

Skill biased technological changes: Case of the MENA Region

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Abstract. *Our work treats the relationship between inequality and technological changes. Specifically, we focus on the transmission mechanisms by which technological innovations affect the inequality in access to employment. The objective of this article is to determine the effects of the diffusion of innovations on the demand for skilled and non-skilled labor. It is focuses on the concept of technological bias and the role of inequality between skilled and unskilled workers. The empirical validation of this work is based on the technique of dynamic Panel. An estimate by the method of Arellano and Bond seems more relevant. Actually, there is a positive relationship between innovations and the demand for skilled labor but a negative relationship for unskilled labor. This result is confirmed in our sample of countries.*

Keywords: Technological changes, inequality in access to employment, skill biased technological changes, complementarity between capital and skilled labor.

JEL Classification: J21, J23, J24, O33, Q55.

1. Introduction

It is now considering reducing inequalities as a priority. In this sense, the report of the World Bank (2005) highlights the need to reduce «inequality traps». However, this problem seems to be more complex in MENA countries where a paradox was highlighted (Hassine, 2015; Johannesen, 2015). Indeed, despite a substantial improvement of human development indicators, these countries have not experienced a significant reduction in inequality. The most recent data from the World Bank shows that the Gini index in the MENA region is relatively large; between 30 and 40. It therefore appears that the problem in the region of equity covers not only traditional education and health issues, underlining the importance of defining the main determinants of inequality in the region.

Inequality is a challenge not only for the poor, but for the whole society, to the extent that they undermine social cohesion and impede social mobility, fuelling social tensions that can lead to civil unrest and political instability. Income inequality is a social phenomenon present in every country in the world but with varying degrees. In several countries such as the MENA region, income inequality generates revolution and political instability. The waves of protests that affected the MENA countries since 2011 are partly the result of inequality and rising poverty in the region. The revolution in the MENA region is born of the refusal to tolerate the glaring socio-economic inequalities perpetuated by the elite for too long installed in power. In many countries today, the issue of inequality finds itself at the forefront of national and international discourse, in order to find the causes of these inequalities in order to reduce them.

Joining an abundant literature on inequality and growth, we discuss the role of innovation as a source of inequalities following an analysis on the biased technological progress (Aghion and Howitt, 1998; Rubart, 2007) and more generally on the idea of “creative destruction” proposed by Schumpeter. The main mechanism used shows that innovation creates both inequalities and profit opportunities. Therefore, what are the implications of technical change on the labor market? How does new technology affect employment and wage distribution?

Technological changes favour more skilled workers; replace the tasks previously performed by unskilled labor and increases inequality. This vision is formed on the basis of decades of experience, which witnessed major changes in technology, including the rapid spread of computers in the workplace and in our lives, and wage inequality. In the United States, for example, the premium for the university – the salaries of university graduates compared to the wages of non-university graduates – rose by more than 25 percent between 1979 and 1995. The overall income inequality also rose sharply. In 1971, a worker at the 90th percentile of the wage distribution earned 266 percent more than a worker at the 10th percentile. In 1995, this number reached 366 percent (Acemoglu, 2002).

Several researchers found a direct causal relationship between these radical technological developments and changes in the distribution of wages in the US economy. The title of the article by Krueger (1993): “How computers have changed the pay structure” on computers and inequality summarizes this view. Yorukoglu and Greenwood (1997) also

give a brief report: the installation and operation of the new technologies often involve the acquisition and processing of information. Competence facilitates this adoption process. Therefore, periods of rapid technological advancements should be associated with of the skill performance. They argue that we are now in the midst of a “third industrial revolution” fueled by advances from the information technology revolution which is responsible for the increase of inequality.

Various studies report an increase in the wage premium provided by university education compared to secondary education. For example, Bradbury (2002) assessed the link between schooling and wages in the 1980s and 1990s in the United States. The author observed an increase of “wage premium of schooling” which he defines as the extent to which well-educated workers earn more than less educated one. The benefits of education have increased in recent decades, which represents a significant cause of the amplification of wage inequality.

Goldin and Katz (1998) argue that the spread batch and continuous process production methods have increased the demand for skills. They add that: “... the change in electricity, after steam energy sources and water power, is enhanced because it reduces the demand for unskilled manual workers in many tasks like pulling, carrying and assembling”. During this period, capital intensive industries greatly increase the demand for skills (Goldin and Katz, 1998).

The evidence of the early 20th century is so powerful that Griliches (1969) suggests that capital and skills are complementary. Nelson and Phelps (1966), Welch (1970), Schultz (1975) and Tinbergen (1975) also showed that technological developments are increasing the demand for qualifications. Personal computers, computer-assisted production techniques and robotics seem to complement skilled workers by replacing many highly labor-intensive tasks. It may be natural to see the increase in inequality over the past decades as a direct consequence of technical change. The thesis of the Skills Biased Technological Changes (SBTC) thus explains the inequality of the wages and the inequality of job access.

For this purpose, we present a review of the theoretical and empirical literature on this issue. After that, we will outline our specified model and the data that we have used for the empirical validation. Finally, we compare some of the theoretical hypotheses using econometric tests on Panel data to verify the impact of technological changes on demand of employment for our sample of countries.

2. Literature review

The underlying assumption is that the adoption of new technologies requires a high level of human capital which is often scarce at the beginning of the technology diffusion process. Given this scarcity, we are witnessing an increase of the skilled workers wages, while the wages of other workers were maintained at their original level, which results in unequal wages. If the newest technologies are more complex than oldest ones, this means that there is a positive correlation between wages and the use of the new technologies.

The SBTC hypothesis is confirmed by estimating the equations which link shares of the employment of the non-manual workers, on the one hand, and the expenditure in R&D and the use of the computers, on the other hand. Berman, Bound and Griliches (1994) showed that computers and R&D spending have a positive and significant impact on increasing the share of the payroll of non-production workers: these two factors account for 70 percent of travel at the expense of the production workers. Focusing on the period 1979-1989, Allen (2001) showed that the wage gap increased in most industries with the rise of R&D.

Autor, Katz and Krueger (1998) got similar results for the sectors other than the production sector in the United States. They formed an increasing demand of the skilled labor during the five last decades and particularly since 1970. They argued that the diffusion of the computers and technologies significantly contributed to this phenomenon and proved that the evolution of skills occurred more quickly in computer-intensive industries. As a whole, the empirical evidence shows that more technologically advanced industries are more likely to show an increase in the relative demand for skilled workers.

Based on matched data of industrial establishment and employees, Doms, Dunne and Troske (1997) showed that there is a positive correlation between new technologies and qualification: user institutions of many advanced production technologies are characterized by a higher share of skilled workforce. Thus, Goldin and Katz (1998) studied the impact of new technologies and new production processes during the first half of the century, in the period following the introduction of electricity. They found that there is a complementarity between new technologies and skilled workers. In particular, the dissemination of production techniques related to the use of electric motors in the first decade of the century fostered an increase in the relative demand for skilled workers in the manufacturing sector in the United States.

For France, using a sample of 4954 companies, for the period 1991-1996, Duguet and Gennan (1997) showed the existence of a technological bias that favors the labor design of companies, which is assumed to be the most skilled workforce. In Canada, in an analysis combining the industrial service sector, Gera, Gu and Lin (2001) found that the technological level indicators (the stock of patents, the age of the capital stock) are positively correlated with use of skills, which aligns well with the SBTC hypothesis. This study confirms the results of Betts (1997) which showed that, over the period 1962 to 1986, technical progress is unfavorable to non-skilled labor in most sectors of the Canadian industry.

The work of Betts (1997) concerns 18 industrial sectors in Canada. He considers two categories of employment by occupation: workers = production labor or blue collar, the rest = indirect labor or white collar. The tests reject the hypothesis that technological changes were neutral in 10 out of 18 sectors. In each case biased technical progress, innovation consumes the qualifications. Card, Kramarz and Lemieux (1996) defended the idea that the same forces that have lowered the real wages of unskilled labor in the United States market have also affected the labor markets in Canada and France.

In a cross-sectional study, Bartel and Lichtenberg (1987) showed that the older the capital, the lower the share in the costs of labor who attended more than 13 years of education. This result indicates that the latest technologies are associated with a more skilled workforce. Moreover, Machin and Van Reenen (1998) started from an international comparison to find that the United States industry is similar to other industries. They identified both a correlation between capital and skilled labor, and a correlation between New Technologies and skilled labor. These correlations are stronger in the United States and Great Britain.

Draper and Manders (1996) were interested in the example of the Netherlands. They considered two groups of sectors: protected areas and exposed areas and two categories of employment by level of education: secondary, learning and more = qualified, primary and extended primary = unqualified. They found that technological changes are important. Indeed, most of the reduction of unskilled labor demand can be attributed to efficient asymmetric technological changes in labor. They also confirm the complementarity between capital and skilled labor.

Casavola, Gagosto and Sestito (1996) used two job categories: blue-collar and white-collar workers to show that the use of new technologies has led to a shift of the relative demand for labor in favor of indirect employees during the second half of the 80s. However, it is not obvious that an increase in the wage premium occurs simultaneously. Entorf and Kramarz (1997), in estimation with individual effects, found that all effects, excepting the experience of new technologies, disappear. Companies select their best employees when seeking someone to work with new technologies containing data processing. These new technologies are used by employees who were already better paid than their colleagues before working on this equipment.

More recently, on a sample of 32 countries over the period 1980-1991, Conte and Vivarelli (2007) have studied the consequences of imported technology made by developed countries in the structure of the workforce of the developing countries and the least developed countries. They noted that there is a complementarity between capital and labor inputs (skilled labor and unskilled labor). However, the imported technology helps increase the skilled workforce and reduce the number of non-qualified employees.

In the case of the developing countries, estimates of the effects of technological changes on employment or on wages remained rudimentary and limited. To fill this gap in the literature, we focus on these countries. Based on a sample of the MENA region, we will try to answer the following questions: What are the effects of technological changes on the demand for skilled and unskilled workers? And what is the nature of the relationship between capital and skills and between technological changes and the educational level?

3. Empirical analysis

3.1. Model and data

The lack of data on the wages by level of qualifications is a limit to our work. However, we rely on the specific effects of the individuals represented by the term α_i to capture the

changes of the relative wages. We will focus on the impact of technological changes on inequality of employment access and not inequality of wages or incomes. According to Panel data, our estimated employment equations have the following structure.

$$L_{it}^s = (1 - \alpha_1) l L_{it-1}^q + \alpha_2 l Y_{it} + \alpha_3 l K_{it} + \alpha_4 l TC_{it} + \alpha_5 l PPP_{it} + \alpha_{it} + \xi_{it} \quad (1)$$

$$L_{it}^{us} = (1 - \alpha_1) l L_{it-1}^{nq} + \alpha_2 l Y_{it} + \alpha_3 l K_{it} + \alpha_4 l TC_{it} + \alpha_5 l PPP_{it} + \alpha_{it} + \xi_{it} \quad (2)$$

Our work considers skilled and unskilled labor (these are explanatory variables) based on these two delayed variables, production, capital, technological changes and the purchasing power parity (these are the Explanatory variables). These models are inspired by the work of Sboui and Saafi (2012).

We will study these two equations in time and space where “i” represents each country and “t” represents each time period ($t = 1, 2, \dots, T$). L^s represents the skilled labor measured by the number of workers who followed a university education. L^{us} is the unskilled labor measured by the remaining workers (no education, primary level reached, complete primary level, secondary level reached complete secondary level). Y represents the production, K is the stock of capital, TC is the technological changes and PPP represents the purchasing power parity.

Our contribution is based on statistical data from several databases. The stock of capital is presented by the share of investment in the real GDP per capita. The data on the stock of capital are from Penn World Tables (Heston et al., 2012) version 7.1. Production is represented by real GDP per capita and drawn from the World Bank (WDI, 2014). PPP is also from Penn World Tables (Heston et al., 2012). Skilled and unskilled labor are taken from the database of Barro and Lee (2010).

We choose to measure the technological changes, first, by the number of patents filed by residents and non-residents, then by spending on R&D as a percentage of GDP and, finally, by the value of imported technologies as a percentage of the imports of goods. The number of patents is taken from World Intellectual Property Organization (WIPO, 2010). On the other hand, the expenditure on R&D and the value of imported technologies are taken from the World Bank (WDI, 2014).

In summary, we will test the SBTC hypothesis. By using two specifications, we will test the impact of technological changes on the demand for skilled employees, on one hand, and the demand for unskilled employees, on the other hand. We will test the impact of technological changes on the inequality of access to employment for skilled and unskilled workers.

3.2. Research methodology

The estimated employment demand function shows the presence of a delayed dependent variable. The presence of this variable represents a major difficulty. This complication originated from the correlation between the dependent variable delay and disruption, although ξ_{it} is supposed uncorrelated. The solution of this problem is based on the instrumental variables estimators and consequently on an estimator by the Generalized

Method of Moments (GMM) developed by Arellano and Bond (1991). This method solves the problems of simultaneity bias, reverse causality and omitted variables that weaken the results. The method of Arellano and Bond (1991) acts as a dynamic Panel estimated in two stages, which brings us first to rewrite the model in first differences to eliminate the individual and time specific effects. The in level lagged values of two or more periods are employed as a result of the instruments of the explanatory variables in first difference, assuming that the errors of the in level equation are not serially correlated.

However, this instrumentation technique seems a little inefficient, given that the delayed in level variables are weak instruments for first differences. Blundell and Bond (1998) proposed a GMM model system, which consists of a model equation in first difference and a level in the initial equation model. Concern the in level equation, the predetermined and endogenous variables are instrumented in level by their own first differences, on the one hand, and the strictly exogenous variables are instrumented in level on the other.

However, Blundell and Bond (1998) showed that if the instruments are weak, the estimator in two stages is biased in the case of small sized sample. Our sample is composed of six countries in the MENA region: Algeria, Egypt, Iran, Malta, Morocco and Tunisia for the period 1965-2010 where technological changes are measured by the number of patents and for the period 1996-2010 where technological changes are measured by spending on R&D and the value of the imported technologies. The result of our estimates is shown in Tables 1; 2; 3.

Table 1. Results of the Estimation (technological changes: number of filed patents)

Equation (1)	Sys-GMM	Equation (2)	Sys-GMM
Skilled Labor ₁	0,0478** (0,000)	Unskilled labor ₁	0,0059** (0,000)
Production	0,2478* (0,000)	Production	-0,0478* (0,003)
Capital	0,7589*** (0,000)	Capital	-0,9783*** (0,003)
Technological Changes	0,9874*** (0,000)	Technological Changes	-0,4587*** (0,000)
PPP	0,4796** (0,000)	PPP	-0,6547** (0,000)

Note: *, **, *** denotes significance at 10%, 5%, 1%; the values in parentheses represent probabilities.

Table 2. Results of the Estimation (technological changes: spending on R&D)

Equation (1)	Sys-GMM	Equation (2)	Sys-GMM
Skilled Labor ₁	0,1598* (0,000)	Unskilled labor ₁	0,1256** (0,000)
Production	0,4587** (0,000)	Production	-0,8974* (0,000)
Capital	0,4785*** (0,000)	Capital	-0,5896** (0,000)
Technological Changes	0,3654*** (0,001)	Technological Changes	-0,9874** (0,001)
PPP	0,9852** (0,000)	PPP	-0,8947* (0,000)

Note: *, **, *** denotes significance at 10%, 5%, 1%; the values in parentheses represent probabilities.

Table 3. Results of the estimation (technological changes: value of imported technologies)

Equation (1)	Sys-GMM	Equation (2)	Sys-GMM
Skilled Labor_1	0,9356* (0,000)	Unskilled labor_1	0,5689* (0,000)
Production	0,9854* (0,000)	Production	-0,1234* (0,000)
Capital	0,6521** (0,000)	Capital	-0,6852** (0,001)
Technological Changes	0,7436** (0,000)	Technological Changes	-0,9874* (0,000)
PPP	0,2589* (0,000)	PPP	-0,3029** (0,000)

Note: *, **, *** denotes significance at 10%, 5%, 1%; the values in parentheses represent probabilities.

Indeed, the validity all of the instruments can be checked based on the over-identification test of Sargan which is based on the GMM estimator. From the results shown in Tables 1; 2; 3, we can say that, whatever the chosen specification, the 6 over-identification tests of Sargan not indicate a problem concerning the validity of the instrumental variables. Since the statistics of these tests are below the thresholds, the null hypothesis is accepted: the instrumental variables are asymptotically uncorrelated with the disturbances of the estimated model and hence the selected instruments are valid.

If the technological changes are represented by the number of patents (Table 1), we found a positive and significant sign of production relative to skilled labor and a negative and significant sign of production relative to unskilled labor. Moreover, the purchasing power parity has a positive and highly significant effect on the skilled labor and a negative and significant effect on the unskilled labor.

The signs of the coefficients of the technological changes and capital are in line with our expectations. We got a very positive and significant effect of technological changes on the demand for skilled labor. In fact, an increase by 1 point of technological changes or the number of patents is accompanied by an increase of the demand for skilled labor by 0,9874. This confirms the SBTC thesis. Similarly, a 1 point increase of the capital is accompanied by an increase of the demand for skilled labor by 0,7589. In addition, we got a negative and very significant effect of technological changes on the demand for unskilled labor. In fact, an increase by 1 point of technological changes or of the number of the filed patents leads to a decrease in demand for unskilled labor by 0.4587. Similarly, a 1 percentage point increase of capital goes hand in hand with a decline in demand for unskilled labor by 0,9783. This confirms the thesis of Griliches (1969) concerning the complementarity between skilled labor and capital.

The same result is found in cases where the technological changes are represented by the expenditure on R&D (Table 2). We reached a positive and significant sign of production relative to skilled labor and a negative and significant sign of production relative to unskilled labor. Besides, the purchasing power parity, it also has a positive and significant effect on skilled labor and a negative and significant effect on unskilled labor.

The signs of the coefficients of technological changes and capital are consistent for a second time with our expectations. We got a very positive and significant effect of technological changes on the demand for skilled labor. In fact, increased technological

changes or expenditure in R&D is accompanied by an increase in the demand for skilled labor. Similarly, a capital increase is accompanied by an increase in the demand for skilled labor. Moreover, we got a negative and significant effect of technological changes on the demand for unskilled labor. In fact, increased technological changes or expenditure in R&D is accompanied by a drop in demand for unskilled labor. Similarly, a capital increase was accompanied by a decline in the demand for unskilled labor. This confirms the thesis of Griliches (1969) concerning the complementarity between skilled labor and capital.

In cases where technological changes are represented by the value of the imported technologies (Table 3), we arrived at a positive and significant sign of production relative to skilled labor and a negative and significant sign of production relative to unskilled labor. An increase in production is correlated with an increase in the demand for skilled labor and a decrease in the demand of unskilled labor. On the other hand, the purchasing power parity has a positive and significant effect on the skilled labor and a negative and significant effect on the unskilled labor.

The signs of the coefficients of technological changes and capital are in line with the theory for the third time. We got a positive and significant effect of technological changes on the demand for skilled labor. In fact, an increase of technological changes or the value of the imported technologies is linked with an increased demand for skilled labor. Similarly, a capital increase is accompanied by an increase in the demand for skilled labor. Besides, we got a negative and significant effect of technological changes on the demand for unskilled labor. In fact, an increase of technological changes or the value of the imported technologies is accompanied by a drop in the demand for unskilled labor. Similarly, an increase in the capital is accompanied by a drop in the demand for unskilled labor. This confirms the thesis of Griliches (1969) concerning the complementarity between skilled labor and capital.

We note that all the measures of the technological changes positively and significantly influence on skilled labor and significantly and negatively influence on unskilled labor. This work is intended to test the thesis of the technologies bias for a set of the MENA region through the use of dynamic Panel models. Therefore, our econometric study proves the existence of a technological bias that favors the demand for the most skilled workforce. Skilled labor is much more complementary with capital than unskilled labor. Nevertheless, the inclusion of different measures of technological changes shows this general result should not be moderate. All types of technological changes promote unskilled labor. All the results of our estimates bind themselves well with the thesis of technological bias. The dissemination of technological innovations led to a permanent change in the structure of employment in favor of these skilled workers.

Moreover, Berman and Machin (2000), Conte and Vivarelli (2007), Saafi and Sboui (2012) and Ben slama and Plassard (2011) confirmed the SBTC hypothesis using the technique of Panel data. Conte and Vivarelli (2007) represented the technological changes by importing technologies. For Berman and Machin (2000), technology indicators are the use of computer and R&D. These two studies were interested in a sample of developing countries. On the other hand, Saafi and Sboui (2012) were

interested in 9 industrial sectors in Tunisia. These authors found that technological diffusion leads to a change in the structure of employment in favor of skilled workers. They also found that increasing the technological value raises the demand for skilled labor and reduces the demand for unskilled labor and that the capital increase is correlated with the increase of the demand for skilled labor. In another study on Tunisia and in the framework of an Alliance for Research on North Africa (ARENA), Iwasaki and Kashiwagi (2011) clarifies the relationship between human capital and employment in Tunisia, estimating the education performance on work and salary. Taking into account regional differences of the surveyed regions (Kebili, Monastir, Beja and Tataouine), the results of their analysis confirm the positive impact of investment in education on productivity and labor income. The level of education gives a positive return on household income. Furthermore, based on French data, Ben slama and Plassard (2011) contributed to the literature on the impact of new technologies on the wages of employees who use a computer at work. Both authors confirmed the existence of a wage premium associated with the use of computers. All these results confirm the thesis of Griliches (1969) concerning the complementarity between capital and skills.

4. Conclusion

Several authors insist that the issue of poverty and income inequality is more important, and one of the most urgent problems of our modern world. Indeed, that income inequality has dramatically impact the daily lives of people. They demonstrated that in a fair society; homicide rates are lower, children experience less violence in more equal societies; people are more confident in unequal societies. Inequality is still one of the dominant social facts in the MENA region and identified the sources of inequality remains a crucial issue.

Quite often these are the basic issues in the economy that are the most difficult to deal with and respond to. The large number of publications is the best witness to the interest of the problem of inequalities that holds the attention of scientists and sociologists. The latest analysis of the origin and evolution of inequality can be broken down into two groups, depending on the direction of relationship. The first trend is interested in the influence of technological changes and growth on the evolution of inequality. The second trend deals, conversely, with the impact of inequality on technological changes and growth. This study seeks to enrich the first debate by analyzing the relationship between inequality and technological changes as a determinant of inequality.

For this, we explained the SBTC thesis by presenting a review of the literature on this thesis. We have empirically tested if technological changes are a determinant of inequality of access to employment in the countries of MENA region where there is a revolution because of inequalities. We confirmed the presence of SBTC. Thus, an increase of technological changes is correlated with an inequality increase of access to employment. We also found a complementarity between capital and skilled labor.

It is important to have a redistributive taxation to avoid exclusion phenomena at the top and bottom of the income scale. To further promote social mobility, we must have at the

same time a tax system that distinguishes between innovation and other sources of inequality at the top of the income scale. In other words, we must not treat innovators on the same footing as annuitants or pure speculators. A tax system that discourages innovation would not only hurt growth but also reduce social mobility.

References

- Acemoglu, D., 2002a. Directed Technical Change. *Review of Economic Studies*, Vol. 69, pp. 781-809.
- Acemoglu, D., 2002b. Technical Change, Inequality, and the Labor Market. *Journal of Economic Literature*, Vol. 40, No.1, pp. 7-72.
- Aghion, P. and Howitt, P., 1998. *Endogenous Growth Theory*. M.A: MIT Press.
- Allen R.C., 2001. The Great Divergence in European Wages and Prices from the Middle Ages to the First World War. *Explorations in Economic History*, Vol. 38, pp. 411-47.
- Autor, D.H., Katz L.F. and Krueger A.B., 1998. Computing Inequality: Have Computer Changed the Labor Market?. *Quarterly Journal of Economics*, Vol. 113, pp. 1169-1213.
- Barro, R. and Lee, J.W., 2010. International Data on Educational Attainment: Updates and Implications, on the web.
- Bartel, A. and Lichtenberg, F., 1987. The Comparative Advantage of Educated Workers in Implementing New Technology. *Review of Economics and Statistics*, Vol. 69.
- Ben slama, R. and Plassard, J.M., 2011. Diffusion des TIC et distribution des salaires à qui profite l'utilisation d'un ordinateur au travail?. working paper. First Mediterranean International Dating.
- Berman, E. and Machin, S., 2000. Skill-Biased Technology Transfer, Evidence of Factor Biased Technological Change in Developing Countries. working paper.
- Berman, E., Bound, J. and Griliches, Z., 1994. Changes in the Demand for Skilled Labor within U.S. Manufacturing Industries: Evidence from the Annual Survey of Manufacturing. *Quarterly Journal of Economics*, Vol. 109, pp. 367-97.
- Betts J. R., 1997. The Skill Bias of Technological Change in Canadian Manufacturing Industries. *Review of Economics and Statistics*, Vol. 74, No. 1.
- Bradbury, T.N., 2002. Research on Relationships as a Prelude to Action. *Journal of Social and Personal Relationships*, Vol. 19, pp. 571-599.
- Card, D., Kramarz, F. and Lemieux, L., 1996. Changes in the Relative Structure of Wages and Employment: a Comparison of the United States, Canada and France. NBER working paper, No. 5487.
- Casavola, P., Gagosto, A. and Sestito, P., 1996. Technical Change and Wages Dispersion in Italy: Evidence from Firm's Data. *Annales d'économie et de statistique*, No. 41-42.
- Conte, A. and Vivarelli, M., 2007. Globalization and Employment: Imported Skill Biased Technological Change in Developing Countries. working paper.
- Doms, M., Dunne, T. and Troske, K., 1997. Workers, Wages and Technology. *Quarterly Journal of Economics*, Vol. 112, No. 1.
- Draper, N. and Manders, T., 1996. Structural Changes in the Demand for Labor. *Research Memorandum*, Vol. 128, Amsterdam, Central Planbureau.
- Duguet, E. and Greenan, N., 1997. Le biais technologique: une analyse économétrique sur données individuelles. *Revue économique*, Vol. 48, No. 5.

- Entorf, H. and Kramarz, F., 1997. Does Unmeasured Ability Explain the Higher Wages of New Technology Workers. *European Economic Review*, Vol. 41, pp. 1489-1510.
- Gera, S., Gu, W. and Lin, Z., 2001. Technology and the Demand for Skills in Canada: an Industry Level Analysis. *Canadian Journal of Economics*, Vol. 34, pp. 132-148.
- Goldin, C. and Katz, L.F., 1998. The Origins of Technology-Skill Complementarity. *Quarterly Journal of Economics*, Vol. 113, pp. 693-732.
- Greenwood, J. and Yorukoglu, M., 1997. 1994, Carnegie-Rochester Conference Series on Public Policy, Vol. 46, pp. 49-95.
- Griliches, Z., 1969. Capital-Skill Complementarity. *Review of Economics and Statistics*, Vol. 5, pp. 465-68.
- Hassine, N., 2015. Income inequality in the Arab Region. *World Development*, Vol. 66, pp. 532-556.
- Heston, A., Summers, R. and Aten, B., 2012. The Penn World Tables (Mark 7.1). Center for International Comparisons of Production, Income and Prices, CIC.
- Iwasaki, E., and Kashiwagi, K., 2011. Return to Education and Their Impact on Income Stratification in Rural Tunisia, First Mediterranean International Dating.
- Johannesen, N., 2015. Economic Inequality in the MENA Countries - Evidence from Cross-Border Deposits, mimeo.
- Krueger, A.B., 1993. How Computers Have Changed the Wage Structure: Evidence from Microdata. *Quarterly Journal of Economics*, Vol. 108.
- Machin, S. and Van Reenen, J., 1998. Technology and Changes in Skill Structure: Evidence from Seven OECD countries. *Quarterly Journal of Economics*, Vol. 113, pp. 1215-44.
- Nelson, R.R. and Phelps, E.S., 1966. Investment in Humans, Technological Diffusion and Economic Growth. *American Economic Review*, Vol. 56, pp. 69-75.
- Rubart, J., 2007. The Employment Effects of Technological Change, Springer.
- Saafi, S. and Sboui, F., 2012. Conséquences de la diffusion des innovations technologiques sur l'emploi industriel en Tunisie: une analyse sur des données de panel. *Revue d'Economie Industrielle*, Vol. 137.
- Schultz, T.W., 1975. The Value of the Ability to Deal with Disequilibria. *Journal of Economic Literature*, Vol. 13, No. 3, pp. 827-46.
- Tinbergen, J., 1975. Income Differences: Recent Research, Amsterdam: North Holland.
- Weinhold, D. and Nair-Reichert, U., 2008. Innovation, Inequalities and Intellectual Property Rights. *World Development*, Vol. 37, No. 5.
- Welch, F., 1970. Education in Production. *Journal of Political Economy*, Vol. 78, No. 1, pp. 35-59.
- World Bank, 2005. Equity and Development. World Development Report 2006.
- World Bank, 2014. 2014 World Development Indicators, Data Report. World Bank. Washington: CD ROM.
- World Intellectual Property Organization (WIPO), 2010. On the web.