International trade, temporary workers and wage inequality in Colombia: the manufacturing sector ♣

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Abstract:

This article delivers empirical evidence for the Colombian manufacturing sectors on the relation of both, trade integration and sector skill intensity, over the skill-premia, during the period 1993-2012 and the subperiod 2000-2012. I bring forward different measures of Skill-Biased Technical Change considering wages and social security benefits, then, I estimate the general bias generated by the skill intensity variable and compare it with the sector-specific bias, obtained from interaction between skill intensity and four measures of international trade. As the openness and the labor flexibility reforms occurred almost simultaneously around the 90s, I control for the share of temporary workers in each manufacturing subsector. I find evidence that, together, skill intensity and international trade bring about more SBTC, causing more wage inequality. However, this effect is compensated by a negative impact of increasing temporary workers on the skill premia.

Key words:

Skill biased technical change, skill premia, international trade, manufacturing sector, labor flexibilization, temporary work, emerging countries, Colombia.

JEL codes:

J31, J82, J88, F14, F15, F16. O14, O33, O54.

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1. Introduction

The trade-tariffs reform in Colombia called "Openness Policy" was implemented officially in the 90s; however, it had already begun some years earlier: the simple average nominal tariff decreased steadily from 31% in 1985 to 12% in 1994.[1] Furthermore, such policy were strengthened during the 2000s and 2010s with the negotiation and execution of Free Trade Agreements with a wide range of countries; among the most representative are those with the United States of America (2012), the European Union (2013) and the Pacific Alliance (2015). To date, there exists 20 Trade Agreements, whilst only four of them were signed before 2000.

As a result, according to the World Bank, real GDP increased more than twice between 1990 and 2014 (an average annual growth rate of 3.6%). The volume of international trade grew on average at an annual rate of 7%, although it run on a deficit trade balance for most of the period (2.7% of the GDP on average). Likewise, according to CEPAL, the income inequality index Gini barely decreased during the whole period: on average, from 0.568 between 1991-1999, to 0.555 during 2002-2010, and to 0.538 during 2011-2014.[2]

Such results appear not to be consistent with the Stolper-Samuelson theorem, as the increasing trade with relatively skilled-labor abundant countries such as those in the European Union as well as the United States, historically, the main destination of Colombian exports, has not driven an increase in unskilled workers' wages, therefore, a corresponding decrease in income inequality has not taken place. The objective of this article is then, assessing empirically whether international trade brings about more or less wage inequality in the Colombian context.

Another issue I consider in this exercise is the fact that, historically, a small part of exports corresponds to high and medium technology manufactures, Álvarez and Bermúdez (2010) calculate these percentages as 2.1% and 10.3%, respectively for 2010. The rest of exports were primary 59%, resource-based manufactures 16.3%, low technology 6.8%, and others 5.5%. Moreover, destination of more than 70% of high and medium technology are developing countries, whilst, a similar percentage of primary, resource-based and low technology go to developed countries. This structure suggests that Colombian exports are mainly unskilled intensive.

[1] See Escobar (2017).
[2] See Figures 1 and 2 in the Appendix.

In this context, the openness reform occurred almost simultaneously with the labor flexibilization reform in the 1990s, affecting equally all formal economic sectors. The impact of this labor cost reduction is observed in a positive time trend of temporary workers, hired either directly or indirectly through agencies, which may influence estimates in favor of unskilled workers' wages, if most of temporary are unskilled, or in favor of skilled if the proportion of skilled is higher, depending on the industrial sector.

Acemoglu (2003) in turn, extends Stolper-Samuelson and Hecksher-Ohlin's framework to show that, including the Skill Bias Technical Change SBTC endogenously in the model, it is possible to explain positive effects of International Trade on skill premia for developed countries. However, for developing countries instead, it could be either positive or negative, conditional to their relative technological level with respect to other developing countries.

Conversely, advanced models explaining wage inequality by interaction of workers skills, job tasks, evolving technologies, and shifting trading opportunities, like Acemoglu and Autor (2011), are not useful for the objective of this study. Indeed, many of the recent empirical trends on international trade that they explain, are quite related to international *intra-industry* trade, offshoring and automation, which were not important for the Colombian case during the 1990s and 2000s. Caicedo and Mora (2011) calculate that only the 9% of total trade between the US and Colombia matches to *intra-industry* trade.

Empirically, one of the most comprehensive studies about the openness effects in Colombia is Attanasio et al. (2004). Using National Household Survey data, they find evidence about tariff reductions and a *relatively small* increase in wage inequality, during the period 1984-1998. Such effect is driven by three factors: the SBTC, measured as the relative skilled workers ratio, which is affected by the increased foreign competition; the negative relation between industrial wage premia and tariff cuts (as an economy-wide phenomenon instead of by sectors); and the reallocation of workers towards the informal sector before the labor flexibility reform.

Unlike that paper, Heskel and Slaugther (2002) show theoretically and empirically that sector bias of SBTC can influence the relative factor prices, not only the factor bias; therefore, SBTC from skill-intensive sectors may cause positive changes in skill premia. They estimate the sector bias by regressing their own measures of SBTC as function of the sector skill intensities. For Acemoglu (2003), instead, the relative productivity of skilled workers (technical change) is endogenous under

trade opening and shaped by the interaction between domestic skill intensity and world skill intensity (or international trade).

Consequently, I contribute to the empirical literature related to the international trade effects on skill premia, by merging the theory of Acemoglu (2003) and the empirical methodology of Haskel and Slaughter (2002), to estimate sector-specific bias of the SBTC generated by the interaction of the skill intensity with trade integration. Skill intensity definition considers non-production workers over production workers, obtained from the Annual Manufacturing Survey. Various proxies, collected from different sources, measure trade integration: traded volume by origin country and destination; tariff changes from their actual level with respect to the former level in 1980; and the share of exporters by subsector. The inclusion of such variables aids me to evaluate robustness of estimates and capturing specific impacts of trade with developed and developing countries.

Thanks to available data in that survey, a source of information that has not been exploited in this topic in the Colombian case, I control by the share of formal temporary workers in each manufacturing sector, separating the effect of the labor flexibilization reform on wage inequality. That effect offers new evidence in this country context, since it may explain the negligible impact of trade reform on the informal labor sector. Furthermore, I extend the period of observation to 1993-2012, in which new Free Trade Agreements entered into force.

The main results of the research are that interaction of sector skill intensity with trade integration causes a decrease on the sector-specific bias of SBTC, with respect to the non-interaction specification, for sector tariff reductions and sector exporting firms. Likewise, the sector-specific bias is positive in practically all econometric models, generating in many sectors wage inequality. But, that effect is moderated when the sector skill intensity increases (fixing trade with developing countries and sector exporters) bringing about less skill premia. Furthermore, the control variable for temporary workers had negative effects on the SBTC, decreasing wage inequality and compensating the positive effect of both, the rise of the sector skill intensity and trade integration.

The structure of this article is organized as follows: Section 2 discusses some relevant literature related with the impact on SBTC, trade, relative skill demand and wage inequality. Section 3 delivers some details about the data used in the research and some stylized facts. Results of the empirical estimates are related in Section 4. Conclusion is presented in Section 5.

2. Literature Review

This article is based on Acemoglu (2003), which explains the relation over time of international trade and wage inequality between skilled and unskilled workers. The author extends the Heckscher-Ohlin model including a production function with endogenous technology and Research and Development process of innovation, according to Grossman and Helpman (1991) and Aghion and Howitt (1992). They show that international trade brings about Skill-Biased Technical Change, generating in turn, an increase in the skill premia in the US, as well as in developing countries (depending on their comparative technical level). All these changes occur without a rise in the relative prices of skill-intensive goods in the US in the long term. Such theoretical findings fit the evidence of increasing wage inequality and relative skill supply during the 80s and 90s, in that country.

Acemoglu initially shows that without endogenous technology, H-O international trade model explains the impact of international trade on increases in the US wage inequality, since the price equalization generated by trade with developing countries, makes increase both, relative factor and skill-intensive goods' prices. After trade openness, the world wage inequality depends solely on the world relative skilled productivity. However, he relates many empirical studies in the US, showing evidence against those results, summarized in four arguments: the relative prices of skill-intensive goods did not increase. There were steady skill-biased technical change during many decades.[3] As in the US, many developing countries also experienced increasing wage inequality. Trade between the US and developing countries did not have significant effects on labor and product market prices.

Therefore, the author develops a model to relate international trade with technical change, showing that increased international trade (expressed as the world relative skill supply) and the domestic relative skill supply, in the context of endogenous technical change, influence technology choice. In comparison with the H-O setup above, in this model, technical change is skill biased. The reasons are the price effect and the market size effect, which make innovation more profitable: the first one corresponds to the higher relative price of skill intensive goods (in the US case), due to international trade rises; and the second one refers to the clientele increase for technology, due to a higher

[3] Acemoglu (2003) defines SBTC as "any change in technology that increases the aggregate demand for skills".

relative skill supply. Furthermore, the SBTC expands supply of skilled-intensive goods, keeping relative good prices stable or letting them grow by a limited amount.

Skill inequality under endogenous technical change is a function of two variables, the domestic relative skill supply and the world relative skill supply (representing international trade). For the US, wage inequality is bigger under endogenous technical change, because its relative skill abundance is higher than the world one. Developing countries instead, have ambiguous effects, depending on their relative skill-abundant level with respect to their competitors: most skill scarce countries should decrease inequality (according to H-O), while the skill abundant should rise the skill premia. Likewise, as trade allows those countries using US technologies, more SBTC in the US rises wage inequality in developing countries.

Acemoglu and Autor (2011) state that, in general, theories based on the "*Canonical model*" (with constant technology)[4] cannot explain several empirical facts in the US labor market. In that model, wage inequality between high and low skilled workers shaped by the supply of skills and the technical change, which is biased exogenously towards high skilled workers. Technology is *factor-augmenting*, complementing both kinds of labor. However, empirical evidence suggests that in the nineteenth century, technical change usually replaced skilled artisans; nowadays, offshoring, outsourcing and automation are substituting workers in some domestic tasks. Likewise, in recent decades, intermediate-skilled worker's wage fall while high skilled and low skilled occupations rise, in favor of *wage and job polarization*.

Even though SBTC is endogenous in Acemoglu (2003), depending on international trade and domestic relative skill supply, that approach neither explains labor market polarization nor workers substitution in certain activities and tasks. Since the objective of this study is analyzing a developing country case under certain economic regulation context, that theoretical structure is valid enough to describe the relation of international trade (mainly *inter-industry*) and wage inequality at industrial sector level. Nevertheless, authors like Medina and Posso (2010) have evaluated empirically the polarization theory using tasks intensities related to adoption of computer technologies for the Colombian case (1984-2009) as well as for Mexico (1990-200) and Brazil (1981-2001), finding evidence in favor of polarization except in the last country.

[4] Among others, Acemoglu and Autor highlight papers of Tinbergen (1974, 1975), Welch (1973), Katz and Murphy (1992), and Card and Lemieux (2001) to introduce the "Canonical Model".

Regarding the empirical methodology of this study, I follow Haskel and Slaughter (2002). The conclusion of their research is that sector bias of Technical Change matters to explain the direction of the TC effect on relative wages. Namely, technical change concentrated in skilled-intensive sectors increases skill premia, whilst technical change concentrated in unskilled-intensive sectors reduces it, this is the sector-bias hypothesis. For a small country world-prices taker, in a multisector context, that conclusion holds in the case of sector-specific TC or sector-pervasive factor-neutral TC, or sector-pervasive SBTC when it increases sector profitability.

This result corresponds to the wage *direct effect* in the case of big countries. As they influence world prices by moving the world relative supply, there is an opposed *indirect effect* on wages, which may offset or reinforce the *direct effect*. Thus, the sector-bias hypothesis holds for big countries when the indirect effect is sufficiently small.[5] The authors tested the hypothesis in ten OECD countries over the 1970s and 1980s, finding supporting evidence. Esposito and Stehrer (2009) found comparable results for three Central and Eastern European transition countries, using a similar methodology. Unlike Acemoglu (2003), they do not study the influence of international trade on the SBTC (and the subsequent relation with wage inequality), as it is assumed to be exogenous.

The relation of international trade and wage inequality, as expression of the more general topic of globalization and income inequality, has been analyzed in many countries. According to Goldberg and Pavcnick (2007), it is not possible to say that *international trade has favored the less fortunate*, on the contrary, there is an increase in income inequality within countries, particularly high in some cases like Mexico or Argentina. As literature do not show evidence of labor reallocation from declining to growing sectors in the economy, they state that wage effects are much larger than the employment effects.

Those wage effects are country and time-specific, thereby, simple theoretical predictions hardly hold when considering heterogeneity of developing countries, specific policies and globalization experience. They argue that the lack of sectoral income reallocation is due to at least three facts: a constrained labor mobility (labor market rigidities) prior to the trade reforms as well as capital market rigidities; trade barriers reductions concentrated in intermediate goods which are unskilled intensive; and the SBTC that can interact with or induced by globalization. Likewise, the relation

[5] This occurs in three cases: when the world relative demand elasticity is high (the small country case), or when there is no substitutability between factors of production (as in Leontief technology), or when there exists a non-traded sector absorbing factor supplies from tradable.

between industry tariff changes and probability of employment in the informal sector depends more on the country labor-market flexibility rather than on trade policies.[6]

Now, looking at the Colombian case specifically, most of the literature agrees on a positive effect of exogenous SBTC, or the workers relative skill supply, on wage inequality (for instance Méndez and Torres (1998) and Arango et al. (2004)). Furthermore, some authors study the impact of trade openness reform and other significant variables on skill premia, finding similar results: for instance, for the period 1976-1996, Cardenas and Bernal (1999) consider into the analysis occupational categories and macroeconomic variables, [7] such as private investment, public expenditure, exports, capital inflows, inflation, and currency overvaluation. All of them explain wages inequality because of the *package-reforms* implementation in the beginning of the 1990s,[8] enabling investment in skill complementary technologies within all economics sectors.[9]

Santamaría (2004) instead, using information from the National Household Survey, between 1978 and 1998, finds that wage inequality is associated mainly with shifts on the relative skill labor supply and technological change; whilst international trade (specially imports) has an equalizing modest effect, as it induces increasing demand for unskilled workers. Additionally, he argues that unemployment growth in the 1990s reduces inequality, since new unemployed had the lowest jobs, most of unemployed are high skilled, and firms demand more skilled workers. He also finds evidence of higher relative skill supply grow with respect to the relative skill demand grow.

Some authors as Attanasio et al. (2004) and Goldberg and Pavcnick (2005) critic the typical measures of trade integration, such as imports, exports, and price indices, with the argument that trade affects wages through prices, therefore, using those variables as regressors to explain wages is controversial, because of simultaneity bias. They propose then a new identification strategy exploiting information on worker's earnings, characteristics and industry affiliation from the

[6] In Brazil, there is no evidence on impacts of tariff declines over the probability of employment in the informal sector. Whilst in Colombia, evidence suggests a positive impact. Such different results across the two countries seems to be related with labor market institutions, which in Brazil are much more flexible than in Colombia (before the labor flexibilization reform).

[7] Occupational categories correspond to the National Household Survey definitions: private employee, public employee, self-employed, domestic service, employer, and family worker without monetary income.

[8] Among the most relevant reforms, between 1991 and 1994, authors highlight the following: average tariffs and non-tariff restrictions decrease, Free Trade Agreement with the Andean Pact, Mexico and Chile, labor market reform (1990), foreign investment reform, (1990), financial market reform (1991), exchange rate regime reform (1991) and pension system reform (1993).

[9] Robbins (2003) finds similar results, mainly for the exchange rate effect on wage inequality.

National Household Survey and merging it with industry-level tariff changes, to explore empirically the effect of openness reform on the SBTC and wage inequality. They find that relative skilled workers (SBTC) increase in all sectors, by more in those with larger tariff reductions, suggesting SBTC endogeneity, and that trade protection increases relative skill wages.

Other interesting findings are that changes in skill premia neither are correlated to changes in tariffs nor vary across industry sectors, discouraging labor reallocation across sectors. Likewise, statistics show that sectors with larger decrease in tariffs are mainly unskilled intensive; and that informal sector expansion occurred before the labor market reform, since foreign competition drove both, large and intermediate firms to reduce labor costs.

Medina and Posso (2010) also critic the existing literature about the Colombian case. Since the SBTC model is not able to explain two key facts of the labor market related with the called *labor market polarization*: the fall of middle-income workers' wages (routine tasks), and the increasing income inequality among the skilled workers (abstract task workers) but a stable inequality for unskilled (routine task and manual task workers). Hence, following Autor et al. (2003), they estimate the Task Biased Technical Change for Colombia, Mexico and Brazil, finding evidence of polarization except for the last one. They also find that inequality reduction within the unskilled workers and increasing inequality with respect to skilled workers; do not offset the effects of the economic recession in 1999.

I contribute to the related literature in three aspects: 1) Using information from the Annual Manufacturing Survey, which has been under-used in this topic, during the period (1993-2012), which give us a longer perspective on the effects of economic reforms in 1990s. 2) Following Acemoglu (2003) theoretical explanations about SBTC endogeneity in developing countries, with respect to trade integration, I modify accordingly Haskel and Slaughter (2002) methodology, by including into the sector bias of SBTC the interacted effect of both, trade integration (or tariff reductions) and relative skill intensity over the sector wage inequality. 3) I analyze the impact of labor flexibility reform on SBTC, by controlling for sector temporary workers.

3. Data and stylized facts

The basic database used in this study uses information from two sources: the Annual Manufacturing Survey (EAM), undertaken by the National Department of Statistics (DANE), and the Administrative Records about destination and origin country of trade, by the National Department for Tax and Customs (DIAN).[10] *The short database* consists of 66 manufacturing subsectors for the period 2000-2012 classified according to the International Standard Industrial Classification ISIC, Adapted to Colombia version 3, at 3-digit level. During the period 1993-1999, EAM subsectors are classified following ISIC-AC version 2, therefore, to obtain a *long database*, for the period 1993-2012, sectors are collapsed to 29 subgroups at the 3-digit level following DANE recommendations. The EAM methodology changed several years before 1993, during 1993-2012, and after 2012, thereby, making the sectors correspond to each other along a period longer than 1993-2012 would result in a less reliable database.[11]

Skilled workers are defined as the sum of professional workers, technicians and technologists, as well as sellers and administrative staff. Unskilled workers, instead, correspond to laborers and production workers. The two variables are available in both databases, except for the period 1995-1999 in the long database. Thus, I use the available information to fill that gap: for the total workers variable I infer the share of skilled and unskilled, according to a moving average growth rate from the last observation and the next future one. Similarly, during the same period, only the total wages and social security were reported, then, the same methodology is applied to compute the shares of both skilled and unskilled wages for each year of the gap period. The same happens with the share of temporary workers with respect to the total workers (temporary plus permanent).[12] I call the

[10] Although most of information used in this study is available in DANE's website, I obtained an aggregated database from the National Department of Planning - DNP, after direct request to the Directorate of Innovation and Business Development - DIDE. International Trade data from DIAN, is also collected and shared by the DNP-DIDE. This information is used as well in Villafradez and Luna (2013).

[11] 8 sectors of the short database, out of the 66, are not included in tables and are discarded of estimations because data for most of the variables was very scarce, remaining 58. Similarly, in the long database, sector 314 is discarded. To use at maximum the available data, I merged some very similar sectors: 353 is merged with sector 354, and sector 361 is merged with sectors 362 and 369. Information on sectors 354, 362 and 369 were very scarce. From the long database I work with 24 sectors out of 29.

[12] In the case of temporary workers, the only information available for the whole period is skilled workers. Hence, I obtain the sum of temporary and permanent workers for the last available years, and, apply the growth rate (the indexed change with respect to 1995) of skilled plus unskilled to forecast the variable and fill the gap. Then, using a similar methodology as for wages and workers, I infer the unskilled temporary workers.

wages and worker variables completed this way, the *projected ones*, even for the short database, in which there were not gaps.[13]

Table 1 compares the Descriptive statistics of the same variables, from the two databases. It is important having into account the relevance of working with these two information sets. The longer one captures more time variations, while the short one more sector variations. As both coincides during the period 2000-2012, estimations using the long database are largely affected by information during 1990s. Even though long database is obtained by merging two EAM methodologies, using the same data for 2000s, estimated results may vary accordingly with each database.

Table 1. Descriptive statistics. Two databases: 2000-2012 and 1993-2012.
(real variables in COP prices of 1999 and thousands)

	2000-2012					1993-2012				
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Sk wage Pr	748	13,908	5,446	5,898	40,881	480	15,155	6,379	4,526	48,819
Uk wage Pr	748	6,184	3,657	1,648	25,726	480	6,834	3,760	2,140	32,070
Tot wage Pr	748	8,875	4,440	3,083	30,956	480	9,813	4,875	2,850	36,047
Sk wage Perm	748	12,316	3,977	4,491	36,459	360	18,056	7,828	6,067	70,031
Uk wage Perm	748	5,993	2,256	2,962	14,220	360	5,625	2,533	424	14,220
Tot wage Perm	748	18,309	5,890	7,636	42,935	360	23,681	9,851	6,552	83,562
Sk wage Pe-te-ag	748	5,933	2,855	1,553	26,270	360	7,863	5,200	2,084	38,141
Uk wage Pe-te-ag	748	4,372	2,125	1,128	17,000	360	3,528	1,788	1,311	14,299
Tot wage Pe-te-ag	748	10,305	4,816	3,147	37,702	360	11,391	6,752	3,399	52,440
Assets[a]	748	9,722	18,000	211	142,000	480	9,535	18,700	235	142,000
Production[a]	748	16,300	32,100	509	312,000	480	14,600	33,800	762	312,000
Sk Perm	748	2,661	3,518	21	27,015	480	5,446	6,600	428	40,323
Uk Perm	748	3,471	3,833	25	22,318	360	9,184	9,466	783	55,691
Tot Perm	748	6,132	6,960	47	41,415	360	14,196	14,852	1,217	91,260
Sk temp	748	495	785	0	5,248	480	681	1,186	0	7,894
Uk temp	748	1,418	3,058	0	25,995	360	3,148	4,758	36	25,999
Tot temp	748	1,913	3,751	0	30,727	360	3,981	5,898	39	29,875
Sk agen	748	573	985	0	7,402	480	992	1,696	9	9,974
Uk agen	748	1,779	2,622	0	21,943	360	3,970	4,824	0	24,292
Tot agen	748	2,352	3,357	0	25,210	360	5,017	6,228	11	34,266

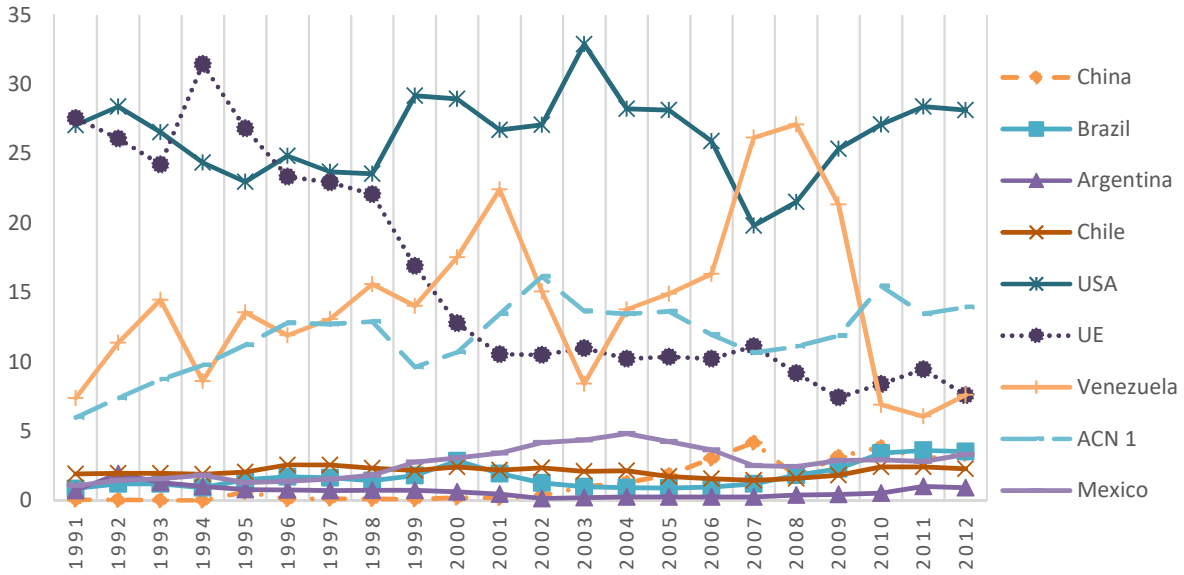
[13] These projected variables are available upon request.

Variable	2000-2012					1993-2012				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Sk Pr	748	3,849	5,173	23	38,837	480	9,139	10,583	662	60,231
Uk Pr	748	6,730	8,837	94	67,858	480	16,225	16,925	1,429	83,836
Tot Pr	748	10,579	13,189	118	86,511	480	25,364	26,421	2,164	143,915

Source: Own calculations. Based on DIAN and DANE. [a] Million COP
Notes: all wages in per worker averages and assets and production in per firm averages.
Sk: skilled, Uk:unskilled, Tot: total, Pr: projected variables, Perm: permanent workers,
Pe-te-ag: permanent, temporary and agency workers, agen: agency workers.

Regarding information on exports and imports, I divide total trade by manufacturing subsector into imports and exports by country of origin and destination. Figures 1 and 2 show the most important Colombian trade partners; among them United States, European Union, China, Venezuela and the Andean Community of Nations stand out. Furthermore, those countries are classified, either, as Developed Countries (DC) or Less Developed Countries (LDC).[14] US and EU are classified as DC, while Venezuela, the Andean Community of Nations, and China, as LDC.

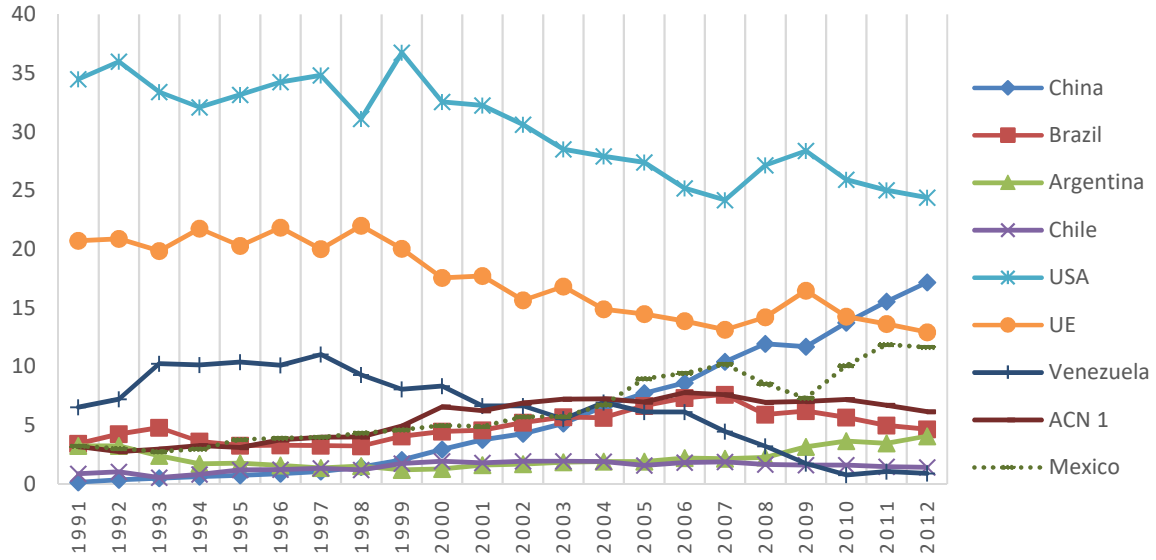
Figure 1. Share of manufacturing exports, 1991 - 2012. Colombia trade partners



Source: DIAN (Administrative records). Own calculations.
Note: 1 Andean Community of Nations (Ecuador, Peru, Bolivia, Colombia).

[14] According to Acemoglu (2003), all developing countries have the same technology level; they may differ only in relative skill abundance. I chose GDP per capita as a proxy of this variable, which allows for better classification of countries as DC and LDC groups. See Table 1 in the Appendix.

Figure 2. Share of manufacturing imports, 1991 - 2012. Colombia trade partners



Source: DIAN (Administrative records). Own calculations.
Note: 1 Andean Community of Nations (Ecuador, Peru, Bolivia, Colombia).

Now, I estimate the effect of the relatively more skilled intensive sectors on real sector average wages, the *skill bias wage gap*, following Boeri and van Ours (2008).[15] This simple exercise allows to understand some relations between the variables of databases across sectors and to interpret afterwards results from the analysis of the sector-specific bias of SBTC. The equation estimated is the following:

$$\log(\bar{w}_{st}) = \alpha D_{st} + X'_{st}\gamma + \varepsilon_{st} \qquad (1)$$

where D_{st} is a dummy variable equal to 1 when the sector is relatively more skilled intensive. X'_{st} is a matrix of specific characteristics affecting sector's real average wage, in this case: sector real average assets, sector real average production, sector average permanent workers, temporary and agency, and several measures of trade. α is the skill abundant sector average wage gap, such that $\hat{\alpha} = \log(\bar{w}^{HA}) - \log(\bar{w}^{LA}) \approx \frac{\bar{w}^{HA} - \bar{w}^{LA}}{\bar{w}^{LA}}$, where $\bar{w}^{HA}$ and $\bar{w}^{LA}$ represents the average wage of the skilled intensive sector (H) and the less skilled intensive sector (L).[16] Tables 2 and 3 present the coefficients obtained by OLS.

[15] This methodology is used originally to estimate the called union wage gap.
[16] In the short database, skilled abundant sectors correspond to those above the total (annual) average across sectors (0.57), 29 sectors out of 67. In the long database, skill abundant sectors correspond to the ones above the total (annual) average across sectors (0.56), 7 sectors out of 26.

Estimates of $\hat{\alpha}$ for the two periods yield positive and significant average wage gap between the most skill abundant and less skill abundant manufacturing sectors. For the short database, real average wages are between 17% and 20% higher than the less skill intensive sectors (the *skill bias wage gap*), depending on the trade integration variable used in the regression. Instead, for the long database, dispersion increases while magnitudes fall, fluctuating the wage gap between 8% and 13%.

Regarding the sector characteristics, it is possible to establish other relations: a) sector average assets are more important explaining the sector average wage in the long database, in which elasticities varies from 12% to 16%. b) similarly, quantity of permanent workers increases real average wages in both databases, whilst direct temporary and agency decreases average wages, though in general, the effects are bigger in magnitude for the long database (except for the agency workers' effect). c) elasticities of trade integration with respect to the sector average wage are positive in most of the cases, except exports to developed countries that has a negative effect in the long database. Likewise, I highlight that in the long database, trade with developing countries bring about higher average wages, while in the short one, this effect is replaced by trade with developed countries.

The above analysis shows the structural difference between the two databases, in general, we can say that *skill bias wage gap* is more important in the short one, as well as trade with developed countries, and that trade integration has a positive effect no matter the variable to measure it. Conversely, effects of workers and assets, on average, are more important in the long database.

Table 2. Skill sector wage gap, 1993-2012. OLS (real variables)

Dep Var: ln(real av wage Pr)	(1)	(2)	(3)	(4)
Dummy skill intensity	**0.13795*****	**0.08153*****	**0.09174*****	**0.12962*****
	(7.375)	(3.610)	(5.741)	(4.361)
Ln(real av assets)	0.16118***	0.13574***	0.12530***	0.13695***
	(8.446)	(6.726)	(9.028)	(6.427)
Ln(real av production)	0.04021	0.06860**	0.12149***	0.09853**
	(1.731)	(2.884)	(6.952)	(3.243)
Ln(Perm)	0.20611***	0.24277***	0.18196***	0.27662***
	(7.681)	(8.430)	(6.759)	(9.143)
Ln(Temp)	-0.09561***	-0.08704***	-0.04919***	-0.04001
	(-6.657)	(-5.372)	(-3.517)	(-1.511)
Ln(Agen)	-0.14805***	-0.15040***	-0.14798***	-0.24096***
	(-10.384)	(-8.747)	(-12.011)	(-7.469)
Ln(trade dc)	-0.00610			
	(-0.715)			
Ln(trade ldc)	0.05472***			
	(4.630)			

Dep Var: ln(real av wage Pr)	(1)	(2)	(3)	(4)
Tariff change		-0.00359***		
		(-4.271)		
Ln(imports dc)			0.02370***	
			(4.006)	
Ln(exports dc)			-0.05735***	
			(-9.540)	
Ln(imports ldc)			0.02660***	
			(3.375)	
Ln(exports ldc)			0.02072	
			(1.948)	
Ln(exporters)				-0.00634
				(-0.278)
Constant	5.06364***	5.69864***	4.81866***	5.17326***
	(26.783)	(33.680)	(32.082)	(17.258)
Obs	360	322	360	132
R2	0.893	0.891	0.933	0.896
F	203.976	180.364	264.629	473.122

$^{*}\ p < 0.05,\ ^{**}\ p < 0.01,\ ^{***}\ p < 0.001$

Source: own calculations based on DANE, DIAN and World Bank data.
Notes: t-statistics in brackets. av: average, Pr: projected variable, Perm: permanent workers, Temp: temporal workers, Agen: agency workers, dc: developed countries, ldc: developing countries, Tariff change with respect to 1980 level.
Sector 314 is not included in tables and is discarded of estimations because data for most of the variables was very scarce.
Sector 353 is merged with sector 354 and Sector 361 is merged with sectors 362 and 369. Time dummies not reported.

Table 3. Skill sector wage gap, 2000-2012. OLS (real variables)

Dep Var: ln(real av wage Pr)	(1)	(2)	(3)	(4)
Dummy skill intensity	**0.19237*** **	**0.17569*** **	**0.20160*** **	**0.16900*** **
	(12.686)	(8.923)	(12.466)	(6.616)
Ln(real av assets)	0.11068***	0.10406***	0.10984***	0.06136**
	(7.318)	(6.505)	(7.569)	(2.779)
Ln(real av production)	0.07653***	0.09708***	0.07758***	0.14502***
	(4.524)	(5.585)	(4.746)	(6.865)
Ln(Perm)	0.13433***	0.19386***	0.12261***	0.24976***
	(8.288)	(10.846)	(7.554)	(9.838)
Ln(Temp)	-0.02477*	-0.03079*	-0.02355*	-0.02578
	(-2.225)	(-2.555)	(-2.136)	(-1.586)
Ln(Agen)	-0.13835***	-0.15511***	-0.13999***	-0.26183***
	(-11.761)	(-10.406)	(-12.033)	(-11.161)
Ln(trade dc)	0.03476***			
	(5.590)			
Ln(trade ldc)	0.01438			
	(1.684)			
Tariff change		-0.00158		
		(-1.872)		
Ln(imports dc)			0.02583***	
			(5.057)	
Ln(exports dc)			0.00826*	
			(1.994)	
Ln(imports ldc)			-0.00717	

Dep Var: ln(real av wage Pr)	(1)	(2)	(3)	(4)
			(-1.278)	
Ln(exports ldc)			0.02699***	
			(3.497)	
Ln(exporters)				0.05318***
				(4.653)
Constant	5.22324***	5.63282***	5.29104***	5.43735***
	(46.391)	(37.570)	(45.026)	(27.530)
Obs	720	604	708	273
R2	0.823	0.781	0.829	0.789
F	208.408	154.166	197.023	178.527

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE, DIAN and World Bank data.
Notes: t-statistics in brackets. av: average, Pr: projected variable, Perm: permanent workers, Temp: temporal workers, Agen: agency workers, dc: developed countries, ldc: developing countries, Tariff change with respect to 1980 level.
Sector 314 is not included in tables and is discarded of estimations because data for most of the variables was very scarce. Sector 353 is merged with sector 354 and Sector 361 is merged with sectors 362 and 369. Time dummies not reported.

4. Empirical methodology

In this section, I link the estimation process suggested by Haskel and Slaughter (2002) and Esposito and Stehrer (2009) with the theory of Acemoglu (2003). I include into the empirical methodology the interaction effect between sector skill intensity and trade integration on the SBTC, while controlling for the sector's share of temporary workers, to consider as well the effect of labor flexibilization policy, and then, analyzing the relation of the SBTC's sector-specific bias with wage inequality.

Firstly, I obtain different measures of SBTC based on estimation of the next expression:[17]

$$\Delta\omega_{jt} = a_0 + a_1 \Delta \log \frac{W_{jst}}{W_{jut}} + a_2 \Delta \log \frac{K_{jt}}{Y_{jt}} + \varepsilon_{jt} \quad (2)$$

Such that $\omega_{jt} = \frac{W_{jst} S_{jt}}{W_{jst} S_{jt} + W_{jut} U_{jt}}$ is the skill-labor share of the total wage bill, and $\Delta\omega_{jt}$ its level change. $\frac{W_{jst}}{W_{jut}}$ denotes the wage skill premia for skilled with respect to unskilled in sector *j* and time *t*. *Y* represents production and *K* capital, and ε de error term, a_0 corresponds to the cross-sector SBTC average and $a_0 + \varepsilon_{jt}$ are interpreted as SBTC sectoral distribution. a_1 can be positive or

[17] This expression comes from Binswanger (1974) and Berndt and Wood (1982), who assume that sectors minimize labor costs using a translog production function with constant returns to scale and quasi-fixed capital. More details can be found in the articles.

negative depending whether the elasticity of substitution between skilled and unskilled workers is below or above one. a_2 represents capital skill complementarity.

Similarly to the authors, besides the measure of SBTC from eq. 2, I suggest four additional definitions for robustness checks: a) excluding the skill premia to avoid non-observed skill-mix variations in the regression, then, the SBTC is defined as the error term and the wage effect common to all sectors is captured by the constant coefficient. b) again, skill premia is discarded, and sector fixed effects and time dummies are included, SBTC is still measured as the error term. c) I instrument the skill premia with explanatory variables of the skill-mix, such us, experience, experienced squared, age and sex, in this specification SBTC is the constant plus the error term.[18] d) simply the ω_{jt}.

Secondly, I use the different measures of SBTC to estimate the following equations (3) to (5) below, in which $\frac{S_{jt}}{U_{jt}}$ represents the skill intensity, skilled over unskilled workers in sector *j* and time *t*, TI_{jt} corresponds to the Trade Integration variable, and $\frac{temp_{jt}}{tot_{jt}}$ is the share of temporary workers (direct + agency) over total workers (direct + agency + permanent):

$$SBTC_{jt} = b_0 + b_1 \frac{S_{jt}}{U_{jt}} + u_{jt} \qquad (3)$$

$$SBTC_{jt} = c_0 + c_1 \left(\frac{S_{jt}}{U_{jt}} * TI_{jt}\right) + c_2 \frac{temp_{jt}}{tot_{jt}} + u_{jt} \qquad (4)$$

$$SBTC_{jt} = d_0 + d_1 \left(\frac{S_{jt}}{U_{jt}} * TI_{jt}\right) + d_2 \frac{S_{jt}}{U_{jt}} + d_3 TI_{jt} + d_4 \frac{temp_{jt}}{tot_{jt}} + u_{jt} \qquad (5)$$

Computing the derivative of the sector SBTC with respect to the sector skill intensity (or relative skill demand), we obtain b_1, which is interpreted as the sector bias of the SBTC.[19] According to the sector bias hypothesis, positive values of b_1 should be associated to positive changes (rise) of skill premia, while negative b_1 should correspond to negative changes (fall) of skill premia.

Acemoglu (2003), who develops a model to explain why skill premia change in time and how it diverges across countries, supports equation (4) theoretically. In the model, increases in time of the

[18] These variables are available in the Colombian Household Survey made by DANE. I acknowledge Tenjo et al. (2018) for generously sharing with me this data.

[19] Haskel and Slaughter (2002) follow Lawrence and Slaughter (1993) to define equation (3). The latter estimate a similar expression to find the sector bias of product-price changes. More detail can be found in the article.

relative skilled workers supply induces SBTC, which is endogenous, and then, there is a rise in the relative skill demand, this is the market size effect. In turn, this is reinforced in the free trade framework, because the increasing price effect of the exporting products rises the relative demand of relative skills as well. Trade always rises wage inequality in developed countries, but the effect in developing countries depends on their relative technology level with respect to other developing countries. Therefore, SBTC depends not only on the relative skill supply, but also on trade integration. Equation (5) extend the econometric model and measure the interaction impact of the sector skill intensity together with trade integration, but also the effect of each variable separately.

While in eq. (3) coefficient b_1 represents the sector bias of the SBTC across sectors, derivatives of SBTC with respect to the sector skill intensity and trade integration are sector and time specific:

In eq. (4): $\frac{\partial SBTC_{jt}}{\partial(S_{jt}/U_{jt})} = c_1 TI_{jt}$ (6) and $\frac{\partial SBTC_{jt}}{\partial(TI_{jt})} = c_1 \frac{S_{jt}}{U_{jt}}$ (7)

In eq. (5): $\frac{\partial SBT\ _{jt}}{\partial(S_{jt}/U_{jt})} = d_1 TI_{jt} + d_2$ (8) and $\frac{\partial SBTC_{jt}}{\partial(TI_{jt})} = d_1 \frac{S_{jt}}{U_{jt}} + d_3$ (9)

I control in equations (4) and (5) for the effect on the SBTC of the temporary workers, both direct and agency. The labor-market flexibilization reform in 1990, introduced two important changes regarding temporal workers, with the objective to reduce firing costs and increase workers turnover: a) duration of the fixed term contracts changed from a minimum of a year to any duration less than that; and b) creation of agency labor, or indirect temporary work.[20] Goldberg and Pavcnick (2007) also highlights the relevance of these kind of institutions, as soon as tariffs reductions had a significant effect on informal jobs in Colombia before the labor reform, while in Brazil, where labor market is flexible, there were no effect. Indeed, temporary workers are skilled or unskilled, and in either case cheaper than permanent, having negative effects in firms' performance and in SBTC, as I show for the Colombian case.[21]

For estimation of equations (2) to (5) I consider different variables to measure the skill relative demand and the skill premia, and to calculate the skill-labor share of the total wage bill as well. I use initially the *projected variables* for skilled and unskilled workers and the corresponding wages. Then, according to the strictly available information from the Manufacturing Surveys, I divide workers by

[20] For details on the labor market reform, see Kugler (1999).
[21] For a discussion on the effect of nonstandard employment in firm performance, see ILO World (2016).

permanent, temporary direct and temporary from agency. I use also the sum of wages, salaries and social security for all workers, permanent, temporary direct and agency workers, for both databases. Additionally, for the short one, I include only wages and salaries of the permanent workers.[22]

According to Goldberg and Pavcnick (2007), one of the main drawbacks of the empirical literature on the relation of trade integration (typically measured with international trade), and inequality, is that trade should not be included in the regressions as an exogenous variable to explain wage inequality, because of potential simultaneous causality. To avoid this issue, I consider as trade integration variable the change in tariffs in time *t* and sector *j*, with respect to the former level in 1980, before the tariff reform, following Attanasio et al. (2004) and Goldberg and Pavcnick (2005).[23]

Likewise, I evaluate trade integration in the short database using the number of exporting firms by ISIC sector, for the period 2007-2012, using the Exporter Dynamics Database from the World Bank. I evaluate also the effect of trade with developing and developed countries, considering that I am not regressing trade integration against wage inequality and that I can compare the results with other measures of trade to assess the possible bias.

All those alternative measures for wage, labor, and trade integration, allows capturing different effects on the sector specific bias of SBTC and checking for robustness of the results. Tables 2 to 5 in the Appendix present descriptive statistics of the variables for the two databases. Tables 2 and 4 show the average of the relative exports (exports/imports) by developing (Ldc) and developing countries (Dc) by sector, as well as the percentage annual change. I study the following trade integration variables: tariff reductions in 2000 and 2012 with respect to the 1980 levels,[24] as well as the average reduction for the whole period, average exporters and their annual change by sector, and average share of trade with developing countries (shtradeldc), developed (shtradedc), and the level change of those shares along the period.

[22] Wages and salaries for permanent workers in the short database is a different variable than wages, salaries and social security for permanent and temporary direct workers. The former is not available for the long one.

[23] I thank the authors for kindly and generously share information on sector average nominal tariffs of 1980, at 3-digit CIIU. That data was collected by the National Department of Planning (DNP). The tariffs between 1993-2012 come from the World Bank and correspond to the MFN applied tariffs at 3-digit ISIC.

[24] Change in tariffs corresponds to the difference between the 1980 tariff level with respect to the actual level of tariff.

Some relevant facts can be observed in Tables 2 and 4, for instance, on average, the 60% of sectors have a positive balance trade with developing countries, whilst, with respect to developed, the percentage decrease to 38%. Most of the sectors (83%) have a decreasing trend of the relative exports towards developing countries, while 57% have the same trend towards developed countries. Likewise, on average, tariffs decreased by 20 percentage points, with a standard deviation of 13 percentage points. There is also an important variation of exporters across sectors, and a decreasing trend during the whole period (2007-2012) at an average annual rate of 2.7%, only 30% of the sectors have a positive trend. Regarding shares of total trade with developing and developed countries, we can observe that 67% and 19% of the sectors, respectively, have a positive change during the period 2000-2012.

Regarding the relative exports in the long database, the share of total sectors showing positive trade balance is the same than in the short one, except that the decreasing trend affects less sectors exporting to developed countries (62%). Average tariffs changes across sectors in the period 1993-2012 is very similar than in the short database and the standard deviation. Unlike the short database, in the long one only very few sectors increase the share of total trade towards developing countries (8.3%), while most of them (87.5%) increase the share towards developed countries, showing the change in the trade structure along the period strengthening trade with developed countries in the sectors.

Tables 3 and 5 summarizes the average skill premia measured with the three variables of wages: projected Pr, wages and salaries WS (only for the short database), and wages and social security W-SC, as well as the annual percentage change along the respective period. Taking the simple average across sectors, we find that the Pr variable (2.52) is 52% bigger than WS (1.66) and 90% bigger than W-SC (1.39). The sectors with positive annual percentage change along the period is similar for the Pr (29) and W-SC (27) while in 50 sectors WS increase (out of 58). These statistics suggest that the increase in skill premia in the period 2000-2012 was mainly among permanent workers. For the long database the average skill premium measured by the Pr and W-SC is very similar, 2.33 and 2.23, respectively, whilst rises along the period are distributed much less unequally across sectors.

The skill intensity variable (or in this case, the relative skill demand) again measured by the projected Pr variable, permanent workers Perm and the sum of permanent, temporary and agency Pe-Te-Ag, have almost the same average across sectors 0.6, except for Perm (0.78) in the short database. In addition, there is an increasing trend in most of the variables along the whole period, corresponding

to 74%, 82% and 67% of the 58 sectors, respectively. In the long database, the variables Pr and Pe-Te-Ag have a similar behavior; the average of skill intensity is 0.59 and 0.54, respectively, while for both variables, 84% of sectors rise along the period.

Unlike the skill premia that presents relatively high variability between the wages variables, the *skill-labor share of the total wage bill* (Sh-tot-wb) average across the sectors, in the short database, is much more stable: 0.55, 0.59 and 0.41 for the projected Pr, the W-S and the W-SC, respectively. Likewise, there is a positive trend in most of the sectors as well, in the 79% for Pr, in the 86% for W-S and in 62% for W-SC. In the long database, the Sh-tot-wb average across the sectors are very close to the short one, as well as the share of sectors with positive trend during the period. Following Haskel and Slaughter (2002), the variability in the sector Sh-tot-wb illustrates the changes in the SBTC.

4.1. Estimate of Equation (2) to obtain the SBTC

I estimate equation (2) using the three measures of wages (Projected, Wages-Salaries and Wages-Social Security) and the corresponding three measures of labor (Projected, Permanent and Permanent-Temporal-Agency) to calculate the Skill-Share of the Total Wage Bill, except for the long database, in which W-S and Perm are not available. For the short database, I use the Arellano-Bond estimator,[25] and for the long one, the OLS estimator was the most appropriate after some statistical testing. In both cases, estimations are regressed with robust standard errors to correct for heteroskedasticity and autocorrelation in estimations. Tables 4 and 5 show the estimates for each database, in which only the better specifications are included.[26]

The specification with skill-mix (sex, experience and education) instrument variables for the wage premia is not appropriate for any of the databases, since the *goodness of fit*, measured by the R-squared is very low, and the instrument variables, in general, do not pass validity and identification tests. The specification discarding the skill premia and including time and sector dummies is not included, because the latter variables were not significant in none of the two databases.[27] The result

[25] Baum (2006), based on Nickell (1981), explains that in the context of a database with small *T* (2000-2012) and large *N* (58 manufacturing sectors), as in this case, estimation of a Dynamic Panel Data model produces a large-sample bias in the coefficient of the lagged variable. Therefore, the Arellano-Bond estimator takes first differences of the regression equation and estimate a system of equations using the Generalized Method of Moments.

[26] I evaluate also specifications including first and second difference variables, the better ones are reported in the tables.

[27] Sector fixed effect specification was rejected by the Hausman test.

about time effects correspond to Figure 3 in the Appendix, where we observe that employment in the manufacturing sector barely change during 1990 and 2014, especially if compared to the ones in agriculture and services, which in contrast were importantly affected by the recession in 1999. In the long database, coefficients of the specification discarding only the wage premia is not significant as well.

Coefficients of the different measures of wage premia are significant and show the expected positive sign, as we observe in Tables 4 and 5. Results of that tables are necessary to calculate two of the three remaining measures of the SBTC. The first one corresponds to the error terms plus the constant terms ($a_0 + \varepsilon_{jt}$) of columns 1-3 (in both tables), the second one is denoted by the error terms (ε_{jt}) of columns 4-6 of Table 4, and the third is simply skill share of total wage bill (ω_{jt}). Those measures are used as dependent variables in equations (3) to (5).

Table 4. Estimate Equation 2, 1993-2012

	(1)	(2)
Dep. Variable	D2.wage bill Pr	D2.wage bill W-SC
D2.ln(Capital/Prodbr)	0.00484	0.00837
	(0.435)	(0.498)
D2.ln(av sk premia Pr)	0.17159***	
	(16.633)	
D2.ln(av sk premia W-SC)		0.23985***
		(15.211)
Constant	0.00036	0.00083
	(0.208)	(0.357)
Obs	432	264
R2	0.437	0.715
F	148.807	115.721

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE and DIAN data. OLS Estimation with robust standard errors.
D2: second difference.
Notes: t-statistics in brackets. av: average, sk: skill, Prodbr: gross production,Pr: projected variable. W-SC: wages and social security of permanent, temporal and agency workers. Regressions based on wages and salaries of permanent workers are discarded for the long database.

Table 5. Estimate Equation 2, 2000-2012

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	D.wage bill Pr	D.wage bill W-S	D.wage bill W-SC	D.wage bill Pr	D.wage bill W-S	D.wage bill W-SC
D.ln(Capital/Prodbr)	0.02903*	-0.00557	0.03235*	0.03485	0.01288	0.03439*
	(2.064)	(-0.991)	(2.219)	(1.875)	(0.837)	(2.173)
D.ln(av sk premia Pr)	0.15460***					
	(5.456)					
D.ln(av sk premia W-S)		0.21540***				
		(17.281)				
D.ln(av sk premia W-SC)			0.19759***			

Dep. Variable	(1) D.wage bill Pr	(2) D.wage bill W-S	(3) D.wage bill W-SC	(4) D.wage bill Pr	(5) D.wage bill W-S	(6) D.wage bill W-SC
			(7.439)			
Constant	0.00538**	0.00038	0.00408**	0.00587**	0.00732***	0.00435*
	(3.225)	(1.102)	(2.822)	(2.858)	(3.755)	(2.120)
Obs	571	571	571	571	571	571
RSS	1.883	0.107	2.050	2.434	2.425	3.079

** p < 0.05, ** p < 0.01, *** p < 0.001*

Source: own calculations based on DANE and DIAN data. Arellano-Bond Estimation with robust standard errors. RSS: Residual sum of squares. Variables in first difference. Lagged variables not included.
Notes: t-statistics in brackets. av: average, sk: skill, Prodbr: gross production, Pr: projected variable, W-S: wages and salaries of permanent workers, W-SC: wages and social security of permanent, temporal and agency workers.

4.2. Estimate of Equation (3) to obtain the sector bias of the SBTC

I estimate equations (3) to (5) using the same econometric methodology as for eq. (2) in the case of the short database, while for the long one, the best specification is now the Fixed Effect Model corrected by robust standard errors. Tables 6 and 7 show in the columns the measure of the SBTC according to the columns of Tables 4 and 5. Interestingly, all the significant b_1 coefficients are positive in the two databases, and in the short one, the magnitude of the bias is very similar across the different measures of SBTC, whilst the ones related to Permanent workers are slightly smaller. I highlight also the difference in magnitude of the bias in the long database, with respect to the short one, which are markedly smaller, suggesting the relevance of the sector bias of SBTC explaining wage inequality after 2000s.

Table 6. 2SLS Estimate of equation 3. 1993-2012

Dep Var.	(1) SBTC(1)	(2) SBTC(2)	(4) D2.wage bill Pr	(5) D2.wage bill W-SC
Skill Int Pr	0.04128**		0.02320*	
	(3.612)		(2.365)	
Skill Int Pe-te-ag		0.06846		0.08588
		(1.588)		(0.967)
Constant	-0.02451**	-0.02983	-0.01365*	-0.03607
	(-3.608)	(-1.585)	(-2.342)	(-0.931)
Obs	432	264	432	264
R2	0.012	0.011	0.002	0.005
F	13.044	2.521	5.595	0.936

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE and DIAN data. Fixed Effects Estimation with robust standard errors. SBTC(1) and SBTC(2) are estimated from models (1) and (2) in Table 4. D2: second difference.
Notes: t-statistics in brackets. skill int: skill intensity, Pr: projected variable. W-SC: wages and social security of permanent, Pe-te-ag: temporal and agency workers, Regressions based on wages and salaries of permanent workers are discarded for the long database.

Table 7. 2SLS Estimate of equation 3. 2000-2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep Var	SBTC(1)	SBTC(2)	SBTC(3)	SBTC(4)	SBTC(5)	SBTC(6)	D.wage bill Pr	D.wage bill W-S	D.wage bill W-SC
Skill Int Pr	0.15659***			0.15781***			0.16191***		
	(4.047)			(4.679)			(4.859)		
Skill Int Perm		-0.01325			0.13068***			0.13299***	
		(-0.908)			(4.398)			(4.923)	
Skill Int Pe-te-ag			0.16210***			0.15040**			0.15881***
			(3.644)			(3.219)			(3.667)
Constant	-0.09101***	0.01091	-0.09259***	-0.09849***	-0.10710***	-0.08979***	-0.09430***	-0.10002***	-0.09147***
	(-4.764)	(0.913)	(-4.145)	(-6.089)	(-4.743)	(-3.471)	(-6.167)	(-5.085)	(-3.971)
Obs	513	513	513	513	513	513	571	571	571
RSS	1.035	0.065	1.051	1.648	1.553	2.170	1.861	1.772	2.414

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE and DIAN data. Arellano Bond Estimation with robust standard errors. Lagged variables not reported.
SBTC(1) to SBTC(6) are estimated from models (1) to (6) in Table 5. D: first difference.
Notes: t-statistics in brackets. skill int: skill intensity, Pr: projected variable, variable, W-SC: wages and social security of permanent, Perm: Permanent workers, Pe-te-ag: temporal and agency workers. Regressions based on wages and salaries of permanent workers are discarded for the long database.

4.3. Estimate of Equations (4) and (5) sector skill intensity and trade integration

Tables (8) to (10) in the Appendix show the significant estimates of the equations. Titles of the columns relate SBTC measure and include the interacted trade integration variable. Initially, we can compare the coefficients obtained by estimations of equations (4) and (5) with those of equation (3). Results are all positive and very similar in the case of interaction of tariffs decrease with the different measures of skill intensity, but the magnitude of coefficients fall noticeably, evidence that this interaction decreases the skill intensity on SBTC; still the coefficient is significant but smaller, and even more for interaction with permanent workers. In the long database, coefficients of Eq. (5) become insignificant.

Coefficients of interactions of trade with developing and developed countries in Eq. (4) are all higher than equation (3) and similar among them. On average, the effect of trade with developing countries is slightly higher. In the long database for Eq. (4), there is evidence of the positive effect of the interaction with the two measures of trade integration, but in this case, the effect of trade with developing countries is more important than trade with developed countries.[28]

In the case of exporters (in logs), the effect of interaction with skill intensity on the SBTC is in the middle of the tariffs change and trade variables. For the short database, in equation (4), this variable is also the only one significant apart of the interaction with a positive sign, suggesting that quantity of exporters by sector matters to explain SBTC. In the short database instead, the only significant variable is trade with developing countries, which has a negative sign when it is not interacted, evidence that it decreases the SBTC.[29]

According to these new specifications, the specific-sector bias of SBTC can be calculated by sector and by time, following the derivatives obtained above (expressions (6) to (9)), therefore, the sign of the effect of trade integration or skill intensity on the SBTC is determined by coefficients in Eqs. (4) and (5), but, the magnitude of the effect of trade integration or skill intensity on the SBTC, depends on the sector average values of those variables. If we take averages during the respective period of these variables, from Tables (2) to (5) in the Appendix, to compute derivatives, we find that for the

[28] These results can be affected by the endogeneity of the trade variable, which may increase the effect on the SBTC, in comparison with the other measures of trade integration.
[29] I estimate equations (4) and (5) without the control variable of temporal workers, finding very similar coefficients to Tables (8) to (10) in the Appendix.

whole manufacturing sector (on average), in both periods, the bias decrease, except for the exporters variable, which increase the effect on the SBTC.

Regarding the control variable included in the equations, I find significant and negative coefficients, fluctuating in a similar rank across trade integration measures, evidence that the labor reform was mainly unskilled biased, and therefore compensating the positive impact of trade integration on wage inequality. Such effect decreases a lot in the long database and remains negative only in the case of tariffs reduction for one of the SBTC definitions, disappearing for trade with developing countries, and becoming positive (though very low) for trade with developed countries. These results are similar in the case of the projected variables and with the sum of permanent, temporary and agency workers, suggesting that there is evidence that the compensation effect can barely be found in 1990s, unlike the 2000s where it becomes very important.

4.4. Wage inequality and sector-specific bias of SBTC

Now, I relate skill premia annual average changes, from Tables 3 and 5 in the Appendix, with the computed average sector-specific bias of SBTC obtained from equations (6) to (9). Given that almost every bias is positive, we should expect accordingly only positive changes in the skill premia. Even though it is not always the case, we can see that this condition holds for many of the sectors and that, in general, there is a positive correlation between the two variables across most of definitions of SBTC and skill premia.[30] Figures 4 to 11 in the Appendix show these relations.

In the short database, the pattern of the relation between the sector-bias of SBTC shaped by trade integration in the presence of skill intensity, with respect to the change in skill premia (Figures 4, 5 and 6 in the Appendix) is very similar no matter the definition of trade, the SBTC, or the skill premia. There is a positive correlation and most of the sectors are in positive axis of the plane.

The correlation of the sector-bias of SBTC shaped by Skill Intensity in the presence of trade integration and the change in skill premia is more heterogeneous (Figures 7, 8, and 9 in the Appendix). The correlation is negative when skill intensity interacts with trade with developing countries, and with exporters by sector, suggesting that this positive sector bias shapes less wage

[30] On the other hand, as it was mentioned in the literature review, Acemoglu (2003) offers a theoretical explanation for the sectors with negative skill premia changes and positive sector-specific bias of SBTC, according to which, technological level differences across sectors (or countries) would produce less wage inequality in those less advanced and more inequality in the others. This topic is left for future research.

inequality. When interaction is with tariff reductions or trade with developed countries, the correlation is positive or tend to zero.

The relation obtained from equation 4 (Figure 10 in the Appendix), suggest that the impact of including separately from the interaction the exporters variable, produces a negative correlation between the sector-specific bias and the skill premia, while the derivative of SBTC with respect to the skill premia (interacted with exporters too) do not alter importantly the correlation.

For the long database, results of Eq. 3 are almost the contrary than for the short one. Indeed, as we observe in Figure 11, the correlations of the significant derivatives with respect to the change in skill premia are almost all negative, except for correlation of the sector-bias shaped for changes in trade with developing countries with changes in skill premia, which is slightly positive. Estimates from equation 4 are not significant. Despite these results, still many sectors are situated in the positive quadrant of the plane, consistent with the sector bias hypothesis.

5. Conclusion

The Colombian manufacturing sector has experienced important changes after the openness policy in 1990. I estimate the *skill bias wage gap* finding that in sectors with relatively more skilled workers, between 2000-2012, the real average is around 17%-20% higher than less skill intensive sectors, while the same estimate for the period 1993-2012 decrease to 8%-13%. Indeed, during 2000s, 87.5% of the manufacturing sectors increase international trade with developed countries, while only 8.3% increase it with developing countries.

Likewise, creation of agency workers in 1990 and labor costs flexibilization to hire direct temporary shaped a decrease in the real average wage in the whole period, but especially after 2000s, in which the increasing trade with developed countries would force firms to rise the share of temporary to maintain competitiveness. This policy has had negative effects on the SBTC, decreasing, in turn, wage inequality between skilled and unskilled workers, and compensating the positive effect of interaction between sector skill intensity and trade integration.

Even though the magnitude of the impact of sector skill intensity, alone, on SBTC is very important, it decreases when interacting with tariff reduction across the sectors, or exporting firms, while

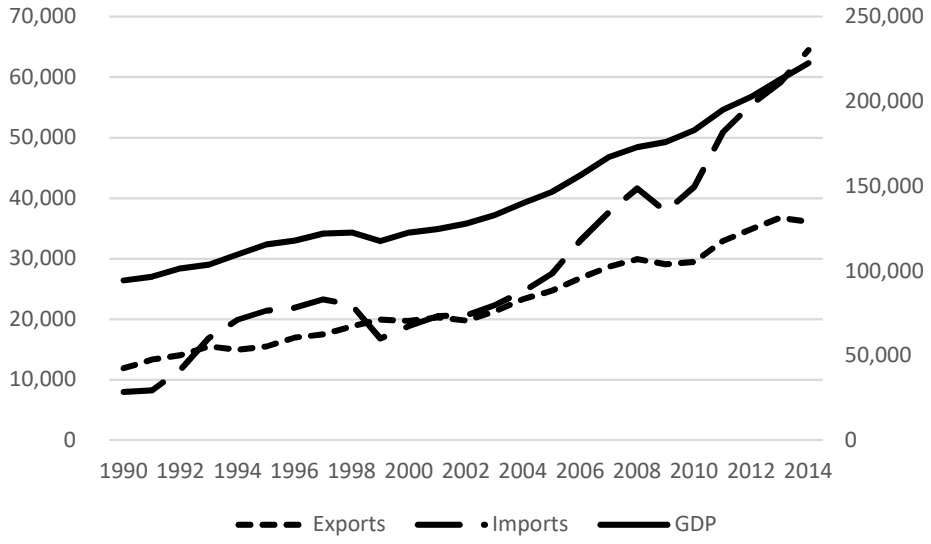
barely change when interacting with international trade with developed and developing countries. In the long database, the impact for trade with developing was bigger in magnitude than after 2000 years, supporting the idea of the structural change in the Colombian trade patterns.

Almost all the sector-bias of SBTC in both databases are positive, either after changes in trade integration or the sector skill intensity, which in turn corresponds to positive changes on wage inequality in many manufacturing sectors. Nevertheless, I highlight some positive or negative correlations between the sector-specific bias and changes of skill premia. For instance, trade with developing countries and exporters by sector; tend to shape less wage inequality when the sector skill intensity increases.

The estimates presented in this paper can be refined in different ways, the measure of the SBTC, which has been controversial because endogeneity, or the methodology to fill the gaps of the database between 1995 and 1990 of the relative skill workers and the skill premia, which may cause bias variations in variables and therefore estimates. For future research, it remains the empirical explanation on the evidence of negative skill premia changes and positive sector-specific bias, which could be related with technological heterogeneity across manufacturing sectors.

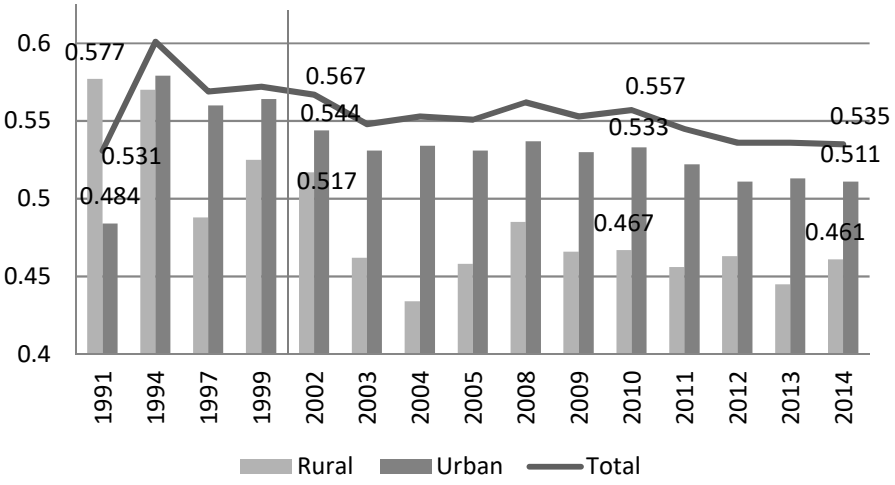
Appendix

Figure 1. GDP at market prices, imports and exports of goods and services, 1990-2014. (constant 2005 Million US$)



Source: World Bank.

Figure 2. Gini index by geographic area. Colombia, 1991-2014



Notes: "From 2002 on, the income figures are not comparable with those of earlier years, owing to the application of new methodological criteria developed by the National Administrative Department of Statistics (DANE) and the National Planning Department (DNP) in the framework of the Mission for the splicing of employment, poverty and inequality series (MESEP)". Source: CEPAL CEPALSTAT.

Table 1. Most important Colombian trade partners, GDP per capita (constant 2005 US$)

Country	1991	2000	2010	Average (20 years)
Austria	28,717	35,027	38,803	34,266
Belgium	28,485	34,009	36,742	33,237
Bolivia	857	965	1,177	983
Bulgaria	2,648	2,707	4,461	3,173
China	**499**	**1,122**	**2,869**	**1,368**
Colombia	**2,841**	**3,074**	**3,938**	**3,276**
Cyprus	16,321	20,890	23,157	20,591
Czech Republic	8,661	10,379	14,174	11,110
Denmark	36,822	45,340	46,293	43,841
Ecuador	2,698	2,613	3,251	2,856
Estonia	-	7,134	10,393	8,106
Finland	26,292	33,217	38,065	32,649
France	28,019	32,392	33,898	31,621
Germany	29,113	32,662	36,127	32,369
Greece	15,707	18,041	21,309	18,831
Hungary	7,448	8,810	10,926	9,188
Ireland	22,484	41,954	44,583	38,400
Italy	25,952	29,872	29,163	28,861
Latvia	4,747	4,571	7,391	5,407
Lithuania	6,304	5,098	8,829	6,256
Luxembourg	54,251	72,394	80,276	70,035
Malta	10,136	15,002	16,050	13,723
Netherlands	29,762	37,547	41,110	36,282
Peru	2,014	2,487	3,835	2,674
Poland	4,380	6,790	10,036	6,900
Portugal	14,402	17,891	18,648	16,987
Romania	3,356	3,327	5,635	4,086
Slovak Republic	7,626	8,957	14,263	9,967
Slovenia	11,394	15,033	19,054	15,338
Spain	19,242	23,921	25,318	23,217
Sweden	30,267	36,576	42,826	36,265
United Kingdom	25,520	34,059	37,611	33,519
United States	**32,504**	**40,965**	**43,952**	**39,794**
Venezuela, RB	**5,661**	**5,256**	**6,010**	**5,567**
EU (Average)	**19,156**	**23,467**	**26,487**	**23,160**
CAN1(Average)	**1,856**	**2,022**	**2,754**	**2,171**
CAN2(Average)	2,103	2,285	3,050	2,447

Source: World Bank. Own calculations

Notes: CAN1. Andean Community of Nations without Colombia (Bolivia, Ecuador and Peru).
CAN2. Andean Community of Nations with Colombia.
EU, European Union 27 countries.

Table 2. Trade balance share and trade integration variables. 2000-2012

	Relative exports						Trade Integration								
CIIUR3	Av X/M Ldc	Annual Δ%	Av X/M Dc	Annual Δ%	Av X/M Totc	Annual Δ%	Δ tar 00	Δ tar 12	Av Δ tariffs	Av Exporters	Annual Δ%	% Av shtradeldc	Δ%	% Av shtradedc	Δ%
151	1.29	17.61	2.10	-9.13	1.58	-4.86	9.06	9.93	7.71	334.33	-5.54	36.75	2.11	30.79	-22.16
152	0.25	-11.20	1.19	-2.14	0.54	-2.55	9.17	-12.48	3.17	38.50	-4.84	34.87	-43.55	26.61	4.02
153	48.97	-23.85	0.25	20.26	4.41	-18.57	8.30	10.76	6.94	147.17	-1.86	58.77	-42.10	17.12	-5.09
154	0.72	4.73	0.07	3.59	0.34	-0.98	8.58	13.49	9.37	312.17	-1.83	45.57	-32.32	35.50	18.54
155	1.62	NA	2.05	NA	1.75	NA	8.77	13.17	9.50	65.67	-3.79	45.48	-21.14	18.01	17.39
157	40.42	-23.05	150.54	29.86	26.13	-5.49	NA	NA	NA	NA	NA	27.22	-2.41	10.29	-0.08
158	4.32	6.83	0.75	0.61	1.93	2.25	NA	NA	NA	NA	NA	38.61	-3.83	24.54	3.64
159	1.88	-10.32	0.18	-4.51	0.57	-9.42	NA	NA	NA	NA	NA	36.00	-16.25	39.67	12.98
160	3.13	40.80	152.73	-21.28	4.48	25.94	1.20	6.20	1.97	8.50	2.71	27.13	-44.81	29.80	0.89
171	0.92	-1.27	0.05	-24.54	0.64	-2.45	38.99	51.12	40.60	208.67	-3.85	27.32	-17.84	9.59	-8.74
172	0.76	-10.00	0.06	-3.71	0.46	-3.52	38.92	46.88	40.03	658.17	-5.48	43.48	35.34	18.36	-15.78
173	NA	NA	NA	NA	NA	NA	36.93	48.37	38.63	536.67	-8.27	NA	NA	NA	NA
174	1.97	-14.81	1.04	-7.52	1.40	-10.02	NA	NA	NA	NA	NA	33.79	21.22	33.54	-29.29
175	4.25	-18.32	2.36	1.03	3.12	-12.89	NA	NA	NA	NA	NA	51.90	15.12	27.22	-7.46
181	5.18	-22.41	11.80	-4.95	7.29	-16.69	52.11	57.16	52.89	1299.17	-8.44	38.23	30.99	40.92	-40.42
182	5.88	-1.45	27.17	14.11	12.25	4.88	54.54	64.18	58.24	32.75	NA	6.06	4.04	84.66	-8.11
191	41.03	0.07	17.93	3.13	25.16	2.80	21.37	26.51	22.41	681.83	-8.04	32.77	8.50	41.38	-21.55
192	0.45	-10.42	1.67	-15.70	0.51	-12.45	36.92	42.01	37.92	515.67	-7.37	65.44	9.20	7.06	-11.49
193	0.38	-19.68	11.15	-7.61	1.56	-15.68	NA	NA	NA	NA	NA	40.37	31.85	38.71	-17.98
201	8.24	-1.28	0.36	11.59	1.66	3.62	27.59	35.11	28.54	74.33	-11.81	36.69	-15.29	34.82	-17.57
202	0.21	-10.01	1.79	-32.74	0.49	-20.26	22.69	29.71	23.63	355.67	-12.81	47.45	18.45	19.14	-36.92
203	23.73	-35.31	0.13	-27.22	0.78	-21.19	NA	NA	NA	NA	NA	28.19	-12.67	33.61	24.49
204	57.20	-17.28	0.37	16.05	2.50	14.48	NA	NA	NA	NA	NA	34.30	9.62	36.92	-68.69
209	0.96	-27.59	1.08	-6.63	0.92	-23.08	NA	NA	NA	NA	NA	57.89	5.40	21.36	-11.15
210	7.63	0.41	0.06	-7.10	0.81	4.58	13.12	20.18	14.08	680.83	-1.80	30.85	10.66	35.46	-14.98
221	11.49	-11.06	0.38	1.80	1.24	-0.61	18.13	19.82	18.03	772.17	-6.65	26.85	5.37	33.91	0.57
222	1.72	-11.19	0.32	8.66	1.09	-6.05	8.58	13.89	9.37	646.33	-4.21	55.47	20.28	11.35	-4.26
223	12.56	NA	0.01	12.17	0.05	-8.55	NA	NA	NA	NA	NA	7.90	2.31	70.78	-22.22
232	1.68	16.82	5.43	-24.88	2.74	-16.05	1.40	9.10	2.00	NA	NA	8.40	-13.15	59.89	-3.48
241	0.86	-0.11	0.06	3.00	0.20	1.64	12.21	17.59	12.85	533.33	2.22	18.40	-1.34	49.72	-13.14
242	2.78	-0.92	0.11	-19.97	0.53	-7.38	7.62	11.94	8.18	1016.50	-2.24	24.94	-0.08	39.36	-6.15
251	0.36	-13.61	0.03	-3.90	0.20	-11.33	25.32	34.75	26.53	47.67	-1.21	31.44	-4.04	19.72	-7.12
252	1.54	-10.17	0.51	10.93	0.89	-1.40	31.46	42.54	33.04	1323.50	-1.40	36.29	8.70	28.94	-8.78
261	2.66	-9.73	1.06	4.25	1.50	-1.74	27.99	35.96	28.97	291.83	-5.45	30.19	3.39	34.18	-11.74
269	1.55	-5.95	2.69	-13.68	2.14	-9.64	27.54	35.87	28.77	466.33	-9.40	32.00	26.87	38.52	-27.69
271	0.74	10.04	2.12	-5.81	1.26	0.01	9.89	17.14	10.78	236.50	6.87	27.55	3.07	32.59	-13.47
272	0.50	11.60	16.76	36.89	2.77	27.59	10.76	17.06	11.62	209.67	0.00	28.42	-39.02	40.54	36.99

	Relative exports						Trade Integration								
CIIUR3	**Av X/M Ldc**	**Annual Δ%**	**Av X/M Dc**	**Annual Δ%**	**Av X/M Totc**	**Annual Δ%**	**Δ tar 00**	**Δ tar 12**	**Av Δ tariffs**	**Av Exporters**	**Annual Δ%**	**% Av shtradeldc**	**Δ%**	**% Av shtradedc**	**Δ%**
281	2.13	-6.99	1.11	3.11	1.19	-2.44	21.25	31.02	22.52	NA	NA	24.31	1.89	38.74	17.49
289	0.97	-12.53	0.21	-3.49	0.48	-7.51	21.05	29.31	22.20	1105.50	-2.49	33.64	8.26	35.00	-7.92
291	1.42	-14.79	0.02	4.87	0.12	-0.59	10.53	18.43	11.56	886.00	1.85	14.31	11.09	59.72	-14.07
292	0.88	-19.78	0.02	-5.41	0.07	-6.20	13.25	18.73	13.89	792.00	1.22	7.86	8.26	62.95	-16.25
293	0.73	-18.74	0.10	-10.12	0.53	-14.50	3.57	8.82	4.59	134.17	-0.29	57.26	24.66	9.54	-10.87
311	1.60	-15.76	0.10	-12.31	0.34	-3.80	19.73	28.48	20.92	237.60	NA	23.97	15.62	47.12	-28.71
312	2.13	-8.94	0.03	12.44	0.27	2.70	18.13	26.55	19.34	232.17	2.54	21.46	9.34	51.60	-18.80
313	1.27	-6.04	0.11	-8.60	0.44	-4.73	17.13	26.26	18.50	107.50	7.20	28.84	-1.19	33.95	-8.99
314	1.79	-4.95	0.13	29.88	0.77	3.57	22.09	29.35	23.27	47.67	-1.14	39.78	22.21	24.44	-13.18
315	0.31	-14.82	0.05	-2.61	0.18	-9.47	18.56	21.11	18.80	191.17	-4.88	49.26	30.28	30.83	-13.94
319	0.59	-21.47	0.02	11.81	0.11	-7.36	21.71	28.70	22.45	252.17	4.27	21.15	21.56	43.60	-12.27
331	0.91	-22.98	0.03	3.41	0.06	-1.13	16.93	21.47	17.43	104.00	0.74	7.62	7.91	66.72	-9.91
332	0.23	-8.72	0.01	-0.53	0.06	-3.01	17.39	21.02	17.63	75.33	0.56	19.94	15.32	48.77	-5.05
341	0.62	-13.38	0.01	-17.64	0.49	-14.27	9.98	11.82	10.14	55.33	-0.35	49.22	-32.36	9.50	1.58
342	3.74	-41.77	0.05	-8.26	0.21	-17.74	13.74	22.49	15.14	33.83	-2.95	37.23	31.90	39.70	-59.48
343	2.45	-17.51	0.06	7.31	0.38	-1.90	18.47	24.00	19.41	247.50	-1.83	26.49	17.74	39.06	-9.72
351	2.06	0.41	0.03	9.66	0.04	10.25	20.11	29.01	21.28	15.67	-8.78	6.07	8.43	71.19	-33.70
353	6.30	-22.48	0.05	8.44	0.05	-3.66	25.74	30.50	26.24	51.83	-7.35	0.34	-1.73	85.70	-0.82
359	0.31	-12.29	0.03	-20.17	0.27	-12.42	13.87	17.46	14.26	85.83	-2.27	30.75	1.08	3.33	-1.79
361	2.70	-22.83	1.24	-8.91	1.50	-14.67	33.73	38.50	34.47	544.67	-7.00	39.67	21.76	31.20	-23.06
369	0.31	-10.11	1.58	-4.58	0.78	-9.57	20.49	25.58	21.23	870.83	-5.69	35.92	28.81	37.82	-18.62

Source: own calculations based on DANE, DIAN, World Bank and DNP.

Notes: NA. Not available information. In the case of the annual percentage change it is not calculated because data was not available for the whole period. In other cases, information was not available for the specific sector. Ldc: developing countries, Dc: developped countries, totc: all countries,

Δ%: annual percentage change, Δ tar: tariffs reduction with respect to the 1980 level, Av: average, shtradeldc: share of trade to developing countries, shtradeldc: share of trade to developed countries. Sectors 156, 231, 243, 273, 300, 321, 322 and 323 are not included in tables and are discarded of estimations because data for most of the variables is very scarce.

Table 3. Skill premia, skill intensity, wage bill. 2000-2012

	Skill premia						Skill Intensity						Wage bill					
CIIUR3	Av Pr	Annual Δ%	Av W-S	Annual Δ%	Av W-SC	Annual Δ%	Av Pr	Annual Δ%	Av Perm	Annual Δ%	Av Pe-Te-Ag	Annual Δ%	Av Pr	Annual Δ%	Av W-S	Annual Δ%	Av W-SC	Annual Δ%
151	2.61	-0.12	1.49	0.33	1.33	-0.37	0.49	-0.98	0.68	-0.50	0.48	-1.40	0.56	-0.50	0.60	0.14	0.39	-1.07
152	2.28	1.14	1.56	0.38	1.57	0.56	0.64	-0.31	0.75	0.19	0.62	-0.75	0.59	0.32	0.61	0.14	0.49	-0.09
153	1.47	1.01	1.60	3.89	1.28	1.38	0.91	1.88	0.93	2.17	0.89	1.58	0.57	1.17	0.61	1.40	0.53	1.37
154	2.61	0.37	2.68	3.02	1.53	1.33	0.88	2.77	1.08	1.91	0.86	2.28	0.69	1.00	0.73	0.88	0.56	1.67
155	1.51	0.83	1.26	1.59	1.21	0.43	0.77	-0.32	0.80	0.03	0.75	-0.60	0.54	0.24	0.56	0.73	0.48	-0.09
157	1.87	-1.68	1.09	1.44	1.61	-1.70	0.60	3.04	0.64	2.50	0.57	2.33	0.53	0.64	0.52	0.72	0.48	0.30
158	2.73	1.47	1.91	2.30	1.39	1.38	0.62	-0.15	0.84	0.45	0.61	-0.39	0.63	0.49	0.66	0.78	0.46	0.52
159	1.41	-1.53	2.33	0.87	1.47	-1.44	1.64	3.52	1.46	4.20	1.62	3.38	0.69	0.58	0.70	0.27	0.70	0.53
160	1.44	-0.41	1.11	15.28	1.23	0.91	0.67	17.06	0.66	16.88	0.65	16.92	0.44	7.51	0.48	6.61	0.40	8.61
171	3.10	0.35	0.73	2.66	1.58	-1.06	0.24	1.57	0.30	1.41	0.23	1.33	0.42	1.14	0.42	1.58	0.27	0.18
172	2.30	1.49	0.63	2.23	1.44	4.92	0.29	1.75	0.36	-0.79	0.28	1.43	0.40	2.01	0.39	1.38	0.29	4.28
173	3.16	3.55	1.06	8.28	1.18	-1.33	0.24	2.05	0.47	6.09	0.23	1.55	0.41	3.65	0.50	4.78	0.21	0.15
174	3.16	0.59	1.47	2.80	1.17	1.78	0.37	2.61	0.62	2.79	0.37	2.29	0.54	1.46	0.59	1.10	0.30	2.95
175	2.47	0.39	1.32	3.71	1.48	-0.31	0.43	0.71	0.55	2.35	0.43	0.37	0.51	0.55	0.56	1.67	0.39	0.04
181	2.38	-1.48	1.29	2.07	1.16	-0.22	0.33	2.44	0.58	2.15	0.32	2.17	0.44	0.53	0.56	0.93	0.27	1.40
182	6.39	8.02	1.62	12.44	0.87	1.70	0.23	4.85	0.71	10.33	0.21	4.68	0.57	6.35	0.59	5.64	0.16	5.53
191	3.30	-3.71	2.46	2.46	1.28	-1.31	0.30	0.04	0.87	5.15	0.29	-0.73	0.50	-2.06	0.70	0.91	0.27	-1.59
192	2.54	-0.74	1.07	2.92	1.24	-0.78	0.30	1.14	0.48	3.51	0.29	0.78	0.43	0.23	0.51	1.41	0.26	-0.01
193	2.50	-0.44	1.12	3.98	1.30	-3.55	0.34	1.88	0.49	5.82	0.33	1.63	0.46	0.75	0.53	1.84	0.30	-1.40
201	3.35	-2.37	1.42	-4.63	2.21	1.18	0.39	-2.57	0.48	-3.02	0.38	-2.87	0.56	-2.28	0.58	-2.15	0.45	-0.93
202	2.43	-0.47	1.05	1.57	1.49	-3.14	0.40	1.92	0.53	5.36	0.40	1.75	0.49	0.69	0.51	0.73	0.37	-0.87
203	2.12	-0.50	0.68	-1.37	1.08	-2.32	0.29	-3.11	0.38	-0.36	0.28	-3.46	0.37	-2.20	0.40	-0.79	0.23	-4.20
204	1.64	-0.78	0.59	-3.67	0.98	0.98	0.20	0.34	0.35	-3.47	0.20	-0.15	0.25	-0.32	0.36	-2.37	0.16	0.68
209	2.00	-0.93	1.03	3.33	1.04	-8.35	0.35	-1.25	0.55	3.64	0.35	-1.70	0.41	-1.43	0.50	1.91	0.26	-7.55
210	1.93	0.01	1.05	0.72	1.45	-1.03	0.53	0.41	0.59	0.62	0.51	-0.15	0.50	0.21	0.51	0.36	0.43	-0.65
221	1.79	1.97	5.88	7.00	1.52	3.40	3.25	4.64	3.44	3.34	3.22	4.48	0.84	1.21	0.84	1.25	0.81	1.60
222	2.11	-1.65	1.39	-0.70	1.48	-0.05	0.62	1.70	0.72	1.43	0.61	1.49	0.56	0.01	0.58	-0.29	0.47	0.77
223	1.89	2.53	1.62	2.85	1.22	1.77	0.77	-1.30	0.90	-0.23	0.76	-1.43	0.58	0.58	0.61	1.26	0.47	0.21
232	1.58	1.22	1.56	10.75	1.38	1.47	0.83	9.72	0.95	8.11	0.81	9.11	0.55	5.79	0.60	4.99	0.51	6.15
241	2.46	2.54	2.37	4.29	1.73	2.06	0.96	1.82	1.14	2.79	0.94	1.47	0.70	1.38	0.70	1.34	0.62	1.44
242	3.38	-0.42	4.72	0.98	1.58	-0.26	1.32	0.81	1.76	1.29	1.30	0.55	0.82	0.08	0.82	0.19	0.67	0.09
251	2.32	-1.30	1.32	0.78	1.49	0.04	0.57	2.52	0.64	1.67	0.56	2.27	0.57	0.53	0.57	0.35	0.45	1.24
252	2.89	-0.19	1.47	1.00	1.45	-1.02	0.47	0.62	0.63	1.28	0.46	0.14	0.58	0.18	0.60	0.41	0.40	-0.53
261	1.69	1.46	0.76	7.44	1.11	-0.54	0.39	3.84	0.51	6.32	0.37	3.42	0.39	3.27	0.43	4.26	0.29	2.05

	Skill premia						Skill Intensity						Wage bill					
CIIUR3	**Av Pr**	**Annual Δ%**	**Av W-S**	**Annual Δ%**	**Av W-SC**	**Annual Δ%**	**Av Pr**	**Annual Δ%**	**Av Perm**	**Annual Δ%**	**Av Pe-Te-Ag**	**Annual Δ%**	**Av Pr**	**Annual Δ%**	**Av W-S**	**Annual Δ%**	**Av W-SC**	**Annual Δ%**
269	2.71	-0.82	0.93	-1.75	1.59	-0.55	0.34	-0.95	0.42	-0.60	0.33	-1.36	0.48	-0.94	0.48	-0.93	0.34	-1.21
271	2.41	5.71	1.59	11.34	1.65	5.30	0.58	5.58	0.70	7.01	0.57	5.20	0.55	4.56	0.57	4.31	0.46	5.29
272	3.22	0.14	1.34	0.83	1.28	-0.07	0.41	0.60	0.69	-1.07	0.40	0.38	0.56	0.30	0.57	0.33	0.33	0.19
281	2.60	0.30	1.37	0.29	1.13	-1.91	0.44	-1.54	0.66	0.73	0.43	-1.73	0.53	-0.60	0.58	0.12	0.33	-2.28
289	2.82	1.02	1.33	2.08	1.38	-0.91	0.41	-0.18	0.57	2.10	0.40	-0.48	0.54	0.39	0.57	0.90	0.36	-0.87
291	2.66	-0.32	1.69	0.01	1.33	0.01	0.57	0.43	0.77	0.57	0.56	0.19	0.60	0.04	0.63	0.00	0.43	0.11
292	1.98	-0.75	1.17	1.80	1.17	-0.27	0.52	1.32	0.68	2.10	0.52	1.00	0.51	0.28	0.54	0.84	0.38	0.45
293	2.57	-1.29	1.57	2.22	1.39	0.05	0.45	1.72	0.60	2.72	0.42	0.80	0.53	0.19	0.61	0.84	0.37	0.54
311	2.78	-5.36	2.75	-5.85	1.73	-5.93	0.99	-1.21	1.18	0.20	0.97	-1.57	0.71	-1.65	0.71	-1.46	0.61	-3.03
312	3.28	3.37	2.47	5.19	1.68	2.42	0.65	1.28	0.90	2.88	0.64	1.12	0.67	1.66	0.70	1.63	0.51	1.69
313	1.98	-1.72	1.46	0.39	1.08	-2.57	0.69	2.38	0.89	1.96	0.68	1.96	0.58	0.27	0.59	0.16	0.42	-0.38
314	3.62	-2.58	2.05	4.57	1.09	-1.93	0.54	6.09	0.87	5.92	0.53	6.15	0.65	1.41	0.66	1.85	0.36	2.79
315	2.55	1.13	1.71	1.41	1.42	1.97	0.54	2.02	0.74	0.54	0.52	1.74	0.57	1.27	0.63	0.50	0.42	1.97
319	3.50	-2.24	2.99	13.11	1.60	-4.82	0.34	4.42	1.02	15.60	0.33	4.11	0.51	1.12	0.67	4.86	0.33	-0.59
331	2.52	-1.17	1.36	5.97	1.52	-2.94	0.51	5.52	0.59	6.07	0.50	5.20	0.56	1.80	0.57	2.36	0.43	1.18
332	2.12	-0.75	1.65	-2.24	2.00	1.29	0.77	-1.71	0.79	-2.31	0.75	-1.96	0.61	-0.96	0.62	-0.90	0.59	-0.26
341	1.97	1.97	2.35	7.77	1.35	3.61	0.59	7.34	0.88	4.62	0.55	7.10	0.52	3.65	0.68	2.49	0.41	5.00
342	2.89	-0.97	1.50	1.26	0.96	-0.49	0.37	0.14	0.72	3.21	0.37	-0.19	0.52	-0.40	0.60	0.56	0.26	-0.50
343	2.67	-0.81	1.41	2.98	1.17	-0.97	0.49	3.34	0.66	3.63	0.48	3.23	0.56	1.10	0.58	1.24	0.36	1.35
351	2.44	7.37	1.92	-1.49	1.64	3.41	0.70	-8.83	0.90	-6.80	0.71	-8.88	0.59	-0.70	0.64	-0.43	0.50	-2.69
353	1.73	6.29	0.88	20.29	1.82	6.14	0.67	20.77	0.63	19.74	0.65	20.45	0.44	9.71	0.42	8.95	0.45	9.98
359	3.14	1.88	3.17	0.90	1.28	-0.32	0.80	-0.68	1.37	0.96	0.79	-0.92	0.71	0.34	0.76	0.23	0.50	-0.59
361	2.46	0.76	1.38	3.33	1.23	2.60	0.43	1.93	0.64	1.75	0.43	1.67	0.52	1.37	0.58	1.50	0.34	2.86
369	2.46	1.26	1.50	3.26	1.38	0.53	0.50	0.70	0.66	2.51	0.49	0.39	0.55	0.91	0.59	1.36	0.40	0.53

Source: own calculations based on DANE, DIAN, World Bank and DNP.

Notes: av: average, Pr: projected variables, W-S: wages and salaries of permanent workers, W-SC: wages and social security of permanent, temporal and agency workers, Perm: permanent workers, Pe-Te-Ag: permanent, temporal and agency workers.

Sectors 156, 231, 243, 273, 300, 321, 322 and 323 are not included in tables and are discarded of estimations because data for most of the variables is very scarce.

Table 4. Trade balance share and trade integration variables. 1993-2012

	Relative exports						Trade Integration						
	Av X/M Ldc	Annual Δ%	Av X/M Dc	Annual Δ%	Av X/M Totc	Annual Δ%	Δ tar 80 - 94	Δ tar 80 - 12	Av Δ tariffs	% Av shtradeldc	Δ%	% Av shtradedc	Δ%
311	1.02	2.20	6.70	-7.11	3.27	-5.31	9.77	6.97	8.00	49.44	-27.61	20.02	7.78
313	1.30	-3.92	0.18	-4.58	0.43	-3.61	NA	NA	NA	38.24	-16.37	35.41	10.04
321	9.91	-19.17	9.97	-4.03	7.42	-12.28	38.17	48.79	39.26	29.08	-28.73	34.05	25.78
322	3.66	-15.12	12.38	-3.95	5.52	-11.84	54.08	60.67	54.86	49.28	-43.47	30.72	29.96
323	1.00	-18.81	2.68	-19.66	1.38	-20.44	21.70	26.51	22.19	43.32	-9.95	31.95	14.10
324	0.74	-7.12	0.59	-9.63	0.67	-7.87	37.07	42.01	37.65	15.00	-35.25	52.85	35.16
331	2.97	-17.50	0.92	-0.56	1.20	-6.80	25.95	32.41	25.87	27.53	-13.63	43.36	-13.27
332	5.47	8.43	0.06	-0.51	0.62	7.81	33.44	38.50	34.15	39.80	-30.23	33.02	19.53
341	3.68	-6.31	0.31	-4.50	0.89	-1.08	13.21	20.18	13.75	38.03	-13.52	26.06	19.03
342	0.69	0.46	0.06	6.90	0.17	4.84	13.42	16.86	13.57	34.12	-14.27	26.56	25.57
351	2.14	6.64	0.14	-3.78	0.45	4.78	8.29	16.21	9.16	50.68	-13.62	16.70	8.16
352	1.14	24.23	4.82	-12.23	2.05	-3.01	6.41	11.94	7.86	41.60	-8.88	21.11	12.27
353[a]	0.34	-2.55	0.03	3.22	0.18	1.62	3.17	8.08	3.45	50.94	25.64	14.91	-22.62
355	1.46	-3.33	0.38	4.83	0.71	1.56	25.31	34.75	26.10	23.29	-20.15	29.59	18.60
356	1.40	0.71	1.55	1.01	1.49	1.20	31.70	42.54	32.51	32.25	-14.34	30.81	20.06
361[b]	0.52	23.10	1.73	3.19	1.01	6.55	28.12	35.92	28.51	38.87	-15.54	27.59	16.86
371	0.35	19.45	11.64	25.31	2.02	22.62	9.64	17.14	10.42	35.42	-18.22	25.36	2.73
372	0.85	-2.50	0.24	-1.31	0.43	-1.04	10.70	17.06	11.29	39.28	41.09	31.78	-36.71
381	1.02	-13.87	0.02	8.19	0.08	2.83	21.20	30.17	21.96	39.43	-10.60	27.52	14.42
382	0.65	-7.43	0.04	7.05	0.13	7.12	10.62	16.52	11.20	60.44	-23.26	12.08	25.25
383	0.55	3.22	0.03	1.90	0.19	5.00	19.73	27.02	20.70	41.57	-29.23	17.29	29.06
384	0.52	-10.90	0.03	0.18	0.05	0.40	17.13	23.66	18.18	38.32	-13.98	25.83	8.43
385	0.37	-10.84	2.09	-9.10	1.29	-12.97	16.20	20.50	16.54	67.66	-9.83	6.67	10.20
390	1.80	-2.39	2.39	-0.95	1.36	-1.05	20.56	25.58	20.92	40.56	-24.26	26.77	46.14

Source: own calculations based on DANE, DIAN, World Bank and DNP.

Notes: NA. Not available information. In the case of the annual percentage change it is not calculated because data was not available for the whole period. In other cases, information was not available for the specific sector. Ldc: developing countries, Dc: developed countries, totc: all countries,

Δ%: annual percentage change, Δ tar: tariffs reduction with respect to the 1980 level, Av: average, shtradeldc: share of trade to developing countries, shtradeldc: share of trade to developed countries. Sector 314 is not included in tables and is discarded of estimations because data for most of the variables was very scarce.

[a] Sector 353 is merged with sector 354. [b] Sector 361 is merged with sectors 362 and 369.

Table 5. Skill premia, skill intensity, wage bill. 1993-2012

	Skill premia				Skill intensity				Wagebill			
CIIUR2	Av Pr	Annual Δ%	Av W-SC	Annual Δ%	Av Pr	Annual Δ%	Av Pe-Te-Ag	Annual Δ%	Av Pr	Annual Δ%	Av W-SC	Annual Δ%
311	2.04	0.80	1.77	-0.04	0.68	-0.04	0.55	-0.26	0.32	0.58	-0.14	0.49
313	1.52	-1.36	1.69	-0.35	1.53	3.32	1.33	3.01	0.60	0.69	0.90	0.69
321	2.47	0.98	1.88	0.04	0.33	1.11	0.23	1.84	1.17	0.44	1.25	0.30
322	2.36	-0.57	1.77	-1.30	0.33	1.30	0.26	1.78	0.42	0.43	0.29	0.31
323	2.57	0.15	2.11	-1.59	0.32	1.07	0.25	1.39	0.69	0.45	-0.15	0.34
324	2.47	-0.86	1.87	-2.10	0.30	1.07	0.23	1.10	0.12	0.42	-0.70	0.30
331	2.48	-0.34	2.45	-0.27	0.36	-1.31	0.26	-1.07	-0.88	0.47	-0.81	0.39
332	2.30	1.32	1.77	0.51	0.42	0.90	0.34	0.51	1.16	0.49	0.61	0.38
341	1.99	-0.34	2.23	2.06	0.52	0.20	0.35	-0.16	-0.07	0.51	1.14	0.44
342	1.93	1.69	2.10	2.01	1.15	1.45	0.90	1.25	1.08	0.68	1.29	0.65
351	2.31	1.30	2.70	1.59	0.88	0.17	0.56	-0.39	0.48	0.67	0.47	0.60
352	3.25	0.66	2.01	-0.50	1.34	-1.03	1.10	-0.83	-0.07	0.81	-0.37	0.68
353[a]	1.83	-0.39	3.54	1.31	0.70	2.21	0.38	1.14	0.80	0.54	1.13	0.55
355	2.14	0.38	1.95	-0.35	0.54	2.54	0.41	3.22	1.44	0.53	1.65	0.44
356	2.66	1.14	2.27	0.13	0.47	0.54	0.31	-0.30	0.77	0.55	-0.10	0.41
361[b]	2.30	0.79	2.19	0.71	0.34	0.12	0.23	-0.48	0.53	0.44	0.15	0.33
371	2.45	3.05	3.27	5.21	0.52	3.80	0.28	2.58	2.74	0.53	4.00	0.45
372	2.78	3.50	1.79	-1.05	0.42	-0.58	0.30	0.81	1.33	0.53	-0.16	0.34
381	2.54	0.76	1.99	-0.34	0.41	1.05	0.29	0.51	0.94	0.51	0.11	0.36
382	2.26	0.59	2.15	0.27	0.51	1.16	0.35	0.67	0.83	0.53	0.53	0.42
383	2.72	0.99	2.33	-0.13	0.61	0.21	0.42	0.39	0.47	0.62	0.13	0.49
384	2.14	2.54	2.44	0.77	0.51	2.60	0.35	2.00	2.29	0.52	1.57	0.45
385	2.62	-1.50	2.39	-0.25	0.54	1.05	0.38	-0.74	-0.17	0.58	-0.44	0.47
390	2.46	0.43	1.90	0.62	0.51	0.41	0.38	-0.06	0.38	0.55	0.31	0.42

Source: own calculations based on DANE, DIAN, World Bank and DNP.

Notes: av: average, Pr: projected variables, W-S: wages and salaries of permanent workers, W-SC: wages and social security of permanent, temporal and agency workers, Perm: permanent workers, Pe-Te-Ag: permanent, temporal and agency workers.

Sectors 156, 231, 243, 273, 300, 321, 322 and 323 are not included in tables and are discarded of estimations because data for most of the variables is very scarce.

Sector 314 is not included in tables and is discarded of estimations because data for most of the variables was very scarce.

[a] Sector 353 is merged with sector 354. [b] Sector 361 is merged with sectors 362 and 369.

Table 6. Estimates of Eq. (2) with instrumental variables 2000-2012

	(1)	(2)	(3)
Dep Var	D.wage bill Pr	D.wage bill W-S	D.wage bill W-SC
D.ln(av sk premia Pr)	0.20571*		
	(2.128)		
D.ln(kapital/Prodbr)	0.03709	-0.00558	0.03598*
	(1.899)	(-1.170)	(1.989)
D.ln(av sk premia W-S)		0.22148***	
		(14.430)	
D.ln(av sk premia W-SC)			0.09052
			(0.340)
Constant	0.00618***	0.00017	0.00551**
	(3.337)	(0.238)	(2.605)
Obs	516	516	516
R2	0.326	0.964	0.273
Overid	1.255	2.787	0.496
Overid_P	0.534	0.248	0.780
Underid	10.744	3.648	1.319
Underid_P	0.013	0.302	0.725
Weakid	4.166	1.387	0.456

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE and DIAN data. First difference estimator. Instrumental variables: average experience, experience square and sector share of women. Estimation with robust standard errors.

Overid test: H_0 equation is underidentified, H_1 equation is identified. Underid test: H_0 instruments are valid, Weakid test: H_0 instruments are weak, Stock-Yogo critical value at 5%: 13.91.

Notes: t-statistics in brackets. av: average, sk: skill, Prodbr: gross production, Pr: projected variable, W-S: wages and salaries of permanent workers, W-SC: wages and social security of permanent, temporal and agency workers.

Table 7. Estimates of Eq. (2) with instrumental variables 1993-2012

	(1)	(2)
Dep Var	D.wage bill Pr	D.wage bill W-SC
D.ln(av sk premia Pr)	0.36960*	
	(2.094)	
D.ln(kapital/Prodbr)	0.00865	0.00909
	(0.350)	(0.297)
D.ln(av sk premia W-SC)		0.42858*
		(2.592)
Constant	0.00654**	0.00042
	(3.067)	(0.122)
Obs	240	240
R2	-0.080	0.201
Overid	1.789	1.953
Overid_P	0.409	0.377
Underid	4.827	2.776
Underid_P	0.185	0.427
Weakid	1.675	0.948

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE and DIAN data. First difference estimator. Instrumental variables: average experience, experience square and sector share of women. Estimation with robust standard errors.

Overid test: H_0 equation is underidentified, H_1 equation is identified. Underid test: H_0 instruments are valid, Weakid test: H_0 instruments are weak, Stock-Yogo critical value at 5%: 13.91.

Notes: t-statistics in brackets. av: average, sk: skill, Prodbr: gross production, Pr: projected variable, W-S: wages and salaries of permanent workers, W-SC: wages and social security of permanent, temporal and agency workers. Regressions based on wages and salaries of permanent workers are discarded for the long database.

Table 8.1. Estimates of Eq. (4) 2000-2012

(continue in 8.2.)

Dep. Var:	SBTC(1)	SBTC(3)	SBTC(4)	SBTC(5)	SBTC(6)	D.wage bill Pr	D.wage bill W-S	D.wage bill W-SC	SBTC(1)	SBTC(3)	SBTC(4)	SBTC(5)	SBTC(6)	D.wage bill Pr	D.wage bill W-S	D.wage bill W-SC
Tr Var:	Δ tariffs	Δ tariffs	Δ tariffs	Δ tariffs	Δ tariffs	Δ tariffs	Δ tariffs	Δ tariffs	Trade ldc	Trade ldc	Trade ldc	Trade ldc	Trade ldc	Trade ldc	Trade ldc	Trade ldc
SI-Pr* Tr Var	0.0052***		0.0051***			0.0054***			0.275**		0.252*			0.242*		
	(-6.071)		(-6.306)			(-6.875)			(-2.653)		(-2.456)			(-2.312)		
Sh-tem	-0.262***	-0.308***	-0.177*	0.039	-0.334***	-0.129*	0.068	-0.250***	-0.152	-0.184*	-0.095	0.087	-0.225*	-0.075	0.127	-0.171*
	(-4.002)	(-4.684)	(-2.487)	(-0.509)	(-4.219)	(-2.461)	(-0.566)	(-3.554)	(-1.503)	(-2.060)	(-0.738)	(-0.711)	(-2.410)	(-0.727)	(-1.104)	(-2.220)
SI-Perm*Tr_ Var				0.0043***			0.0043***					0.177**			0.168**	
				(-4.194			(-5.088					(-3.136			(-3.009	
SI-Pe-te-ag*Tr_Var		0.0054***			0.0048***			0.0053***		0.283**			0.264*			0.249*
		(-5.163)			(-4.322)			(-4.102)		(-2.697)			(-2.565)			(-2.406)
Const	0.051	0.067*	0.012	-0.08**	0.080*	-0.003	-0.082*	0.044	0.011	0.023	-0.012	-0.081	0.038	-0.0125	-0.084	0.022
	(-1.866)	(-2.323)	(-0.455)	(-2.936)	(-2.223)	(-0.158)	(-2.146)	(-1.326)	(-0.276)	(-0.646)	(-0.239)	(-1.749)	(-0.964)	(-0.285)	(-1.941)	(-0.649)
Obs	423	423	423	423	423	471	471	471	504	504	504	504	504	561	561	561
RSS	1.068	1.092	1.608	1.465	2.034	1.805	1.688	2.304	1.311	1.293	1.972	1.961	2.286	2.249	2.223	2.711
Z-statistic	3.911	3.521	4.524	4.250	3.114	4.720	3.567	4.524	-1.075	-1.064	-0.875	-0.731	-1.008	-1.013	-0.143	-0.806

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE and DIAN data. Arellano-Bond Estimation with robust standard errors. SBTC(1) to SBTC(6) are estimated from models (1) to (6) in Table 5. D: first difference.

Notes: t-statistics in brackets, SI: skill intensity, Pr: projected variable. W-SC: wages and social security of pe-te-ag workers, W-S: wages and salaries of permanent workers, Perm: permanent workers, Pe-te-ag: permanent, temporal and agency workers, Δ tariffs: tariff reductions between the actual level and the one in 1980, ldc: developing countries, dc: developed countries. Tr Var: trade integration variable, Sh-term: temporal over Pe-te-ag workers. Z-statistic tests the null hypothesis that b_1-c_1=0, from equations (3) and (4).

Table 8.2. Estimates of Eq. (4) 2000-2012

(continuation of 8.1.)

Dep. Var:	**SBTC(1)**	**SBTC(3)**	**SBTC(4)**	**SBTC (5)**	**SBTC (6)**	**D.wage bill Pr**	**D.wage bill W-S**	**D.wage bill W-SC**	**SBTC(1)**	**SBTC(3)**	**SBTC(4)**	**SBTC (5)**	**SBTC (6)**	**D.wage bill Pr**	**D.wage bill W-S**	D.wage bill W-SC
Tr Var:	**Trade dc**	**Trade dc**	**Trade dc**	**Trade dc**	**Trade dc**	**Trade dc**	**Trade dc**	**Trade dc**	**Exporters**	**Exporters**	**Exporters**	**Exporters**	**Exporters**	**Exporters**	**Exporters**	Exporters
SI-Pr* Tr Var	0.188***		0.204***			0.216***			0.034***		0.037***			0.04***		
	(-7.824)		(-7.216)			(-7.662)			(-3.658)		(-4.194)			(-4.168)		
Sh-tem	-0.253***	-0.266***	-0.197**	0.030	-0.319***	-0.141**	0.085	-0.251***	-0.193**	-0.274***	-0.120	0.147	-0.389***	-0.11	0.153	-0.360**
	(-4.180)	(-4.518)	(-2.835)	(-0.542	(-4.815)	(-3.076)	(-1.107	(-4.557)	(-3.203)	(-4.039)	(-1.276)	(-1.132	(-3.347)	(-1.039)	(-1.127	(-2.905)
SI-Perm*Tr_Var				0.198***			0.205***					0.023***			0.024***	
				(-9.359)			(-8.849)					(-3.568)			(-3.57)	
SI-Pe-te-ag*Tr_Var		0.180***			0.164***			0.185***		0.036***			0.032**			0.034**
		(-7.237)			(-4.865)			(-4.632)		(-3.629)			(-3.108)			(-3.181)
Constant	0.063*	0.070**	0.031	-0.068**	0.089**	0.013	-0.083**	0.059*	-0.036	-0.005	-0.088*	-0.175**	0.049	-0.094*	-0.173**	0.036
	(-2.456)	(-2.771)	(-1.114)	(-3.003)	(-3.11)	(-0.687)	(-2.732)	(-2.402)	(-1.405)	(-0.190)	(-2.298)	(-3.232)	(-1.106)	(-2.085)	(-2.946)	(-0.764)
Obs	504	504	504	504	504	561	561	561	230	230	230	230	230	231	231	231
RSS	1.16	1.217	1.737	1.585	2.262	1.938	1.761	2.591	0.588	0.552	0.936	0.845	1.084	1.011	0.894	1.2
Z-statistic	-0.691	-0.360	-1.061	-1.847	-0.249	-2.135	-0.956	-0.458	3.063	2.762	3.443	3.518	2.470	3.221	0.039	3.641

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE and DIAN data. Arellano-Bond Estimation with robust standard errors. SBTC(1) to SBTC(6) are estimated from models (1) to (6) in Table 5. D: first difference.

Notes: t-statistics in brackets, SI: skill intensity, Pr: projected variable. W-SC: wages and social security of pe-te-ag workers, W-S: wages and salaries of permanent workers, Perm: permanent workers, Pe-te-ag: permanent, temporal and agency workers, Δ tariffs: tariff reductions between the actual level and the one in 1980, ldc: developing countries, dc: developed countries. Tr Var: trade integration variable, Sh-term: temporal over Pe-te-ag workers. Z-statistic tests the null hypothesis that b_1-c_1=0, from equations (3) and (4).

Table 9. Estimates of Eq. (5) 2000-2012

Dep. Var:	SBTC(2)	SBTC(5)	D.wage bill W-S
Tr Var:	Exporters	Exporters	Exporters
Tr Var	0.02020**	0.02737	0.03652
	(3.280)	(1.185)	(1.517)
Sh-tem	0.03031	0.09276	0.10056
	(1.114)	(0.869)	(0.910)
SI-Perm*Tr Var	-0.01248***	-0.02261*	-0.02320*
	(-3.302)	(-2.036)	(-2.027)
SI-Perm	0.04787***	0.24251***	0.24798***
	(3.658)	(4.580)	(4.528)
Constant	-0.10409**	-0.29288*	-0.33893**
	(-3.073)	(-2.365)	(-2.610)
Obs	230	230	231
RSS	0.033	0.668	0.695

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE and DIAN data. Arellano-Bond Estimation with robust standard errors.

SBTC(1) to SBTC(6) are estimated from models (1) to (6) in Table 5. D: first difference.

Notes: t-statistics in brackets, SI: skill intensity, W-S: wages and salaries of permanent workers, Perm: permanent workers, Δ tariffs: tariff reductions between the actual level and the one in 1980, ldc: developing countries, dc: developed countries. Tr Var: trade integration variable, Sh-term: temporal over Pe-te-ag workers

Table 10. Estimates of Eq. (4) 1993-2012

Dep. Var:	SBTC(1)	SBTC(2)	D2.wage bill W-SC	SBTC(2)	D2.wage bill Pr
Tr Var:	Δ tariffs	Δ tariffs	Trade ldc	Trade dc	Trade dc
SI-Pr*Tr_Var	0.00193**				0.03691*
	(-3.287)				(-2.65)
Share temporal	-0.00214	0.03998	0.00371	0.06252*	0.00464
	(-0.846)	(-1.385)	(-0.073)	(-2.212)	(-1.029)
SI-Pe-te-ag *Tr Var			0.15006*		
			-2.43		
Constant	-0.01847**	-0.03335*	-0.01976	-0.04068*	-0.01007*
	(-3.315)	(-2.575)	(-1.029)	(-2.484)	(-2.263)
Obs	414	253	264	264	432
R2	0.009	0.013	0.004	0.012	0.003
F	5.518	4.747	3.517	3.187	4.503
Z-statistic	3.439	2.920	-2.029	0.157	0.043

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: own calculations based on DANE and DIAN data. Fixed Effects Estimation with robust standard errors.

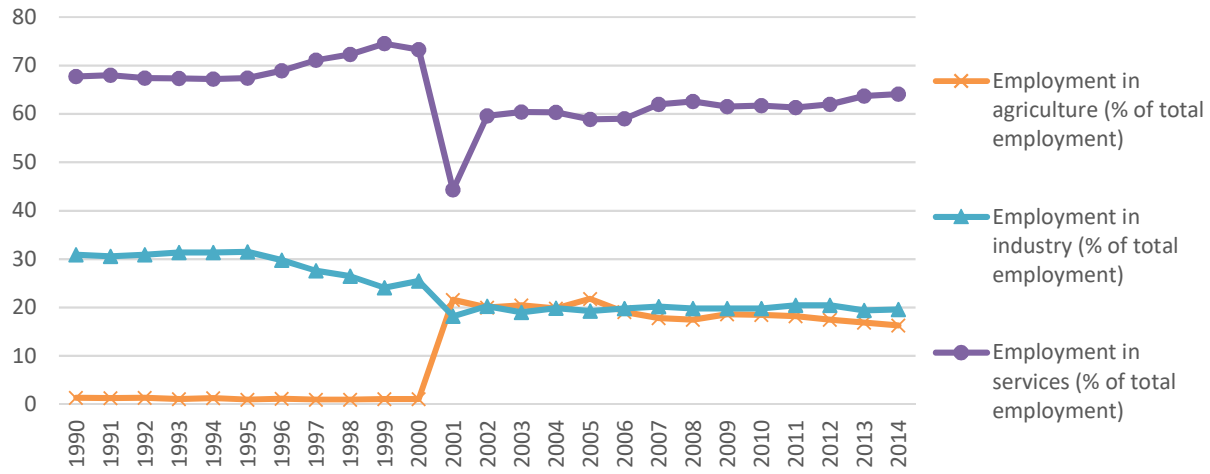
SBTC(1) and SBTC(2) are estimated from models (1) and (2) in Table 4. D2: second difference.

Notes: t-statistics in brackets, SI: skill intensity, Pr: projected variable, W-SC: wages and social security of Pe-te-ag workers, Pe-te-ag: permanent, temporal and agency workers, Δ tariffs: tariff reductions between the actual level and the one in 1980, ldc: developing countries, dc: developed countries, Tr Var: trade integration variable, share temporal: temporal over Pe-te-ag workers.

Z-statistic tests the null hypothesis that b_1-c_1=0, from equations (3) and (4).

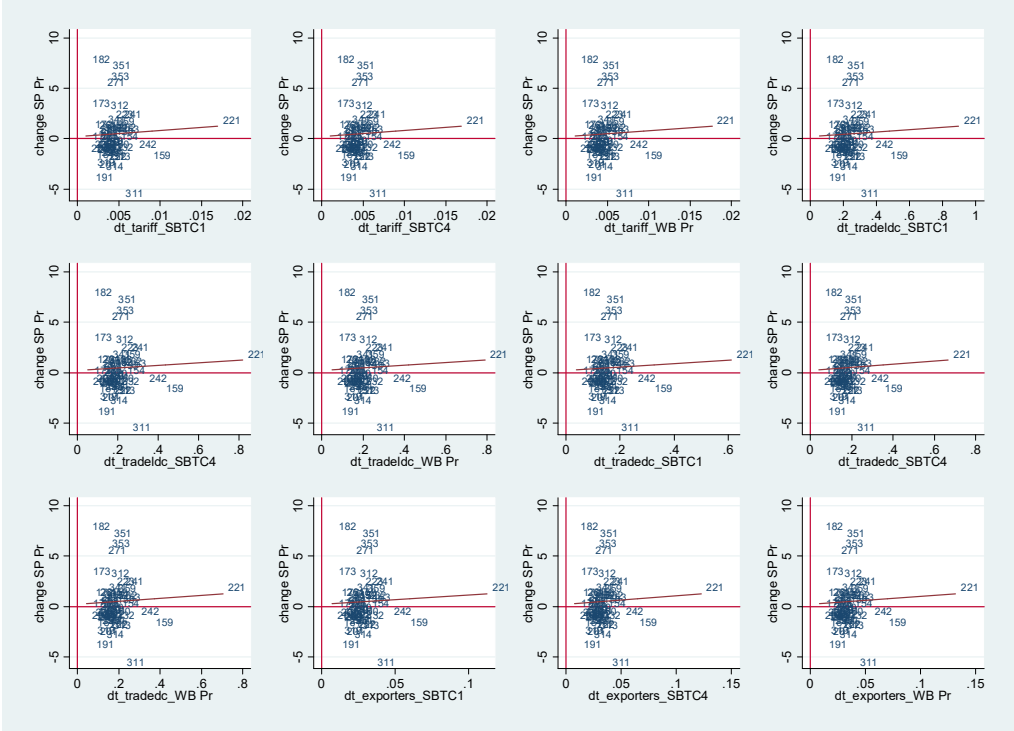
Regressions based on wages and salaries of permanent workers are discarded for the long database.

Figure 3. % of total employment in Colombia, by sector. 1990-2014



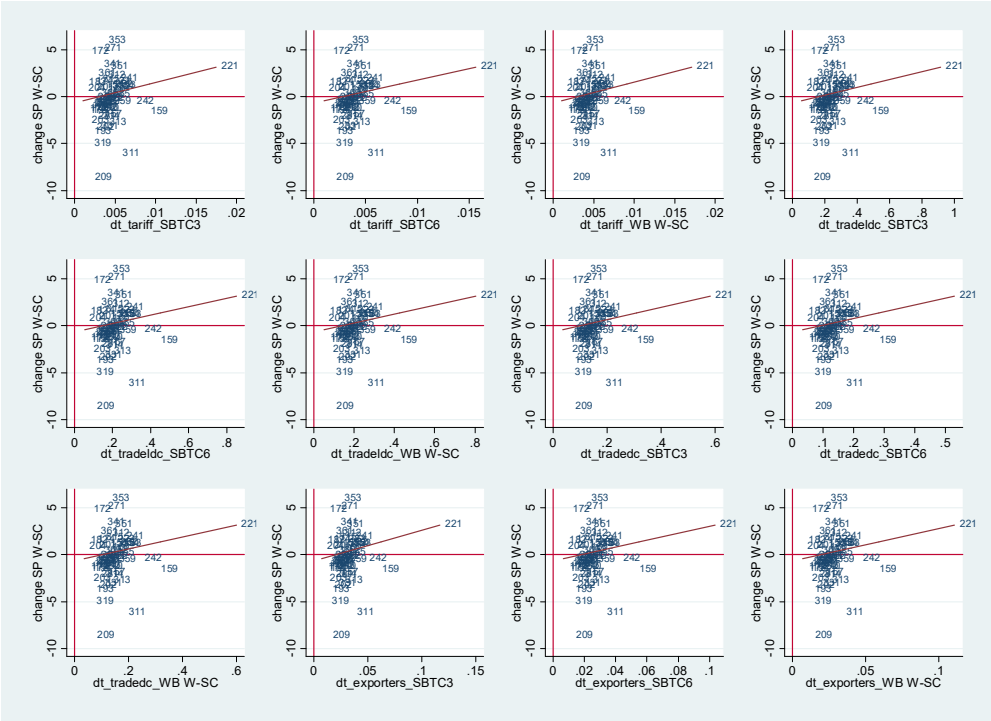
Source: World Bank.

Figure 4. Eq. 4. Annual percentage change of skill premia (Projected) and Trade derivatives (dt) 2000-2012



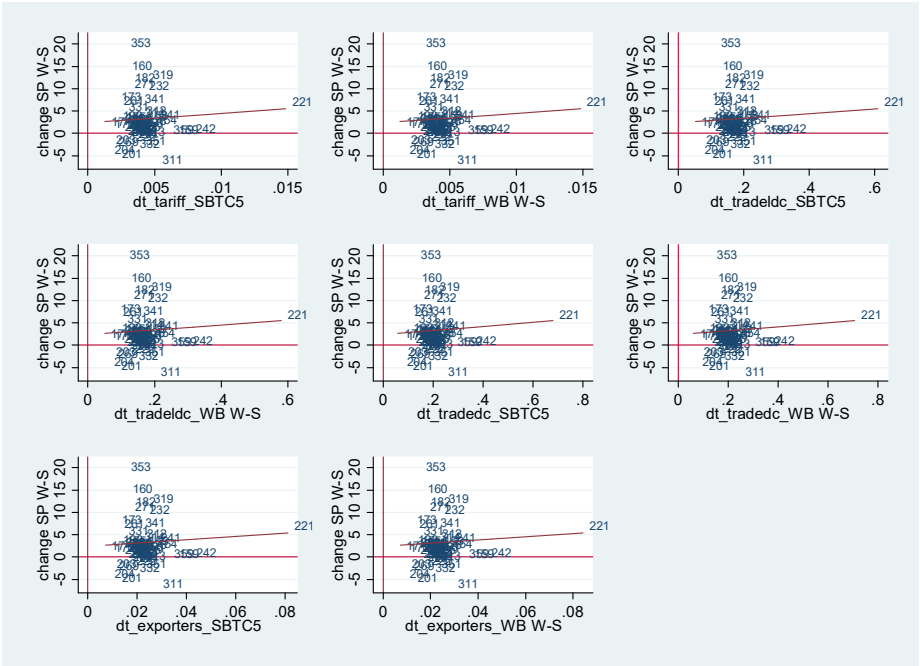
Notes: trade derivatives obtained from Eqs. (4) and (7) in the text. Change SP Pr: annual percentage change (during the period 2000-2012) of Projected Skill Premia, ldc: developing countries, dc: developed countries. SBTC1 and SBTC4 correspond to the SBTC measures obtained from Table 5. WB Pr is a SBTC measure: Projected wage bill variable.

Figure 5. Eq. 4. Annual percentage change of skill premia (Wages and social security of permanent, temporal and agency workers) and Trade derivatives (dt) 2000-2012



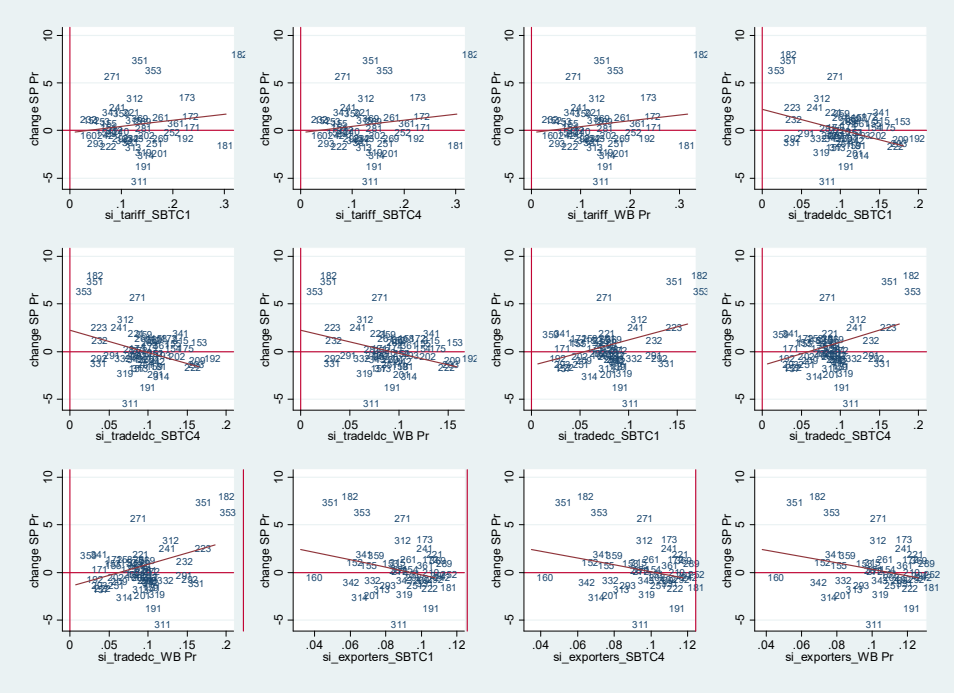
Notes: trade derivatives obtained from Eqs. (4) and (7) in the text. Change SP W-SC: annual percentage change (during the period 2000-2012) of wages and social security Skill Premia, ldc: developing countries, dc: developed countries. SBTC3 and SBTC6 correspond to the SBTC measures obtained from Table 5. WB W-SC is a SBTC measure: wages and social security wage bill variable.

Figure 6. Eq. 4. Annual percentage change of skill premia (Wages and salaries of permanent workers) and Trade derivatives (dt) 2000-2012



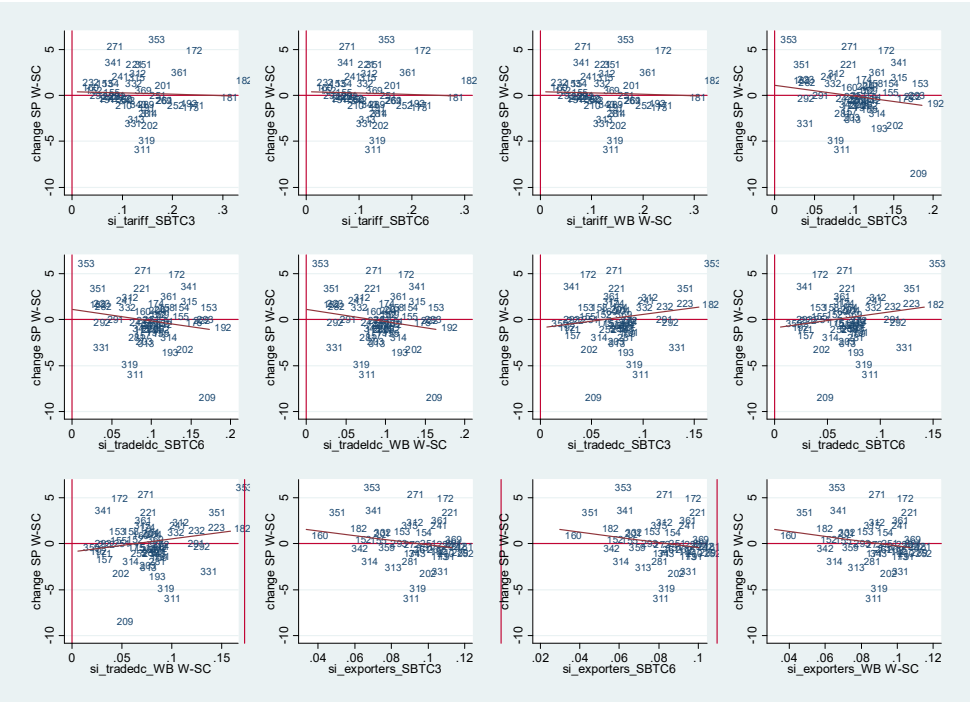
Notes: trade derivatives obtained from Eqs. (4) and (7) in the text. Change SP W-S: annual percentage change (during the period 2000-2012) of wages and salaries Skill Premia, ldc: developing countries, dc: developed countries. SBTC5 corresponds to the SBTC measure obtained from Table 5. WB W-S is a SBTC measure: wages and salaries wage bill variable.

Figure 7. Eq. 4. Annual percentage change of skill premia (Projected) and skill intensity derivatives (si) 2000-2012



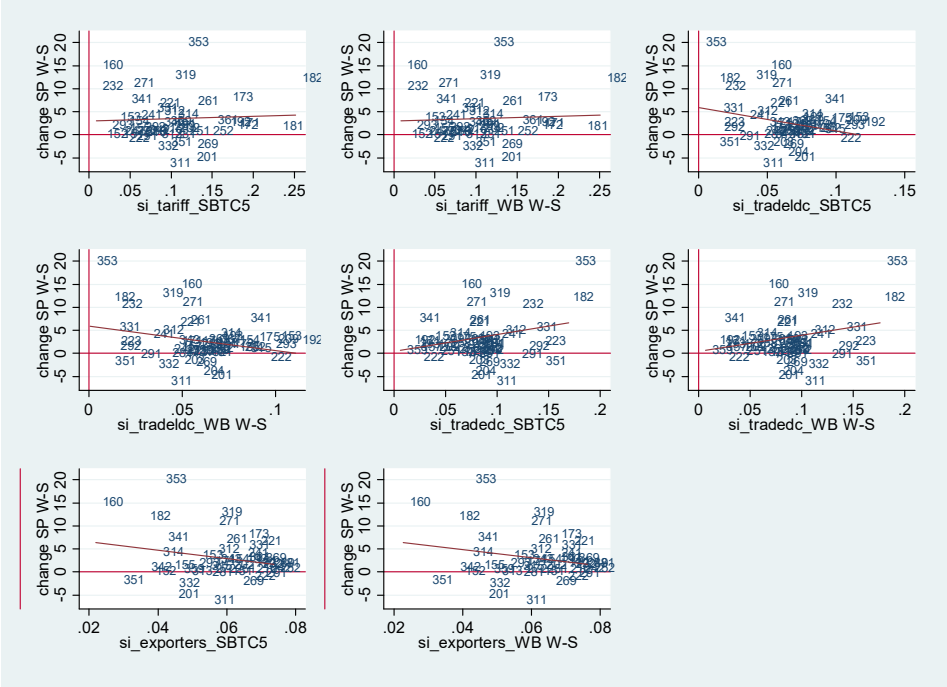
Notes: skill intensity derivatives obtained from Eqs. (4) and (6) in the text. Change SP Pr: annual percentage change (during the period 2000-2012) of Projected Skill Premia, ldc: developing countries, dc: developed countries. SBTC1 and SBTC4 correspond to the SBTC measures obtained from Table 5. WB Pr is a SBTC measure: Projected wage bill variable.

Figure 8. Eq. 4. Annual percentage change of skill premia (Wages and social security of permanent, temporal and agency workers) and Skill intensity derivatives (si) 2000-2012



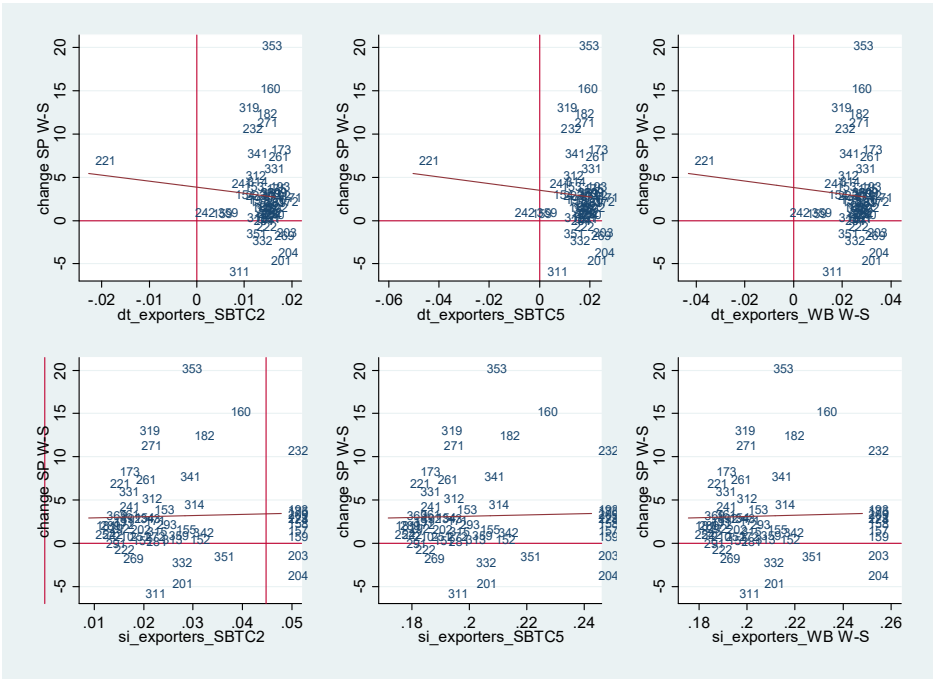
Notes: skill intensity derivatives obtained from Eqs. (4) and (6) in the text. Change SP W-SC: annual percentage change (during the period 2000-2012) of wages and social security Skill Premia, ldc: developing countries, dc: developed countries. SBTC3 and SBTC6 correspond to the SBTC measures obtained from Table 5. WB W-SC is a SBTC measure: wages and social security wage bill variable.

Figure 9. Eq. 4. Annual percentage change of skill premia (Wages and salaries of permanent workers) and Skill intensity derivatives (si) 2000-2012



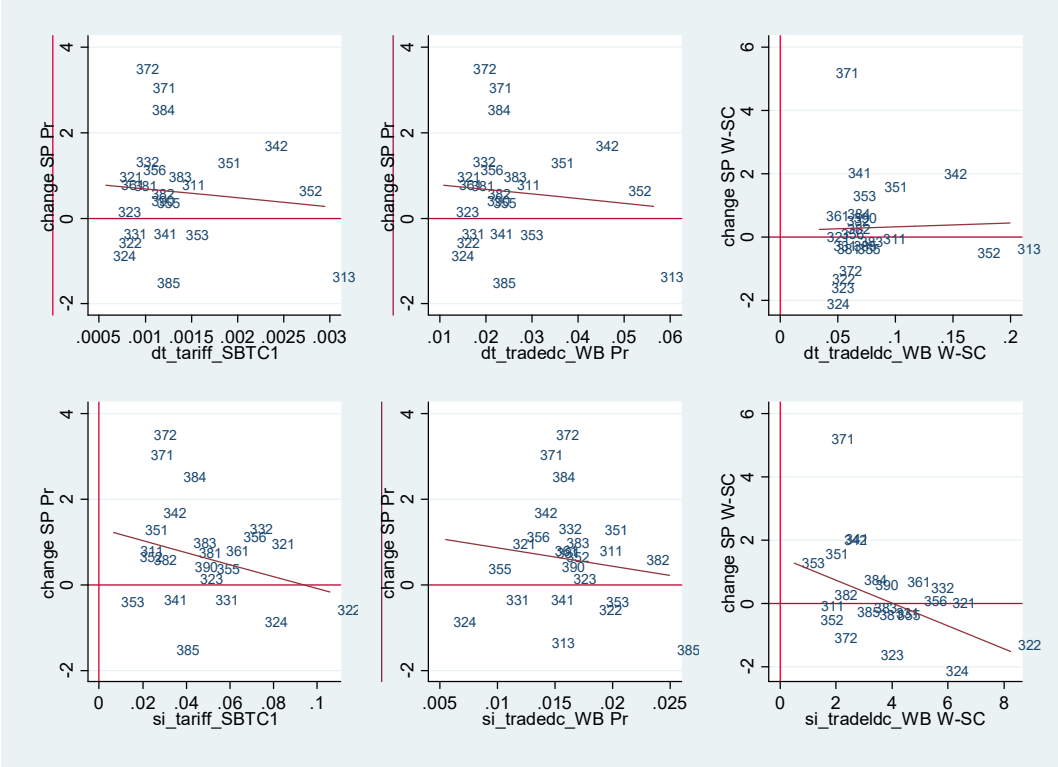
Notes: skill intensity derivatives obtained from Eqs. (4) and (6) in the text. Change SP W-S: annual percentage change (during the period 2000-2012) of wages and salaries Skill Premia, ldc: developing countries, dc: developed countries. SBTC5 corresponds to the SBTC measure obtained from Table 5. WB W-S is a SBTC measure: wages and salaries wage bill variable.

Figure 10. Eq. 5. Annual percentage change of skill premia (wages and salaries of permanent workers) and trade (dt) and skill intensity (si) derivatives 2000-2012



Notes: trade and skill intensity derivatives obtained from Eqs. (5), (6) and (7) in the text. Change SP W-S: annual percentage change (during the period 2000-2012) of wages and salaries Skill Premia. SBTC2 and SBTC5 correspond to the SBTC measures obtained from Table 5. WB W-S is a SBTC measure: wages and salaries wage bill variable.

Figure 11. Eq. 4. Annual percentage change of skill premia (Projected and W-SC) and trade (dt) and skill intensity (si) derivatives 1993-2012



Notes: trade and skill intensity derivatives obtained from Eqs. (5), (6) and (7) in the text. Ldc: developing countries, Dc: developed countries. Change SP W-SC: annual percentage change (during the period 1993-2012) of wages and social security Skill Premia. Change SP Pr: annual percentage change (during the period 1993-2012) of Projected Skill Premia. SBTC1 corresponds to the SBTC measure obtained from Table 4. WB W-SC is a SBTC measure: wages and social security wage bill variable. WB Pr is a SBTC measure: Projected wage bill variable.

Bibliography

- Acemoglu, D. (2003). Patterns of skill premia. The Review of Economic Studies, 70(2), 199-230.
- Acemoglu Daron, and Author David (2011). "Skills, tasks and technologies: Implications for employment and earnings." Handbook of labor economics 4 (2011): 1043-1171.
- Aghion, P., & Howitt, P. (1990). A model of growth through creative destruction (No. w3223). National Bureau of Economic Research.
- Álvarez, M., & Bermúdez, M. (2010). La estructura de exportaciones colombianas: con necesidades de cambio. Bogotá: MCIT.
- Attanasio, O., Goldberg, P. K., & Pavcnik, N. (2004). Trade reforms and wage inequality in Colombia. Journal of development Economics, 74(2), 331-366.Arango et al. (2004)
- Baum, C. F. (2006). An introduction to modern econometrics using Stata. Stata press.
- Boeri, T., & van Ours, J. (2008). Unemployment benefits. Boeri T., Van Ours J.(a cura di), The economics of imperfect Labour markets, Princenton University Press., Princenton (NJ).
- Bustos, P. (2011). Trade liberalization, exports, and technology upgrading: Evidence on the impact of MERCOSUR on Argentinian firms. American Economic Review, 101(1), 304-40.
- Caicedo Marulanda, C., & Mora Rodríguez, J. J. (2011). Comercio Intraindustrial Colombia-Estados Unidos: el caso de los bienes altamente tecnológicos (1995-2005). Cuadernos de Economía, 30(54), 83-104.
- Cardenas, M., Kugler, A., & Bernal, R. (1999). Labor market regulation and labor demand in Colombia: 1976-1996.
- Duranton, G. (2016). Agglomeration effects in Colombia. Journal of Regional Science, 56(2), 210-238.
- Escobar, J. D. U. (2017). La política comercial en Colombia, sus instituciones y los costos de comerciar. Revista del Banco de la República, 89(1064), 5-16.
- Esposito, P., & Stehrer, R. (2009). The sector bias of skill-biased technical change and the rising skill premium in transition economies. Empirica, 36(3), 351-364.
- Haskel, J. E., & Slaughter, M. J. (2002). Does the sector bias of skill-biased technical change explain changing skill premia? European Economic Review, 46(10), 1757-1783.

- Goldberg Pinelopi Koujianou and Pavnick, Nina (2005). “Trade, wages, and the political economy of trade protection: evidence from the Colombian trade reforms”. Journal of International Economics 66, 75–105.
- Goldberg, P. K., & Pavcnik, N. (2007). Distributional effects of globalization in developing countries. Journal of economic Literature, 45(1), 39-82.
- Grossman, G. H., & Helpman, E. (1991). E.(1991),“Innovation and Growth in the Global Economy”. MTTPress, Cambridge.
- Lawrence, R. Z., Slaughter, M. J., Hall, R. E., Davis, S. J., & Topel, R. H. (1993). International trade and American wages in the 1980s: giant sucking sound or small hiccup?. Brookings papers on economic activity. Microeconomics, 1993(2), 161-226.
- Medina, C., & Suárez, C. M. P. (2010). Technical Change and Polarization of the Labor Market: Evidence for Brazil, Colombia and Mexico (No. 007269). Banco de la República.
- Méndez, J. A. N., & Torres, F. J. S. (1998). Educación y salarios relativos en Colombia, 1976-1995: determinantes, evolución e implicaciones para la distribución del ingreso. República de Colombia, Departamento Nacional de Planeación, Unidad de Análisis Macroeconómico.
- Nickell, S. (1981). Biases in dynamic models with fixed effects. Econometrica: Journal of the Econometric Society, 1417-1426.
- Santamaría, M. (2004). Income inequality, skills and trade: Evidence from Colombia during the 80s and 90s. Universidad de los Andes.
- Villafradez, R. A., & Luna, Y. (2013). ESTIMACIÓN DEL IMPACTO DEL COMERCIO EXTERIOR EN EL EMPLEO MANUFACTURERO EN COLOMBIA, 1991-2010. Revista Civilizar De Empresa Y Economía, 4(7), 27-50.
- Tenjo Galarza, J. Álvarez Vos, O., Gaviria, A., Jiménez, M.C. (2018) Evolution of returns to education in Colombia (1976-2014). Forthcoming.
- [dataset] World Bank. “World - Exporter Dynamics Database 1997-2014”. Data repository: Microdata Library http://microdata.worldbank.org.
- [dataset] DANE. “Encuesta Annual Manufacturera”. Data repository: Microdata http://microdatos.dane.gov.co/index.php/catalog/MICRODATOS/about_collection/6/2.