterpart (Messina and Silva, 2017). If such hypothesis is correct, we should expect the skill premium for younger generations to be smaller than for older generations, holding constant potential experience.

The evidence on this hypothesis is mixed for Latin America. Rodríguez et al. (2016) find evidence of heterogeneous returns for post-secondary education in Chile, with some individuals facing negative returns to their first-best choice compared to their second-best choice, depending of their unobserved ability. Camacho et al. (2017) use administrative data from Colombia and find that once selection based on ability and socio-demographic characteristics by the end of high school is accounted for, the penalty for attending a recently created post-secondary program instead of an existing one disappears. Bassi et al. (2012) use data from Brazil, Argentina, and Chile to compare what are the skills demanded by firms in these countries with what schools teach students. They find that firms not only demand academic skills, but also behavioral and socioemotional skills, with the great majority of firms reporting that these skills are in short supply. Wang (2015) tries to explicitly test for the hypothesis of degraded tertiary using Brazilian data, by comparing the college premia of younger and older cohorts, while controlling for the increase in supply. He finds evidence supporting the hypothesis since between 1995 and 2013 there was a reduction in the skill premium for younger workers.

Another possible cause put forth for the reduction in skill premium is “skill obsolescence” (Campos-Vazquez et al., 2016). Under this hypothesis, skills learned in the past may become depreciated due to rapid technological changes. This hypothesis is closely linked with the idea of age-biased technological changes (Behaghel and Greenan, 2010). The implication is symmetrically opposed to that of the degraded tertiary hypothesis, since we expected that older workers would be more harmed by the obsolescence of their skills. This hypothesis could also help account for the observed decline in experience premium. Campos-Vazquez et al. (2016) find that in Mexico, between 2000 and 2015, the wages of the oldest cohort declined, whereas the wages of the youngest cohort observed a modest gain. Messina and Silva (2017) replicate their analysis for other Latin American

countries, including Brazil. Results suggest that the mean log hourly wages of college educated workers across age cohorts have remained fairly stable between 1986 and 2011 for Brazil, thus suggesting neither of these hypotheses.

Hence, the evidence suggests that although changes in relative supply are enough to account for the decline in skill returns, other explanations must be considered to explain the decline in returns to potential experience. Studies on quality of supply were mostly focused on explaining changes in skill premium, but the evidence for Brazil do not indicate these mechanisms to be relevant. Therefore, we believe that future research should focus on the determinants of the experience premium. There are many potential hypotheses for the decline in this return. Technological changes may have taken place that favor younger generations (age-biased technological changes) or skill obsolescence related to age may be in action, although it may not be restricted to high-skilled workers. The real increases in minimum wage may be responsible for such reduction in the experience premium if it is more binding for less experienced workers. Finally, the expansion of higher education might have resulted in a delayed entrance under better wages in the labor markets for many younger workers, at the same time that incentives for retirement may induce experienced workers with high earnings to retire earlier.

2.3 Changes in occupational structure and the supply of skills

[Firpo et al. \(2011\)](#) argue that occupations may have an important role in explaining changes in wage inequality in the last decades, through task content. As they show for the United States, their task content measure for occupations, based on the degree of automation and offshorability, explain at least half of the observed changes in the level and dispersion of wages across occupations and help to account for the increased polarization in wages observed in the United States since the 1980s.

Since a more skilled workforce can perform more complex tasks and develop new products, it is also possible that the recent changes in the relative supply of skilled labor in Brazil have resulted in changes in the occupational structure of the economy. This channel is investigated by [Jaume \(2018\)](#), [Haanwinckel \(2018\)](#) and [Mak and Siow \(2018\)](#). The latter develops a model that combines both occupational choice, in the spirit of [Roy \(1951\)](#), and firm and worker matching, in the spirit of [Becker \(1973\)](#). They simulate their model calibrated for 1999 using the education distribution observed in 2013, keeping all other parameters constant. Although their model underestimates the level of inequality, it is able to explain around 70% of the decrease in the Gini coefficient in the period.

[Haanwinckel \(2018\)](#) models an economy with several goods and production functions as combinations of several tasks that vary in complexity. More skilled workers are more productive than less skilled ones in all tasks, and this advantage grows as the level of

complexity increases. He uses his model to analyze how changes in relative labor supply between 1998 and 2012 affected the wage distribution. He finds that the skill premium of workers with secondary and tertiary education with respect to those with primary or no education decreased considerably. However, in line with the work of [Ferreira et al. \(2017\)](#), the overall effect of changes in labor supply are negligible, since the reduction in returns to skills is followed by an endowment effect that increases inequality. [Haanwinckel \(2018\)](#) also models the impact of changes in demand and minimum wage, which we discuss in later sections.

Finally, in contrast with [Haanwinckel \(2018\)](#), [Jaume \(2018\)](#) develops a Ricardian economy with a unique good that is produced by the combination of infinitely many occupations that also vary in complexity. Again, more educated workers have comparative advantages over less educated ones that increase with respect to the complexity of occupations, which ensures positive assortative matching between workers and occupations. In his model, an increase in overall education has direct and indirect effects. First, with an increased relative supply of more educated workers, their wages reduce, making it more profitable for firms to employ them on less complex tasks. At the same time, the wages of less educated workers increase both because their relative supply reduced, but also because the higher demand for the occupation they perform, a consequence of increased production due to more complex occupations.⁸ Hence, inequality should decrease as a consequence of educational expansion. He calibrates his model using representative data for the whole Brazilian economy in 1995 and the ISCO-88 3-digit occupation classification. Based on this model he then estimates the effects of education expansion between that year and 2014. His model predicts 85% of the decline in wage inequality during the period.

Hence, [Jaume \(2018\)](#) and [Mak and Siow \(2018\)](#) seem to agree between themselves and the previous literature on the relevance of education as a driver of inequality reduction, whereas [Haanwinckel \(2018\)](#) suggests that education had an ambiguous net impact on inequality due to opposing endowment and price effects, in line with the recent research of [Ferreira et al. \(2017\)](#), [Alvarez et al. \(2018\)](#), and [Fernández and Messina \(2018\)](#). What is the source of such disagreement? On the one hand, these studies limit their analysis to static labor markets in which workers are allocated to occupations based on a quite limited number of characteristics, in the case [Jaume \(2018\)](#), only on their education.⁹ On the other hand, the sources of shocks in [Jaume \(2018\)](#) and [Mak and Siow \(2018\)](#) are limited to

⁸The labor productivity of each occupation remains the same, but there is an implicit complementarity among occupations in the model. As the productivity of one occupation increases, more labor must be employed in other occupations to produce the unique final good, as the author assumes a Cobb-Douglas production function with elasticity of substitution equal to one.

⁹In the case of [Mak and Siow \(2018\)](#), workers are endowed with cognitive and non-cognitive skills.

labor supply, while [Haanwinckel \(2018\)](#) includes changes in demand and minimum wage. Consequently, it comes as no surprise that almost all changes in inequality are driven by movements in the relative supply of skills. Although the push towards more structural models that account for the role of occupations is certainly a valuable contribution, future research should try to extend them in the direction of accommodating other features of labor markets and workers' characteristics. Particularly, a dynamic model in which workers build up experience would not only help in accounting for the contribution of other worker characteristics, but also in understanding the reasons behind the observed decrease in the experience premium.

3 Changes in Demand: Trade Liberalization, Commodity Shocks, and Technological Change

In the first years of the 21st century, Brazil was hit by a positive demand shock that resulted in favorable terms of trade and spurred growth in the commodity sector of the economy, together with economy-wide gains. Similarly, in the early 1990s, Brazil underwent important economic reforms that liberalized markets both through reduced tariff and non-tariff barriers on imports. Traditional neoclassical models predict that both shocks, by changing the relative price of goods that are intensive in a particular kind of factor - in our case, low or high-skilled labor - can lead to changes in income distribution. At the same time, important technological changes took place around the world, which researchers point out as potential sources of polarization and increasing wage inequality in the developed countries since these new technologies increased the demand for high-skilled workers ([Autor and Dorn, 2013](#); [Autor and Handel, 2013](#)). In this section we investigate the possible impacts each of these factors may have had in the Brazilian wage distribution.

3.1 Trade liberalization and its impact on inequality

It is widely agreed among economists that international trade can affect the distribution of earnings within countries by changing the relative prices of products and factors. For instance, the well-known Stolper-Samuelson theorem within the Heckscher-Ohlin model predicts that increases in the relative price of a given product will increase the remuneration of the factor most intensively used in its production. Moreover, it predicts that trade liberalization increases the relative prices of the relatively more abundant factor of production. By using two types of labor, skilled and unskilled, this theorem can help us understand relative changes in the wages of low and high educated workers.

Latin America has provided researchers with a fertile ground for investigations of trade liberalization impacts due to the large tariff reductions that took place in many countries in the region during the late 1980s and early 1990s. Overall, the evidence suggest that Stolper-Samuelson mechanism are unable to account for the whole story of changing inequality in the region, since most Latin American countries have seen the relative wages of skilled workers increase after episodes of trade liberalization (Goldberg and Pavcnik, 2007; Pavcnik, 2017). Moreover, there is scant evidence of sector mobility, at least in the short-run, an important assumption in general equilibrium models of trade. Some arguments have been put forth to explain this inability of the theory to account for the observed changes, including that the sectors most affected by trade liberalization were precisely those intensive in skilled labor. Other models, however, have emphasized other aspects of trade to make sense of the observed changes, such as trade-induced skill-biased technological changes, short-run factor immobility, and firm heterogeneity. In this section, we review studies that investigate both traditional and new models of international trade and wage inequality in the Brazilian context.

Following the overall trend in the region, Brazil experienced a large decrease in protectionism in the late 1980s and early 1990s. Ferreira et al. (2007b) report average nominal tariffs reduction to 13.9% in 1995 from 43.4% in 1987. Effective rates fell even more, to 20.0% from 55.8%. Neoclassical trade theory predicts that these cuts in tariffs should affect relative price, relative wages, and inequality. Gonzaga et al. (2006) test the Stolper-Samuelson's theorem in the Brazilian context. They report a decrease in skill premium of 15.5% between 1988 and 1995 in the manufacturing sector. Based on mandated wage equations, they estimate that changes in prices due to trade liberalization are actually responsible for an approximate 25% drop in the skill premium during the period, concluding that other changes in the economy (such as skill-biased technological changes) counter-acted the wage effects of trade liberalization. Ferreira et al. (2007b) expand the analysis to the whole economy. Unlike other Latin American countries, Brazil observed a reduction in wage inequality in the period, which the authors suggest was driven by the larger incidence of tariff reductions in more skill-intensive industries, leading to larger reduction in prices in these industries, and consequently, to reductions in the relative wages of skilled workers. Their decomposition exercises show that industry-specific wage changes were unimportant, a finding consistent with previous work by Pavcnik et al. (2004). However, changes in occupational reallocation and economy-wide returns to skills both contributed to reductions in inequality, account for nearly 60% of the reduction in the Gini coefficient between 1988 and 1995.¹⁰

¹⁰However, the authors cannot fully attribute reductions in skill premium to changes in international trade.

[Dix-Carneiro and Kovak \(2015\)](#) investigates the impact of the tariff reductions on regional skill premia using the local labor markets approach. They assume that the Brazilian economy is made of a set of small economies with no labor mobility across regions. Each region is endowed with skilled and unskilled labor, together with a vector of industry-specific factors, which lead to differential participation of industries across regions. Moreover, industries differ by the intensity with which they use skilled and unskilled labor. In their framework, the impact of uniform tariff reductions on the regional skill premium will be mediated by the differential industry-composition of each region, weighted by the share of skilled workers employed by each of them. Therefore, the skill premium will fall more in regions where the tariff decline was more incident on industries employing a larger share of skilled workers. Contrasting the traditional local labor markets approach, in this setting the “differential tariff shock” will depend not only on industry composition, but also on the labor composition of these industries. Their results show that regions facing more negative tariff shocks experience larger reductions in regional skill premium. The effects are significant both in the 1991-2000 and 1991-2010 periods and are similar in magnitude, meaning that changes in tariffs can have long lasting effects on regional skill premia. Considering the longer period, they estimate that trade liberalization in the late 1980s and early 1990s was responsible for 11% to 14% of the observed decline in the skill premium.

Finally, following a new strand of literature on international commerce, [Helpman et al. \(2017\)](#) look for possible impacts of trade liberalization on interfirm wage differences and wage inequality. They observe an increasing importance of within sector-occupation wage variance in explaining overall wage inequality in the period, much in line with the findings of [Alvarez et al. \(2018\)](#). Their model relies on firm heterogeneity instead of neoclassical trade theory to link wage inequality and trade liberalization. Besides heterogeneity in productivity, their model also includes heterogeneity in firm’ screening costs and fixed exporting costs. The intuition behind it is that exporting firms tend to be larger in size and pay higher wages than non-exporting firms. Firms select into export or non-export activities based on their productivity and fixed costs of exporting, whereas different screening costs enable firms of the same size to pay different wages. Once tariffs are reduced, the share of workers in the exporting sector increases,¹¹ which in turn increases wage inequality. Focusing only on the formal manufacturing sector, they document that between 1986 and 1995 Brazil experienced a 10% increase in the

¹¹This increase in the share of workers results from job displacement, since in principle tariff reductions should not directly increase the absolute size of the exporting sector. In line with this result, [Menezes-Filho and Muendler \(2011\)](#) showed that more protected firms displace more workers after trade liberalization, but these workers are not reabsorbed by more productive or exporting firms, resulting in idle resources in the economy.

share of workers employed in exporting firms. Their model predicts an increase in wage inequality of 2% in the period, while the observed increase in the standard deviation of log wages was 8% in the period.

Therefore, recent work by [Dix-Carneiro and Kovak \(2015\)](#) and [Helpman et al. \(2017\)](#) supports the previous conclusion of [Gonzaga et al. \(2006\)](#) and [Ferreira et al. \(2007b\)](#) that trade liberalization had an effect on skill premium and wage inequality, although their findings suggests a rather limited impact of trade liberalization on these outcomes. Moreover, the conclusion by [Helpman et al. \(2017\)](#) seems to contradict that of other authors who analyzed the period by finding the trade liberalization episode to be inequality-increasing. Besides the fact that [Helpman et al. \(2017\)](#) include in their analysis only formal workers in the manufacturing sector, we must consider that apart from [Dix-Carneiro and Kovak \(2015\)](#), all other papers analyzed a period of high volatility in inequality, as shown by [Ferreira et al. \(2007a\)](#): the Gini went from 0.578 in 1986 to 0.609 in 1988, and reached a maximum of .625 in 1989, then decreased to 0.573 in 1992 and increased again to 0.591 in 1995. Other measures of inequality display similar volatility. Hence, whereas in the 1988-1995 period there was a decrease in inequality, if we consider 1986-1995, we observe an increase. This is something that may be behind the conflicting results of these papers, and studies that rely exclusively on this period of high volatility in inequality measures should be evaluated with care.

3.2 Commodity boom

More recently, Brazil experienced a large improvement in terms of trade caused by a surge in the prices of commodities. This increase was to a large extent caused by the rise of China on international commerce. The participation of China in Brazilian exports and imports increased dramatically between 2000 and 2010: from 2% and 2.3% to 14.5% and 15.1%, respectively. Exports were mostly of agricultural and extractive products, whereas imports were mostly from manufactured goods ([Costa et al., 2016](#)). The increase in domestic demand brought about by the commodity boom may have impacted wage inequality through skill premium even without differential demand across sectors of the economy. As argued by [de La Torre et al. \(2015\)](#), differences in the elasticity of labor supply is a sufficient condition for symmetric increases in demand to have a differential impact on wages across skill levels. If unskilled labor supply is less responsive to wage changes, symmetric increases in demand will result in larger relative wage increases for this group. [Bargain and Silva \(2017\)](#) estimate labor supply elasticities for some countries in Latin America, including Brazil. They find that among married women, the largest labor force reservoir in these economies, the labor participation of skilled workers is more responsive to changes in demand than that of unskilled workers, with the elasticities for

skilled workers in this groups being around 20-30% larger than for the unskilled.

However, there is evidence of differential impacts across regions based on their initial basket of industries. [Costa et al. \(2016\)](#) uses these differences to investigate the impact of the surge in China's import penetration and expanded demand for some Brazilian products. Using data from the Brazilian Census representative of the whole economy, they show that local labor markets¹² at the 80th percentile of exposure to increased demand experienced a 0.93 p.p. higher increase in average wages than regions in the 20th percentile. Similarly, labor markets in the 80th percentile of exposure to imports from China experienced a 0.82 p.p. drop in average wages of manufacturing workers. Labor markets more exposed to export shocks also increased the share of formal jobs. Therefore, if there were different impacts of the boom according to industry composition, we expect that differences in the intensive use of skilled vs. unskilled labor across these industries may result in changes in skill premium and wage inequality. In fact, as documented by [Benguria et al. \(2018\)](#), the industries in the commodity sector of the Brazilian economy are more unskilled-intensive¹³ than in the tradable manufacturing sector, followed by the industries in the non-tradable sector. Moreover, the distribution of skill intensity of industries in the commodity and tradable sectors is more homogeneous than in the nontradable sector.

[Adão \(2015\)](#) and [Benguria et al. \(2018\)](#) use differences in industry composition across local labor markets to assess the impact of the commodity boom on skill premium and wage inequality in Brazil. The first develops a Roy model in which heterogeneous workers self-select into a commodity and a non-commodity sector based on their productivity in each of these sectors. An increase in commodity prices increases the wages of both skilled and unskilled workers, benefiting more the latter due to the high intensity of unskilled labor in the commodity sector. As a result, workers reallocate across sectors, and regions specialized in producing commodities observe a convergence in wages with more industrialized regions. Using data from the Brazilian Census, [Adão \(2015\)](#) estimates that this process can account for 5-10 percent of the reduction in the variance of log wages between 1991 and 2010. [Benguria et al. \(2018\)](#), using matched data of workers in the formal sector and firms, consider a similar cost mechanism by which the increase in commodity prices rises the relative price of unskilled workers, thus reallocating workers across industries. However, they also consider a second mechanism, a wealth channel. With the increase in commodity prices there is a surge in demand in the whole economy, benefiting firms that serve the domestic market. Hence, there should be a reallocation of

¹²These labor markets are defined based on microregions, which are groups of municipalities developed by IBGE based on the integration of their local economies.

¹³The commodity sector includes agriculture, mining and fuels. Skilled labor is defined as college-educated labor force.

workers from exporting to non-exporting firms. They show that firms that do not engage in exporting activities are precisely the ones that, on average, pay lower wage premia, resulting in wage compression.¹⁴ They estimate that the largest observed increase in commodity prices, between 2002 and 2011, is associated with a reduction in skill premium of 7 log points.¹⁵ They confirm the proposed cost and wealth channels, accounting for an estimated 2/3 of the reallocation across sectors and between exporter and non-exporter firms.

Finally, the commodity boom may have impacts on the wage distribution simply due to the resulting currency appreciation. As the value of domestic currency raises, exporting firms suffer losses, which may trigger the mechanism described in the model developed by [Helpman et al. \(2010\)](#). Since exporting firms are larger and pay higher wages, and because interfirm wage dispersion is lower within the nontradable sector, the reallocation of labor from the exporting to the nontradable resulting from currency appreciation should result in decreased dispersion of wages. [Messina and Silva \(2017\)](#) argue that this can be a potential mechanism in explaining decreased wage inequality in Brazil, where 2/3 of the decrease in inequality among workers in the same sector and occupation occurred through a reduction in the variance of wages between firms. However, they do not provide an empirical analysis of this hypothesis. Some evidence against it is provided by [Benguria et al. \(2018\)](#), who investigate the possible confounding effect of commodity prices and exchange rate in their specification, showing that this is not what is driving their results. However, their focus is limited to skill premium and reallocation of workers, and may not account for other mechanism responsible for determining interfirm wage differentials. Further research is necessary to clarify the role of exchange rate appreciation on inequality.

3.3 Effects of trade liberalization on regional, racial, and gender wage gaps

[Barros et al. \(2010\)](#) and [Ferreira et al. \(2007a\)](#) had already noticed the relevance of gaps between groups defined by location, race and gender in explaining changes in overall wage inequality. More recently, [Ferreira et al. \(2017\)](#) reinforce their conclusion, showing that racial, gender, and regional gaps were important factors in accounting for the reduction in wage inequality between 1995 and 2012. Changes in the composition of the workforce with respect to race, gender, and regional and urban situation combined

¹⁴Notice that the employment reallocation from exporting and non-exporting firms is compatible with the inequality reducing mechanism modeled by [Helpman et al. \(2010\)](#) and [Helpman et al. \(2017\)](#).

¹⁵[Fernández and Messina \(2018\)](#) document a decline in the college-premium with respect to secondary and primary school of 56.6 log points between 1995 and 2013 for the whole Brazilian economy.

account for a reduction in wage inequality, as measured by the Gini index, of -0.30 in the period, while the whole reduction in the Gini was -8.95 points. Changes in the payment structure related to these racial and gender gaps account for -1.59 and regional and urban-rural gaps for -1.27, respectively. Taken together, the total effect of these three categories explain around 1/3 of the reduction in inequality in the period. However, these changes in payment structure were more important up to 2003. This may caution against expecting that such trends will continue to contribute to the drop in inequality in the coming years.

What was behind the reduction in such gaps? The answer to this question is far from clear, and probably varies among these groups. With respect to regional gaps, the conclusions drawn by [Dix-Carneiro and Kovak \(2017\)](#) may provide some guidance. They found that regional wage premia decreased substantially for regions more affected by trade liberalization, and this effect instead of vanishing in the long-run actually exacerbates, with more affected regions observing relative decreases both in average wages and employment. Even though the authors do not explore this possibility, their finding can explain the convergence in regional gaps if the regions most affected by trade liberalization are precisely those that exhibited the largest premia. [Adão \(2015\)](#), in the context of the commodity boom, argued that the regions more affected by the rise in commodity prices were precisely the ones with lower average wages. Therefore, regional gaps should decrease. Similarly, if the commodity boom benefited mostly rural areas, it should have also contributed to the reduction in the gap between urban and rural areas.¹⁶ [Freguglia and Menezes-Filho \(2012\)](#) use data from RAIS to investigate the decrease in inter-regional wage differentials and show that nearly 2/3 of the differences in regional wage premia are explained by differences in composition, including unobserved ability. Hence, we should also expect that at least part of the convergence in regional gap be the result of a convergence in the distribution of skills across regions.

Trade liberalization may also have played a role in reducing gaps among minorities, a possibility investigated by [Hirata and Soares \(2016\)](#) with respect to the black-white wage gap. The prediction of taste-based discrimination models is that racial gaps should decline with increased competition ([Becker, 1955](#)). [Hirata and Soares \(2016\)](#) find that regions that were more exposed to foreign competition after trade liberalization in the early 1990s are also the regions with larger declines in the conditional racial wage gap between 1991 and 2000. Racial gaps may also have fallen as a consequence of decreased interfirm heterogeneity in wages. [Gerard et al. \(2018\)](#) show that 20% of the white-nonwhite wage gap is explained by nonwhites being less likely to work in firms with higher wages, and at least one third of this under-representation is due to unexplained preference

¹⁶We thank Liliana Sousa for suggesting this channel.

for white workers in these high-paying firms, which suggests discriminatory practices in hiring and retention of workers. Moreover, within firm differences in wage premiums across races account for another 5-6% of the total racial wage gap. The wage losses due to unexplained differences in sorting and wage-setting are larger among workers with higher skills, as measured by workers fixed-effects, suggesting that discrimination may be important in explaining differences at the top of the distribution. We may therefore conjecture that the observed decrease in firm heterogeneity during the 1990s and 2000s documented by [Alvarez et al. \(2018\)](#) may be somehow related with the reduction in the wage gap across races. However, without causal models it is not possible to pin down the exact direction of this effect: was it the reduction in firms' heterogeneity that led to a decrease in racial wage gaps, or was it a reduction in discrimination that contributed partially to the compression of the firm-specific pay premium?

[Machado et al. \(2018\)](#) find that the gender earnings gap in Brazil is diminishing across generations, at least within the formal sector. If taste-based discrimination is also behind the observed gender gap, then the trade liberalization episode in the early 1990s may be also responsible for part of the reduction in the gender gap. [Morchio and Moser \(2019\)](#) develop an equilibrium search model that includes firm and worker heterogeneity, as well as gender-specific amenities and employer taste for discrimination. Using matched data for firms and workers in the formal Brazilian sector, they find evidence for taste-based discrimination, as it explains around 2/3 of the observed raw gender gap in earnings¹⁷ of 15 log points. The gender earnings gap conditional on a richer set of dummies - years of schooling, interacted with potential experience dummies, and state, industry and occupation dummies - increases the earnings gap to 22 log points,¹⁸ meaning that women are on average endowed with more characteristics that earn higher returns, such as years of education. As [Gerard et al. \(2018\)](#) did for races, they also find that firm heterogeneity plays an important role in explaining differences of payment across genders. They decompose the overall gender gap into a within- and between-firm pay gap, finding that half of the differences is explained by each of these components. The importance of firms effects, together with occupation and industry effects, is also documented by [Machado et al. \(2018\)](#), with a larger impact of these covariates on the gender gap among more educated workers. Again, given the recent decrease in firms fixed-effects documented by [Alvarez et al. \(2018\)](#), it is not clear whether this was partially caused by a reduction in gender differences in payment or the reduction in the gender gap was the result of decreasing inequality in payment policies across firms.

Considerable differences in the lifecycle income profile of men and women are an

¹⁷Earnings include differences in hours worked. For hourly wages, the gap is 7.8 log points.

¹⁸20 log points for hourly wages.

important factor behind the gender wage gap. For Brazil, this fact is established by [Fraga et al. \(2017\)](#); [Machado et al. \(2018\)](#) and [Morchio and Moser \(2019\)](#), with the latter showing that this distinct pattern does not arise between white and non-white workers in Brazil. Gender differences in earnings reach a peak around age 40 and reduces thereafter. [Morchio and Moser \(2019\)](#) show that women transition less to high paying jobs, what may explain such differences. Moreover, if mobility rates were equalized the gender gap would be in fact inverted. [Fraga et al. \(2017\)](#) investigate the role played by distinct selection patterns across genders, finding smaller chances of high-ability women remaining in the labor market than high-ability men. Their results also indicate that almost 1/3 of the conditional gender wage gap among formal workers is due to different patterns in selection. [Fraga et al. \(2017\)](#) conjecture that such differences arise due to timing of fertility decision. [Morchio and Moser \(2019\)](#) investigate the role of motherhood and maternity leaves in explaining some of the facts documented by them. They find precisely the opposite, with wage growth of mothers accelerating relative to women that did not take a leave, conditional on mothers remaining employed. However, the authors caution that these results may be biased due to some factors, such as the significant drops in labor force participation among women after motherhood. In a nutshell, many factors may help explain the recent reduction in gender gaps, such as changes in the fertility decisions, selection into the labor market, convergence in mobility rates of men and women, and diminishing returns to potential experience. Further research on this topic would be needed to clarify the observed trends and its effects on Brazilian inequality.

3.4 Skill- and age-biased technical change

Together with changes in international commerce, technological change is another possible cause for the rise in inequality that high-income countries are experiencing since the 1980s. In particular, automation and technologies of information (TI) are responsible for the obsolescence of many former middle-class jobs in developed countries or enabled these jobs to be outsourced. This resulted both in an increase in the skill premium, given the skill-biased nature of these technological changes, and polarization of the wage distribution, with an increase in employment in the top and bottom of the distribution, with a compression in the middle ([Acemoglu and Autor, 2011](#); [Autor and Handel, 2013](#); [Autor and Dorn, 2013](#); [Firpo et al., 2011](#)).

The potential of automation and TI in affecting developing countries is yet controversy. Particularly for Latin America, evidence points to a different story than that in developed countries, with neither signs of polarization nor increased inequality, according to [Maloney and Molina \(2016\)](#). However, among the 21 countries that they analyzed, Mexico and Brazil displayed some trends that resemble that of polarization, with relative

growth of occupations such as operators, crafts and clerks being smaller than that of others, following trends similar to the US.

Few papers in Brazil tried to assess the impact of technological changes in the economy. [Corseuil et al. \(2018\)](#) look at the potential impact of the expansion in digital technology in Brazil in the early 2000s, using the differential rollout of internet provision to evaluate the changes in the demand for skills, defined based on occupations' task content. They rely on variation in rollout across three dimensions: municipalities, differences in industry participation, and time, arguing that industries that use information technology intensively and are located in municipalities with early access to internet are likely early adopters of digital technology, which induces them to replace routine and manual task for cognitive, non-routine jobs. They find a shift in demand towards more cognitive and non-routine tasks. Although they do not investigate the effects on relative wages and inequality, if we assume that such tasks are generally performed by skilled workers, the adoption of digital technology should have increased inequality in Brazil. Since in the period there was a reduction in inequality, it is possible that the increase in the demand for non-routine and cognitive jobs was off-set by the large inflow of more skilled workers or by other competing trends in demand (the commodity boom, for instance).

In his analysis of demand shocks, [Haanwinckel \(2018\)](#) considers three channels that may alter the relative demand for skills: technical changes, conceptualized as shift towards more complex tasks in the production of goods; reduction in the entry cost gap between different goods; and convergence in physical productivity across goods. The increase in task complexity, which mimics skill-biased technological changes, induce more productive firms to employ only college-educated workers, increasing their wage premium. Simultaneously, it transfers high school educated workers to less complex firms where they share similar activities with less educated workers, thus generating a "polarization" in labor markets. By itself, this technological change should increase inequality, at the same time making labor markets more assortative. However, the other two components work towards reducing it, as they reduce cross-firm wage dispersion. First, because the most productive firms employ only college educated workers, there is minimal cross-firm wage dispersion for workers with high school or less, reducing within-group inequality for these workers, especially those with secondary education. Second, the convergence in entry costs reduces the cross-firm wage premium for college workers and consequently inequality within this group too. The overall effect of this combined demand shock accounts for 40% of the decline in variance of log wages in the period analyzed.

Based on these works, we see that skill-biased technological change may have operated in Brazil in the period, but its magnitude was so small that it was off-set by other demand changes or economic mechanisms triggered by an increase in the relative supply

of educated workers. Nonetheless, we caution that there is a small number of studies on this topic, which should deserve more attention, both in Brazil and Latin America in general.

4 Changes in Institutions: Minimum Wages and Formality

Apart from changes in the educational composition of labor supply, Brazil's labor markets experienced important institutional changes in the first decade of the 21st century. As we discussed in the introduction, the minimum wage more than doubled in real terms between 1994 and 2013, with a real increase of almost 60% after 2003. At the same time there was a considerable formalization in labor markets, with the share of informal jobs decreasing from half the working force to 38% between 2000 and 2012. Simultaneously, differences in wages between workers employed under these circumstances also decreased. These movements were followed by changes in enforcement of labor legislation and a significant decrease in unemployment, which raised workers' bargaining power. Finally, although the dispersion of wages for both formal and informal workers decreased in the 2000s, the dispersion of wages of workers in the formal sector remained smaller than that of workers in informal sectors. These changes are all expected to affect the earnings distribution, reducing wage inequalities.

4.1 Minimum wage

Overall, studies in Brazil have not found negative employment responses to the minimum wage, nor large displacement to the informal sector, but they do find compression in wages (Lemos, 2009; Corseuil et al., 2015; Saltiel and Urzúa, 2018). These results may be due to concomitant economic growth. For example, Saltiel and Urzúa (2018) find larger negative effects of the minimum wage on employment in regions less exposed to commodities booms. Besides the overall economic situation, the effect of the minimum wage may also depend on its bite, as measured for instance by its size relative to median income. Messina and Silva (2017) document wide variations in the ratio between minimum and median wages across Latin American countries. For Brazil, it has increased from around 0.4 in 1994 to nearly 0.6 in 2014. For Uruguay, these figures were respectively 0.2 and 0.4, whereas for Peru both figures were around 0.8. These differences are related to compliance to the minimum wage. On one hand, around 40% of the population makes less than the minimum wage in Peru, since it is so high that it has no practical effects on wage distribution. On the other hand, in Uruguay the minimum wage is so low

relative the median wage that it barely affects the wage distribution, since most of the population makes more than the minimum wage. Brazil is an intermediary case in which we observe a large hike in the distribution of wages around the minimum wage, which demonstrates its importance in determining the wage distribution.

With respect to inequality, most studies in the previous decade find a negative relationship between increases in the minimum wage and inequality. For the period between 1981 and 1999, [Menezes-Filho and Rodrigues \(2009\)](#) use the semiparametric approach of [DiNardo et al. \(1996\)](#) and find that decreases in the real minimum wage during the period were related to increases in inequality. Covering a period of real increases in the minimum wage, [Firpo and Reis \(2007\)](#) find that they were associated with lower wage inequality between 2001-2005. [Neumark et al. \(2006\)](#) arrive at a different conclusion for the period between 1996 and 2001. They use a measure of bindingness to assess the impact of the minimum wage on the distribution of family income. The minimum wage is related to small increases in wages for the bottom of the distribution only in the short-run, that is, when they consider the contemporaneous share of earners below the minimum wage. However, when they consider the effects of this share in previous quarters, i.e., long-run effects, it becomes negative.

As pointed out by [Saltiel and Urzúa \(2018\)](#), the effects of the minimum wage may depend on the macroeconomic situation, with increases being beneficial only when a growing economy can support them. [Ferreira et al. \(2017\)](#) provide evidence suggesting this mechanism. They show that raises in the minimum wage increased inequality in the period between 1995 and 2002, marked by smaller growth and higher unemployment, while they find the opposite effect between 2003 and 2012. Using data from the Brazilian formal sector, [Engbom and Moser \(2018\)](#) and [Haanwinckel \(2018\)](#)¹⁹ take a more structural approach and find that minimum wage increases contributed considerably to reductions in inequality between 1996 and 2012, estimating that 60% of the wage inequality reduction during the period was the direct or indirect consequence of minimum wage increases. In both models, the minimum wage can have important spillover effects, not only raising the wages of those directly affected by them, but also on percentiles as high as the 80th. In [Engbom and Moser \(2018\)](#), these effects on higher percentiles of the distribution happen because firms must keep up their wages' rank with respect to the wages of competing firms. As some firms have to adjust their wages due to minimum wage increases, so must other firms if they want to attract the same type of workers. Therefore, minimum wage increases spill over to higher-paying firms.²⁰ [Haanwinckel \(2018\)](#) finds spillovers up to the

¹⁹For [Haanwinckel \(2018\)](#) the period of analysis starts in 1998 and only for the Brazilian state of Rio Grande do Sul.

²⁰Such effect could also be the result of wages being indexed on the minimum wage. However, we do not have information on this matter. We thank Lilita Sousa for this point.

40th percentile. Also, the mechanism by which his model leads to spillovers is based on distance-dependent complementarity,²¹ a property stating that workers of similar types are substitutes (for instance, complete primary and incomplete high school) and compete for the same tasks, whereas those of very different types (college graduates and workers with primary school only) are complements.

Apart from a 60% reduction in the variance of wages, minimum wage increases are also associated with reductions in the skill premium and variance of firm fixed effects, both documented to be crucial mechanisms in the reduction of inequality in the period (Ferreira et al., 2017; Alvarez et al., 2018; Fernández and Messina, 2018). Finally, neither Engbom and Moser (2018) nor Haanwinckel (2018) discuss the possible effect of the minimum wage through the so-called “lighthouse effect” (Lemos, 2009). According to this hypothesis, the minimum wage is used as a reference wage and has a role coordinating wage policy, inclusive among informal workers. Hence, it is possible that increases in minimum wages compressed wages even in the informal sector.²²

4.2 Role of formalization and unions

Ferreira et al. (2017) find that increased formalization and a decreasing wage gap between formal and informal workers account for a decrease of -0.32 and -1.14 points in the Gini coefficient between 1995 and 2012, out of a total reduction of 8.95 points. They argue that changes in the labor market and higher enforcement of labor regulation may have contributed to the rise in formal jobs and decrease in inequality. First, a better economic outlook may have increased workers’ bargaining power because of higher demand for labor, placing them in a better position to demand formalized labor contracts, possibly reducing wage gaps across groups. Second, Mattos et al. (2018) present causal evidence that increased enforcement of regulation by the Ministry of Labor and Brazilian Public Prosecutor’s Office increases the share of formal jobs. Differences in formal employment may also arise from international trade (Dix-Carneiro and Kovak, 2017), and this effect may be mediated by enforcement itself, with increases in informality where labor regulation is less enforced (Ulyssea and Ponczek, 2018).

The impact of increases in enforcement on inequality in Brazil is not clear yet. On the one hand, Meghir et al. (2015) show that an increase in enforcement reduces informality, raises welfare by reallocating workers to higher productivity jobs, and does not affect unemployment. The result is higher wages in both sectors, while the effect on inequality is ambiguous, with a reduction when measured by the 90/10 ratio and an increase when measured by the 75/25 ratio. On the other hand, Ulyssea (2018) develops a model in

²¹See Teulings (2003) for more details on this property.

²²We thank again Liliana Sousa for highlighting this possibility.

which firms must choose whether to be formal, and if formal, whether to hire formal or informal workers. His counterfactual scenario with increased enforcement leads to a reduction in the number of informal firms, but results in welfare loss. This happens because more enforcement imposes entry costs on informal firms, reducing their number. Since informal firms hire mostly low-skilled labor, the wages of these workers are reduced due to lower demand, increasing the skill premium. Given these conflicting results, more research is needed to clarify the net effect of higher enforcement on wage inequality.

Declines in unionization have been pointed out as a possible factor behind the increasing inequality in the United States in the last decades. For instance, [DiNardo et al. \(1996\)](#) finds a significant role for de-unionization in explaining rising inequality in that country. Similarly, [Firpo et al. \(2018\)](#) find that de-unionization is associated with decreasing wage inequality at the lower tail of the wage distribution in the United States, whereas it increases wage dispersion in the upper tail. In Brazil, however, research on this topic is limited. A possible reason for this lack of studies is the distinct way in which unions are organized in Brazil. Until 2017, a constitutional mechanism called “union contribution” entitled unions with an annual and automatic transfer proportional to salaries. This legal structure provided large incentives for the creation of new unions with the exclusive aim of capturing this rent, not necessarily representing workers interests ([Menezes-Filho et al., 2008](#)). According to [Messina and Silva \(2017\)](#), labor union membership in Brazil is higher in the upper half of the income distribution, which may reflect this particular incentive structure.

Among the few exceptions in the Brazilian literature, [Arbache \(1999\)](#) looks directly to the effect of unions on wage premium and wage dispersion of semi-skilled formal male workers in the manufacturing sector. This restriction on the sample may potentially reduce concerns with selection, although no procedure is explicitly conducted aiming at correcting it. He finds that unions are associated with higher wages, although the premium is small. However, unions seem to increase wage dispersion, with wage dispersion among union members being around 11 percent higher than among non-union members. A possible explanation for this is that unions in Brazil do not promote standardization, that is, unions amplify the returns to various workers’ attributes instead of reducing them. Other reasons for such result is the larger dispersion of workers’ characteristics and the smaller bindingness of the minimum wage among unionized workers. Hence, given the reduction in union density reported by [Messina and Silva \(2017\)](#) of 22 to 17 percent, we should expect a decrease in inequality due to union participation. However, the limited number of studies and information on this topic prevent more thorough analysis of the impact of unions on wage inequality.

5 Conclusion and a Guide for the Future

5.1 General conclusions

The decrease in wage inequality in Latin America, and Brazil in particular, was a surprising event in a world that observed widespread increases in dispersion of wage distribution since the 1980s. Economists have discussed the causes behind the observed trend in Brazil since the early 2000s, offering possible explanations for this phenomenon that included large increases in the supply of more educated workers, which affected inequality both through price and composition effects ([Barros et al., 2010](#)); increases in the minimum wage and formalization, which led to a compression of the distribution of wages; trade liberalization that reduced the skill premium through general equilibrium effects; and decreases in wage gaps across regions, races, and genders. Recently, some studies revisited these causes and added new evidence on this issue. Here, we reviewed these papers, discussing to what extent they agree and disagree with each other, highlighting their weaknesses and strengths. Considering the overall literature, we conclude that the observed decrease in inequality that started in the mid-1990s and accelerated during the 2000s resulted from a combination of favorable economic outlook, which included macroeconomic stability and beneficial terms of trade, with structural and institutional changes in the economy, most notably a growth in the share of skilled labor and increasing real minimum wages. This situation allowed for overall wage increases, but at a faster rate in the bottom of the income distribution, thus reducing wage inequality.

It has been theorized that changes in international trade, which include the trade liberalization carried out in the early 1990s and the commodities boom set by the rise of China in the 2000s, have potential implications for the wage distribution within countries. Recent research on the effects of these events on the Brazilian economy confirms the existence of the traditional mechanism of relative factor prices ([Dix-Carneiro and Kovak, 2015](#); [Adão, 2015](#)), but also point to other mechanisms, such as changes in the firm-specific wage premium ([Helpman et al., 2017](#)), wealth and cost channels that shift demand and employment across sectors ([Benguria et al., 2018](#)), and reductions in regional, racial, and gender wage gaps ([Dix-Carneiro and Kovak, 2017](#); [Hirata and Soares, 2016](#); [Morchio and Moser, 2019](#)). In particular, these other mechanisms may help explain the compression in firm effects, an important factor behind the reduction in inequality that has been recently uncovered, as documented by [Alvarez et al. \(2018\)](#). However, the direct impact of trade liberalization and the commodity boom seem to play a rather limited direct role.

The economic benefits of trade and the commodity boom may have derived mostly from their positive impact on economic growth and how it allowed for policies and structural changes to reflect in lower inequality. First, real increases in the value of the

minimum wage seem to have had a substantial impact on wage inequality. [Ferreira et al. \(2017\)](#) estimate that around 17% of the decrease in inequality between 2003 and 2012 is accounted by increases in the minimum wage, while [Engbom and Moser \(2018\)](#) and [Haanwinckel \(2018\)](#) find that it explains nearly 60% of the reduction in wage dispersion between 1996 and 2012, including direct and indirect effects. [Saltiel and Urzúa \(2018\)](#) and [Ferreira et al. \(2017\)](#) argue that increases in the minimum wage only have distributive effects during periods of economic growth, as they are followed by increases in formalization and employment. Hence, the favorable external situation and overall economic stability were essential ingredients that allowed real raises in the minimum wage in the last decades to result in lower inequality. Second, symmetric increases in demand, such as that prompted by the commodity boom, may have heterogeneous effects across worker groups if the elasticity of labor supply differs across them, as highlighted by [de La Torre et al. \(2015\)](#) and [Bargain and Silva \(2017\)](#).

Although previous research has highlighted the role of increases in relative supply of skilled workers, especially due to the large number of high-school and college graduates, recent research disputes such claim. Although the importance of declining skill premia is confirmed by many studies ([Ferreira et al., 2017](#); [Alvarez et al., 2018](#); [Fernández and Messina, 2018](#)) and that labor supply is the main factor behind it ([Fernández and Messina, 2018](#)), the increase in years of schooling also had an inequality-increasing effect due to the convexity of its returns. [Ferreira et al. \(2017\)](#) and [Haanwinckel \(2018\)](#) find that this endowment effect is so large that it cancels out the gains from reduction in returns. Of course, other factors may be behind the effects of having a larger share of skilled workers on the economy, such as decreases in the quality of education, skill obsolescence, and occupational structure ([Messina and Silva, 2017](#); [Jaume, 2018](#)). However, more research is need on these topics.

Some important questions, however, remain unanswered. One of them is what drove the reduction in the potential experience premium. Recent research confirms that it did have quite an important role in inequality reduction ([Ferreira et al., 2017](#); [Alvarez et al., 2018](#); [Fernández and Messina, 2018](#)). The reasons behind such decline, however, are not yet clear, especially because the observed changes in labor supply do not seem to account for the drastic change in its return ([Fernández and Messina, 2018](#); [Ferreira et al., 2017](#)). Age-biased technological changes, skill obsolescence, higher minimum wages, and changes in selection into the labor market may have favored younger workers and could be possible explanations for such reduction, but the empirical research on this topic is scant.

The role of technological change, which has been pointed out as one of the main drivers of increasing inequality and polarization in high-income countries, is yet to be

determined in Brazil. The little evidence on this is provided by [Corseuil et al. \(2018\)](#), who confirm that it had an effect in boosting the demand for more skilled workers; and by [Haanwinckel \(2018\)](#) who finds evidence that technological changes, defined as increases in the complexity of tasks performed by firms, increase wage inequality and polarization. The effect studied by [Haanwinckel \(2018\)](#), however, is small, being dwarfed by other demand shocks that resulted from reduced entry cost gap between goods and convergence in productivity. He argues that these two shocks are also responsible for reductions in cross-firm wage dispersion, which is a third factor associated with decreases in inequality that has not yet been properly explained. [Alvarez et al. \(2018\)](#) point out that compression in productivity dispersion does not seem to be the factor driving this convergence, but rather reductions in pass-through, while [Engbom and Moser \(2018\)](#) argues that minimum wages are responsible for this observed reduction in pass-through. However, other possible explanations for the decline in interfirm wage premia may be a decline in monopsony power ([Tucker, 2017](#); [Card et al., 2018](#)), a decline in gender and racial gaps ([Gerard et al., 2018](#); [Morchio and Moser, 2019](#)), and changes in international commerce ([Helpman et al., 2010](#); [Messina and Silva, 2017](#)). We believe this to be a promising area of research.

Finally, the new line of research based on tax records may provide useful information on the dynamics of inequality in Brazil. As for now, it seems that including such information in the estimations of inequality leads to the conclusion of its stagnation in the past decades, especially because the role of top earners in inequality seems to have increased in the period ([Medeiros et al., 2014, 2015](#)). However, an underestimation bias of inequality in usual official sample surveys such as PNAD is not necessarily true if the cases of omitted income reporting are equally distributed across the distribution. For instance, [Barros et al. \(2007\)](#) argue that poorer families may omit non-monetary income or occasional income transfers from the government (such as unemployment insurance) or from relatives. In fact, [Barros et al. \(2007\)](#) compute similar or smaller measures of inequality using different sources of information than the traditional Brazilian Household Survey (PNAD). Hence, more research is needed on this topic to clarify the role of top earners in inequality and its dynamics.

5.2 What to expect in the coming years

In the last years, the decline in inequality in Brazil has stalled, displaying a small increase in the last quarters. Should we expect a halt in the process of inequality reduction in the coming years, even an increase? Also, what could be done for Brazil to return to the previous path of inequality reduction?

Real minimum wage increase, one of the main factors behind the decrease in wage

inequality in the 2000s, has possibly lost its potential of reducing it. The reason is twofold. First, the economic outlook in Brazil is still dire. Wages are stagnant, unemployment rose quickly, and growth is probably far from returning to the levels observed during the commodity boom. As argued by [Ferreira et al. \(2017\)](#) and [Engbom and Moser \(2018\)](#), the negative relationship between the minimum wage and inequality seems to depend on the economic context, and the current outlook may not be suitable for this sort of policy. Second, the minimum wage bite has increased to historically high standards, and are among the largest in the region, now reaching around 70% of the median wage.²³ It is possible that at such high levels, no room is left for the minimum wage to act as a compressor of the earnings distribution. In fact, recently the Brazilian government announced a stop on the policy of real increases in the minimum wage.

The international context may not favor reductions in inequality either. First, the commodity boom that seems to have favored the reduction in inequality will probably not return any time soon. Second, with the devaluation of the real, we should expect an increase in the employment in exporting firms, thus triggering an inequality-enhancing mechanism as described by [Helpman et al. \(2010\)](#). Moreover, if skill-biased technical change was actually acting in Brazil, but countered by other trends, with the retreat of these other forces, inequality may rise as a consequence.

Changes in the wage gaps among groups of workers should follow the underlying causes behind their decrease in the last decades. Therefore, changes that reduce interfirm heterogeneity and increase competition should reduce racial and gender gaps. Nonetheless, it is also possible that the current high levels of unemployment may penalize more these minority groups and increase gaps. It is not clear what is behind the gaps across formal and informal workers and whether more enforcement would increase or decrease them. Regional gaps probably vary according to overall economic dynamics that may be beyond the control of policy makers. However, based on the numbers reported by [Ferreira et al. \(2017\)](#), we should expect that the speed of convergence in the return among the groups will decrease, as it did during the 2000s compared to the 1990s.

Education expansion is a way of reducing inequality that may be effective, if the Brazilian economy manages to switch from a situation characterized by the “paradox of progress” and move to a phase of decreasing inequality in the “Kuznets curve”. Not only is there a long way until Brazil reaches the levels of schooling as other developed countries, but there is space for improvement in the quality of education, where Brazil lags behind even among developing countries. However, apart from improving the quantity and quality of schooling, there is little space for the government to act.

²³Based on data from PNAD Contínua, third quarter of 2018.

References

- D. Acemoglu and D. Autor. Skills, tasks and technologies: Implications for employment and earnings. In *Handbook of labor economics*, volume 4, pages 1043–1171. Elsevier, 2011.
- R. Adão. Worker heterogeneity, wage inequality, and international trade: Theory and evidence from brazil. *Unpublished paper, MIT*, 2015.
- J. Alvarez, F. Benguria, N. Engbom, and C. Moser. Firms and the decline in earnings inequality in brazil. *American Economic Journal: Macroeconomics*, 10(1):149–89, 2018.
- J. S. Arbache. Do unions always decrease wage dispersion? the case of brazilian manufacturing. *Journal of Labor Research*, 20(3):425–436, 1999.
- D. H. Autor. Skills, education, and the rise of earnings inequality among the other 99 percent. 344(6186):843–851, 2014.
- D. H. Autor and D. Dorn. The growth of low-skill service jobs and the polarization of the us labor market. *American Economic Review*, 103(5):1553–97, 2013.
- D. H. Autor and M. J. Handel. Putting tasks to the test: Human capital, job tasks, and wages. *Journal of Labor Economics*, 31(S1):S59–S96, 2013.
- D. H. Autor, A. Manning, and C. L. Smith. The contribution of the minimum wage to us wage inequality over three decades: a reassessment. *American Economic Journal: Applied Economics*, 8(1):58–99, 2016.
- O. Bargain and J. Silva. Labor supply in latin america. *Background paper for J. Messina and J. Silva (forthcoming), Wage Inequality in Latin America: Understanding the Past to Prepare for the Future. Washington, DC: World Bank.*, 24, 2017.
- R. J. Barro and J. W. Lee. A new data set of educational attainment in the world, 1950–2010. *Journal of development economics*, 104:184–198, 2013.
- R. Barros, S. Cury, and G. Ulyssea. A desigualdade de renda no brasil encontra-se subestimada?: Uma análise comparativa com base na pnad, na pof e nas contas nacionais, 2007.
- R. Barros, M. De Carvalho, S. Franco, and R. Mendonça. Markets, the state, and the dynamics of inequality in brazil. *Declining inequality in Latin America: A decade of progress*, pages 134–74, 2010.

- M. Bassi, M. Busso, S. Urzúa, and J. Vargas. *Disconnected: Skills, education, and employment in Latin America*. Inter-American Development Bank, 2012.
- G. S. Becker. *The Economics of Racial Discrimination*. PhD thesis, University of Chicago, 1955.
- G. S. Becker. A theory of marriage: Part i. *Journal of Political economy*, 81(4):813–846, 1973.
- L. Behaghel and N. Greenan. Training and age-biased technical change. *Annals of Economics and Statistics/Annales d'Économie et de Statistique*, pages 317–342, 2010.
- F. Benguria, F. Saffie, and S. Urzúa. The transmission of commodity price super-cycles, 2018.
- A. Camacho, J. Messina, and J. Uribe Barrera. The expansion of higher education in colombia: Bad students or bad programs?, 2017.
- R. M. Campos-Vazquez, L. F. Lopez-Calva, and N. Lustig. *Declining wages for college-educated workers in Mexico: Are younger or older cohorts hurt the most?* The World Bank, 2016.
- D. Card, J. Heining, and P. Kline. Workplace heterogeneity and the rise of west german wage inequality. *The Quarterly journal of economics*, 128(3):967–1015, 2013.
- D. Card, A. R. Cardoso, J. Heining, and P. Kline. Firms and labor market inequality: Evidence and some theory. *Journal of Labor Economics*, 36(S1):S13–S70, 2018.
- C. H. Corseuil, M. Foguel, and M. Hecksher. Efeitos dos pisos salariais estaduais sobre o mercado de trabalho: uma nova abordagem empírica. *Economia Aplicada*, 19(1): 131–169, 2015.
- C. H. Corseuil, J. P. Poole, and R. K. Almeida. The impact of digital technologies on worker tasks: do labor policies matter?, 2018.
- F. Costa, J. Garred, and J. P. Pessoa. Winners and losers from a commodities-for-manufactures trade boom. *Journal of International Economics*, 102:50–69, 2016.
- A. de La Torre, G. Beylis, and A. Ize. *LAC Semiannual Report October 2015: Jobs, Wages and the Latin American Slowdown*. The World Bank, 2015.
- J. DiNardo, N. M. Fortin, and T. Lemieux. Labor market institutions and the distribution of wages, 1973-1992: A semiparametric approach. *Econometrica*, 64(5):1001–1044, 1996.

- R. Dix-Carneiro and B. K. Kovak. Trade liberalization and the skill premium: A local labor markets approach. *American Economic Review*, 105(5):551–57, 2015.
- R. Dix-Carneiro and B. K. Kovak. Trade liberalization and regional dynamics. *American Economic Review*, 107(10):2908–46, 2017.
- N. Engbom and C. Moser. Earnings inequality and the minimum wage: Evidence from brazil, 2018.
- M. Fernández and J. Messina. Skill premium, labor supply, and changes in the structure of wages in latin america. *Journal of Development Economics*, 135:555–573, 2018.
- F. H. Ferreira, P. G. Leite, and J. A. Litchfield. The rise and fall of brazilian inequality: 1981–2004. *Macroeconomic Dynamics*, 12(S2):199–230, 2007a.
- F. H. Ferreira, P. G. Leite, and M. Wai-Poi. *Trade liberalization, employment flows, and wage inequality in Brazil*. The World Bank, 2007b.
- F. H. Ferreira, S. P. Firpo, and J. Messina. *Ageing Poorly? Accounting for the decline in earnings inequality in Brazil, 1995–2012*. The World Bank, 2017.
- S. Firpo and M. C. Reis. O salário mínimo ea queda recente da desigualdade no brasil. *Desigualdade de renda no Brasil: uma análise da queda recente*, 2:499–506, 2007.
- S. Firpo, N. M. Fortin, and T. Lemieux. Occupational tasks and changes in the wage structure, 2011.
- S. Firpo, N. Fortin, and T. Lemieux. Decomposing wage distributions using recentered influence function regressions. *Econometrics*, 6(2):28, 2018.
- E. Fraga, G. Gonzaga, and R. R. Soares. Selection on ability and the early career growth in the gender wage gap. (Working Paper 10791), 2017.
- R. S. Freguglia and N. A. Menezes-Filho. Inter-regional wage differentials with individual heterogeneity: evidence from brazil. *The Annals of Regional Science*, 49(1):17–34, 2012.
- L. Gasparini, S. Galiani, G. Cruces, and P. Acosta. *Educational upgrading and returns to skills in Latin America: evidence from a supply-demand framework, 1990-2010*. The World Bank, 2011.
- F. Gerard, L. Lagos, E. Severnini, and D. Card. Assortative matching or exclusionary hiring? the impact of firm policies on racial wage differences in brazil, 2018.

- P. K. Goldberg and N. Pavcnik. Distributional effects of globalization in developing countries. *Journal of economic Literature*, 45(1):39–82, 2007.
- G. Gonzaga, N. Menezes Filho, and C. Terra. Trade liberalization and the evolution of skill earnings differentials in brazil. *Journal of International Economics*, 68(2):345–367, 2006.
- D. Haanwinckel. Supply, demand, institutions, and firms: A theory of labor market sorting and the wage distribution, 2018.
- E. Helpman, O. Itzhoki, and S. Redding. Inequality and unemployment in a global economy. *Econometrica*, 78(4):1239–1283, 2010.
- E. Helpman, O. Itzhoki, M.-A. Muendler, and S. J. Redding. Trade and inequality: From theory to estimation. *The Review of Economic Studies*, 84(1):357–405, 2017.
- G. Hirata and R. Soares. Competition and the racial wage gap: Testing becker’s model of employer discrimination, 2016.
- E. J. Hobsbawm. *Age of extremes*. Little Brown and Company, 1995.
- D. Jaume. The labor market effects of an educational expansion: A theoretical model with applications to brazil, 2018.
- S. Lemos. Minimum wage effects in a developing country. *Labour Economics*, 16(2): 224–237, 2009.
- L. F. López-Calva and N. C. Lustig. *Declining inequality in Latin America: A decade of progress?* Brookings Institution Press, 2010.
- N. Lustig, L. F. Lopez-Calva, and E. Ortiz-Juarez. Declining inequality in latin america in the 2000s: the cases of argentina, brazil, and mexico. *World Development*, 44: 129–141, 2013.
- C. Machado, M. Neri, and V. Neto. The gender gap, education, and the life cycle profile in the brazilian formal labour market, 2018.
- E. Mak and A. Siow. Occupational choice, matching and earnings inequality. *Unpublished manuscript*, 2018.
- W. F. Maloney and C. Molina. Are automation and trade polarizing developing country labor markets, too?, 2016.

- M. Manacorda, C. Sánchez-Páramo, and N. Schady. Changes in returns to education in latin america: The role of demand and supply of skills. *ILR Review*, 63(2):307–326, 2010.
- E. Mattos, R. Politi, and G. Fuschini. Fiscalização no mercado de trabalho e informalidade nos municípios brasileiros. *Nova Economia*, 28(1):103–126, 2018.
- M. Medeiros, P. Souza, and F. Á. d. Castro. A estabilidade da desigualdade de renda no brasil, 2006 a 2012: Estimativa com dados do imposto de renda e pesquisas domiciliares (the stability in the income inequality in brazil, 2006-2012: An estimate with tax and survey data). *Ciência & Saúde Coletiva*, 20(4), 2014.
- M. Medeiros, P. Souza, and F. Á. d. Castro. O topo da distribuição de renda no brasil: Primeiras estimativas com dados tributários e comparação com pesquisas domiciliares, 2006-2012 (top incomes in brazil: First estimates with tax data and comparison with survey data, 2006-2012). *DADOS—Revista de ciências sociais, Rio de Janeiro*, 58(1), 2015.
- C. Meghir, R. Narita, and J.-M. Robin. Wages and informality in developing countries. *American Economic Review*, 105(4):1509–46, 2015.
- N. Menezes-Filho and E. A. d. S. Rodrigues. Salário mínimo e desigualdade no brasil entre 1981-1999: uma abordagem semiparamétrica. *Revista Brasileira de Economia*, 63(3):277–298, 2009.
- N. A. Menezes-Filho and M.-A. Muendler. Labor reallocation in response to trade reform, 2011.
- N. A. Menezes-Filho, J. P. Chahad, H. Zylberstajn, and E. T. Pazello. Trade unions and the economic performance of brazilian establishments. *Estudos Econômicos (São Paulo)*, 38(1):55–72, 2008.
- J. Messina and J. Silva. *Wage inequality in Latin America: Understanding the past to prepare for the future*. The World Bank, 2017.
- I. Morchio and C. Moser. The gender gap: Micro sources and macro consequences, 2019. URL https://www.econ.iastate.edu/files/events/files/gg2019_submission_corrected.pdf.
- D. Neumark, W. Cunningham, and L. Siga. The effects of the minimum wage in brazil on the distribution of family incomes: 1996–2001. *Journal of Development Economics*, 80(1):136–159, 2006.

- N. Pavcnik. The impact of trade on inequality in developing countries, 2017.
- N. Pavcnik, A. Blom, P. Goldberg, and N. Schady. Trade liberalization and industry wage structure: Evidence from brazil. *The World Bank Economic Review*, 18(3):319–344, 2004.
- J. Rodríguez, S. Urzúa, and L. Reyes. Heterogeneous economic returns to post-secondary degrees: Evidence from chile. *Journal of Human Resources*, 51(2):416–460, 2016.
- C. Rodríguez-Castelán, L. F. López-Calva, N. Lustig, and D. Valderrama. *Understanding the dynamics of labor income inequality in Latin America*. The World Bank, 2016.
- A. D. Roy. Some thoughts on the distribution of earnings. *Oxford economic papers*, 3(2): 135–146, 1951.
- F. Saltiel and S. Urzúa. The effect of the minimum wage on employment in brazil, 2018. URL <http://www.clapesuc.cl/research-paper/does-an-increasing-minimum-wage-reduce-formal-sector-employment-evidence-from-brazil>
- C. N. Teulings. The contribution of minimum wages to increasing wage inequality. *The Economic Journal*, 113(490):801–833, 2003.
- L. Tucker. Monopsony for whom? evidence from brazilian administrative data, 2017.
- G. Ulyssea. Firms, informality, and development: Theory and evidence from brazil. *American Economic Review*, 108(8):2015–47, 2018.
- G. Ulyssea and V. P. Ponzek. Enforcement of labor regulation and the labor market effects of trade: Evidence from brazil, 2018.
- J. Van Reenen. Wage inequality, technology and trade: 21st century evidence. *Labour economics*, 18(6):730–741, 2011.
- Y. Wang. Education expansion and decline in tertiary premium in brazil: 1995-2013, 2015.