Anton Tchipev

Intermediate products, specialization and the dynamics of wage inequality in the US

Quaderno N. 06-08

Decanato della Facoltà di Scienze economiche
Via G. Buffi, 13 CH-6900 Lugano

Intermediate Products, Specialization and the Dynamics of Wage Inequality in the US*

by

Anton Tchipev

Universitá della Svizzera Italiana
Istituto di Ricerche Economiche
Via Maderno 24
6904 Lugano
Switzerland
Fax: 0041 (0)58 666 4 662
Tel: 0041 (0)58 666 4 226
E-mail: anton.tchipev@lu.unisi.ch

Last revision: 4.12.2006

*This paper represents a shortened and revised version of a Chapter of my Ph.D. Dissertation at the University of Konstanz entitled "Trends in Wage Inequality: The Role of Trade, Technical Change and Labor Market Institutions".

Intermediate Products, Specialization and the Dynamics of Wage Inequality in the US

Abstract

This paper attempts to reconcile the slowdown in wage inequality in the 1990s with the view that international trade was a major factor contributing to the sharp increases in inequality during the 1980s. I present a model that highlights the importance of intermediate products and attributes the trend reversal of inequality to the restructuring of the economy. The model is supported by evidence on the evolution of the imports of intermediate products.

1 Introduction

The sharp inequality increases in the US and other Anglo-Saxon countries since the beginning of the 1980s spurred a huge literature seeking for explanations. The most prominent hypotheses spelled out in the early literature attribute the inequality increases to either (i) technical change, or (ii) international trade or (iii) a decline in labor market institutions, for reviews see Gottschalk and Smeeding (1997) and Katz and Autor (1999). Drawing on an additional decade of evidence, a number of recent studies have challenged the conclusions of this literature, focusing, in particular, on the skill-biased technical change hypothesis (Card and DiNardo, 2002, Beaudry and Green, 2005, Lemieux, 2006). Card and DiNardo (2002) were among the first to document a trend reversal in the dynamics of wage inequality in the US (see figure 1). They conclude that the rise in inequality was an "episodic" event, which is hard to reconcile with the skill-biased technical change explanation. In a similar vein, Beaudry and Green (2005) and Lemieux (2006) suggest that the most important changes in wage inequality over the last three decades were concentrated in the 1980s. Although Autor, Katz and Kearney (2005) and (2006) contest this view and offer an interpretation in favor of the skill-biased-technical-change hypothesis, their analysis also points to some important differences in the evolution of inequality between the 1980s and the 1990s. Overall, there seems to be an agreement today that (i) a trend-reversal in the dynamics of several measures of inequality occurred from the 1980s to the

1990s, and that (ii) this trend-reversal calls for a re-evaluation of the explanations put forward in the early literature.

The present paper builds upon the stylized facts established in this literature (see figure 1) but, in contrast, focuses on the major alternative explanation: international trade. More precisely I address the following questions. Is the slowdown in the skilled-unskilled wage differential consistent with the view that international trade was an important factor contributing to the rising demand for skilled labor during the 1980s? If yes, why did the relative demand shift in favor of the skilled not continue during the 1990s, a decade of progressing globalization and increasing volumes of trade?

The issue is addressed both from a theoretical and an applied perspective. On one hand, I present a model which demonstrates that the catch-up process of newly industrialized countries need not continuously increase the skilled/unskilled relative wage. Rather, it suggests that in face of continuously falling prices of intermediate goods originating from these countries a turn point in the dynamics of the relative wage is to be expected. On the other hand, I present evidence that the imports of intermediate goods exhibit a time pattern remarkably similar to that of inequality. In light of the presented model this evidence suggests that the globalization-induced shift in relative labor demand was concentrated nearly in the same period as most of the inequality increase. Overall, the analysis performed here supports the view that international trade may be one of the important factors determining the evolution of wage inequality in the US.

The paper is structured as follows. Section 2 presents and discusses the evidence. Section 3 introduces the theoretical model. Its more technical part is subdivided into two subsections: 3.1 derives the comparative static results for the initial phase when the imported intermediates are also produced domestically, 3.2 derives the comparative static results under specialization. Section 4 concludes.

2 Evidence on the time path of intermediate imports

In order to illustrate the dynamics of intermediate imports and to put it in a context I rely upon two data sources: the Schott (2004) data on the imports of parts and components[1] and the NBER Manufacturing Productivity Database described in Bartelsman and Gray (1996). Scott (2004) obtained the imports of parts at the 4-digit 1987 SIC level by aggregating the imports of products containing the word "part" (or its variants "parts", "prts", "pts" and "component") in their verbal description from two more detailed industry classifications: for the period 1972-1988 aggregation proceeded from the 7-digit TSUSA, and for the period starting in 1989 aggregation proceeded from the 10-digit Harmonized System. The switch from the TSUSA to the HS in 1989 introduces an important break in the Schott series implying that the levels of the intermediate imports are

[1]These data and a detailed description are available at *http* : *//www.som.yale.edu/faculty/pks4/sub_international.htm*

not comparable across the two periods. In what follows I am comparing only the growth rates, implicitly assuming that both the TSUSA and the HS classifications allow to track the trend in the imports of parts equally well.

Based on the data described above Figure 2 plots the indices of total real imports of parts and components and total real value of shipments. Nominal imports of parts and components are converted to real using the implicit deflator for non-energy inputs from the NBER MP Database.[2] The indices are reset to 100 in 1979 and 1989 to facilitate comparison across the periods 1972-1979, 1979-1989 and 1989-1996 respectively. The break years of these periods correspond roughly to the peaks of the business cycle. Moreover, 1989 is the year in which the switch from the TSUSA to the Harmonized System occurred. The periods obtained in this way are of approximately equal length with no significant changes in classification occurring within either of them.

We see in Figure 2 that real imports of parts and components increased at a much higher rate during the 1979-1989 period as compared to the other two periods. Interestingly, the growth in the real imports of parts and components during the last period was no higher than it was during the first. The slowdown in the growth of imported intermediate products appears even more pronounced if one

[2]This deflator is constructed as recommended by Bartelsman and Gray (1996, p. 21). The NBER MPD contains explicit deflators for material cost *pimat* and for energy expenditure *pien*. The deflator for non-energy inputs is obtained as the ratio of nominal non-energy materials (matcost-energy) to real non-energy materials (matcost/pimat)-(energy/pien).

takes into account the fact that total shipments accelerated in the last period.

The dynamic pattern depicted in figure 1 resembles much that in figure 2, but what can we make out of this similarity? In any case it would be wrong to take the imports of parts and components as the cause for the inequality increases, because the first should be regarded as endogenous. It would be also wrong to conclude that globalization, which is the candidate to be the exogenous force behind the inequality increase, slowed down in the 1990's. But if intermediate imports and inequality cannot be considered "cause" and "effect", then what's the use of uncovering the coincidence in their timing? The interpretation suggested here is that the acceleration in the imported parts and components during the 1980s indicates a period of restructuring in manufacturing whereby domestically produced unskill-intensive inputs were increasingly being substituted for imported inputs. Note that during the second period the imports of parts and components increased four times while total sales remained roughly constant. This suggests to attribute the acceleration of the imports to substitution of domestically produced parts and components.

The main channel through which this substitution worked is outsourcing. Consider for example the simplest form of outsourcing where a firm closes an unskill-intensive intermediate production line in the home country and opens an analogous production line abroad. The products are still used by the firm in the home country as inputs for subsequent more skill-intensive stages of production. Outsourcing of this form would show up in the industry statistics as an increase in

the imports of parts and components without a significant change in shipments.[3] It may be argued that outsourcing provides a cost-advantage to the firm allowing it to potentially expand its sales. However, no matter whether the cost reduction is passed through or not we would expect to observe an increase in the imports of parts and components, overproportional to the increase in shipments. This is basically the pattern observed in all periods. Note further that other forms of outsourcing have basically the same implications for the aggregate statistics. For example, the implications would be the same if a subcontractor rather than the firm itself operated the production line in the foreign country.[4] Measuring outsourcing by the increase in the imports of intermediate goods in excess of the increase in shipments Tchipev (2006) calculates for a sample of 4-digit manufacturing industries the implied changes in the non-production wage bill-share and finds that they match quite well the actual changes. The results in Tchipev (2006) provide direct evidence that the imports of parts and components during the 1980s substitute domestic production. Finally, note that while the term "outsourcing" is often associated with the activities of multinational enterprizes,

[3]Shipments would decrease, if originally the domestically produced inputs were counted as industry sales. Since the reference unit in the NBER MPD is the establishment this depends upon whether the inputs were produced and used within the same establishment or not.

[4]One form of outsourcing which has different implications is the relocation of the assembly activities. Under the assumption that the final good is consumed in the US we would expect this to lead to an increase in exports of parts from the US and an increase in the imports of final goods.

thus invoking some connotation of non-market interaction, the substitution of domestically produced inputs for foreign-produced outputs may well be viewed as a phenomenon driven by market forces. I shall take up this point in the next section where I use a competitive framework to model the process.

All this suggests that we should interpret Figure 2 as evidence that outsourcing, i.e. the first-time relocation abroad of unskill- intensive production activities, was most intensive during the 1980s. Naturally this interpretation raises the question why outsourcing slowed down during the 1990s in spite of continuing globalization. The explanation I put forward is that the manufacturing sector has been restructured by the end of the 1980s so that unskilled labor was predominantly employed in activities which were less susceptible to outsourcing. Basically, this are activities which are spatially non-separable from those performed by skilled workers. For a variety of reasons such activities exist in nearly every industry. Cleaning an office or the low-skill intensive work on a production line which has to be continuously monitored by specialists provide two simple examples.

In what follows I present a model that makes the point more precise. It illustrates how the continuous catch-up process of newly industrialized countries leads to two different phases of adjustment in a developed economy. The results of the model match the presented evidence and provide an insight on the possible link between trade and the observed dynamics of wage inequality.

3 The Model - Assumptions, Intuition

In this Section I present a Walrasian general equilibrium model of a small open economy. One should always be careful when modelling the US as a small open economy. This assumption means that the prices of the traded goods are exogenous. At the level of aggregation of that model this is perhaps a reasonable assumption. There are only two traded goods in the model: the country imports intermediate goods (I) and exports sophisticated final goods (X). Globalization is modelled as a continuous fall in the price of the intermediate goods p_I. The fall in the the prices of imported intermediate goods can be attributed to the catch-up process of newly industrialized countries (improvements in the infrastructure, efficiency of the administration, legal system, labor force discipline and basic skills in these countries), the falling transportation costs, and the improved information on the business opportunities in those countries. All these can be viewed as exogenous factors with a potentially strong impact on the price of the intermediate good p_I which motivates the assumption of exogenous goods prices.

The model consists of a system of equilibrium conditions which are assumed to be satisfied in each point of time. The dynamics of the endogenous variables (more precisely we are interested in the wages of skilled and unskilled labor) is derived qualitatively as a function of the dynamics of the exogenous parameter P_I and the system of equations describing the equilibrium in each point of time.

It is assumed that p_I falls continuously over time, while the other parameters (endowments, preferences and technologies) remain constant. The remaining assumptions are the following. All standard assumptions of Walrasian general equilibrium models hold: one price for each good (factor of production), perfect competition, no disequilibrium trade, instantaneous and simultaneous price and quantity adjustment. All production functions feature constant returns to scale. All households have identical and homothetic preferences. There are two primary factors of production - skilled (H) and unskilled (L) labor. There are three types of goods. It is important that these three broad categories, denoted Y, I and X, should not be associated with specific industries. Rather, the output of each industry should be viewed as a bundle of these three aggregates, as suggested by the following examples.

First, there are the non-traded intermediate products and services, Y, which are produced with unskilled labor alone. We can think of good Y as embodying the unskilled labor services in creating the infrastructure (construction of houses, offices, roads, electricity and water supply) and maintaining it (repairs, cleaning, security) as well the labor services used in hotels, restaurants and mensas, truck and taxi driving, retail trade and so on. I assume that good Y is used both in production as an intermediate input for producing good X and in consumption as a final good.

Second, there are the pure intermediate goods, I, which are also produced with unskilled labor alone and, by contrast to Y, are traded. We can think of I as

the unskilled labor services embodied in all kinds of traded goods such as semi-conductors, automobile parts, TV parts, and even sewing and assembly services embodied in reimports of good X. [5] Note that all the goods captured by the aggregate category I are not directly consumable. Even when a consumption good such as a bicycle or a TV-set is entirely produced in a newly industrialized country its sale value in the developed world rarely accrues to 100 percent to that country. On one hand, there might be licence payments or other transfer payments arising from the fact that the local producer in the newly industrialized country is using foreign technology, product design or marketing services. On the other hand, there is always some fraction of the sales value accruing to gross- and retail traders in the final destination. All these payments should be viewed as value added in the production of the final consumption good (X in our model) accruing to domestic factors of production. To the extent that these payments tend to constitute a large fraction of the price of the final goods this provides the motivation to assume that the imported good I is a pure intermediate good.

[5]Trade models not featuring transport costs or differentiated products allow to determine only net trade. We assume here that the country is a net importer of good X which does not mean that good X never flows in the opposite direction. Suppose for example that an almost finished TV-set that has been produced in the US, is exported to Mexico for final processing (assembly) and then reenters the US as a finished TV-set. It is reasonable to treat the whole deal az zero net trade in good X and a net import of good I from Mexico to the US with value of the import of I equal to the value added of the assembly operation performed in Mexico.

Third, there are the sophisticated final goods, X, produced with high-skilled labor (H), traded intermediates (I), and non-traded intermediates (Y). We can think of good X as a broad aggregate including products such as houses, computers, cars, TV's, mobile phones, high-quality clothing and shoes, etc, virtually all consumption goods requiring a non-negligible input of skilled labor. Basic unskill-intensive consumption goods such as sugar, rice and T-shirts, for example, are excluded from the model under the implicit assumption that the expenditures on them are small and do not change much over time.

The main result of the model is that a monotonic decrease over time of the price of traded intermediates (I) leads to a U-shaped time path of the real unskilled wage - initially the unskilled wage falls, but then it starts to increase. The turn point occurs at the time when the traded intermediates I stop to be domestically produced. The intuition for this result can be explained as follows.

During the first phase, the cheaper the imported intermediates become, the more they displace unskilled workers employed in the production of similar goods. The domestic production of such goods declines and more and more unskilled workers have to be absorbed by the non-traded sector. This restructuring process is accompanied by a continuous fall in the unskilled wage, which is linked to the price of the imported intermediate via the zero profit condition. Alternatively, we may say that the shrinking of the domestic I-sector reduces the demand for unskilled labor causing its wage to fall. Eventually, no worker is employed in the production of the imported intermediates. From this point on the further fall

in their price needn't reduce the domestic unskilled wage any more. The latter is now closely linked to the demand for good Y because this is the only sector employing unskilled labor. In fact, the falling price of imported intermediate goods raises the demand for good Y via two channels. First, the cheap input from abroad boosts the X sector leading firms in this sector to demand more of the non-traded good Y which they use as an intermediate. Second, the fall in the price of imported intermediate goods represents a terms of trade improvement. The generated income effect leads to increased consumer demand for good Y. Both effects tend to raise the wage of unskilled labor. In what follows I present the model formally and derive the results.

3.1 Phase 1: Close substitutes of the imported intermediates are produced also domestically

Suppose that initially the aggregate category I is produced domestically. The equilibrium at each point of time is described by the following system of equations.

$$w_L = p_I \quad (1)$$

$$w_L = p_Y \quad (2)$$

$$c_X(p_Y, p_I, w_H) = 1 \quad (3)$$

$$a_{HX}(p_Y, p_I, w_H).X = \bar{H} \quad (4)$$

$$a_{YX}(p_Y, p_I, w_H).X = Y_X \quad (5)$$

$$a_{IX}(p_Y, p_I, w_H).X = I_X \quad (6)$$

$$Y_C^{marsh.}(p_Y, 1, w_L\bar{L} + w_H\bar{H}) + Y_X = L_Y \quad (7)$$

$$I_X + L_Y - \bar{L} = I_M \quad (8)$$

Where w_H and w_L are the wages of skilled and unskilled labor respectively, p_Y, p_I are the prices of goods Y and I respectively. Note that good X has been chosen as numéraire and its price is set to one in Eqs. 3 and 7. $c_X(.)$ is the cost function and $a_{HX}(.)$, $a_{YX}(.)$, $a_{IX}(.)$ are the corresponding optimal requirements of the three inputs per unit output of good X. $\bar{H}$ and $\bar{L}$ are the endowments with skilled and unskilled labor respectively. X is output of good X, Y_X and I_X are the total amounts of good Y and I respectively used in the production of good X. $Y_C^{marsh.}(.)$ is the marshallian demand function for good Y. L_Y is total unskilled labor used in the production of good Y, and I_M are the imports of good I. The system consists of eight equations in the eight variables $p_Y,\ w_L,\ w_H,\ X,\ Y_X,\ I_X,\ L_Y,\ I_M$. Eqs. 1- 3 are the zero profit conditions for

the three produced goods. Note that by choice of units we have normalized the per-input requirements of unskilled labor in the production of goods Y and I to one. Eqs. 4-8 represent the goods and factor market equilibrium conditions. Note that after normalization L_Y is both total labor used in the production of good Y and output of good Y (as such it stands on the right-hand-side of Eq.7, while the left-hand-side gives the demand for good Y). The latter consists of two terms: consumption demand and input demand from the X sector. Eq. 8 gives the imports of good I as a residual between domestic demand, I_X, and domestic production, $\bar{L} - L_I$ (this is total unskilled labor allocated to sector I; with the normalization it is also the domestically produced output of good I).

It is now obvious that as long as the system consisting of Eqs. 1-8 holds, the fall in P_I translates directly into a proportional fall in the real unskilled wage w_L. The price of the non-traded intermediates also falls in the same proportion (Eq.2). The changes in the other endogenous variables during this phase can be derived qualitatively as follows. The price of skilled labor rises (Eq.3). Since the prices of goods Y and I change proportionately we can apply the composite commodity theorem to derive the changes in input coefficients: $a_{HX}(.)$ would unambiguously fall and the input coefficient of the composite good would rise. The fall in $a_{HX}(.)$ implies a rise in the output of good X (Eq.4). Since the total input of skilled labor is fixed by the endowment the rise in the output of good X must be accounted for by an increase in the input of the composite good. In principle, it would be possible that one of the components of the composite good

falls while the other increases overproportionally. This would require, however, extreme substitutability/complementarity patterns in the production of good X. I rule this possibility out here and assume that the expansion of the X sector entails that both Y_X and I_X rise.

The remaining results are easy to establish. The consumption demand for good Y rises because of its falling price and rising income (this follows from the assumption of homothetic preferences and the terms of trade improvement). From Eq.7 we see that the amount of unskilled labor allocated to the non-traded sector (L_Y) rises because both production and consumption demand increase (Y_X and $Y_C^{marsh.}(.)$). Finally, Eq.8 provides a consistency check on our results: with the domestic use of the traded intermediates (I_X) growing and their domestic production ($L_X = \bar{L} - L_Y$) declining this equation implies that the imports (I_M) must rise, something we knew already based on the terms of trade improvement. The central result here is that the endowment of unskilled labor is continuously shifting from the import competing sector (I) towards the non-traded sector (Y). I assume that this continuous process would eventually lead to specialization: the economy will produce only goods Y and X with the total endowment of unskilled labor allocated to the non-traded sector ($L_Y = L$). This brings us to the second phase of adjustment in which the further fall in p_I has completely different implications for the unskilled wage.

3.2 Phase 2: close substitutes of the imported intermediates are not produced domestically

When good I is not produced domestically the equilibrium values of all endogenous variables satisfy the following system.

$$w_L > p_I \tag{9}$$

$$w_L = p_Y \tag{10}$$

$$c_X(p_Y, p_I, w_H) = 1 \tag{11}$$

$$a_{HX}(p_Y, p_I, w_H).X = \bar{H} \tag{12}$$

$$a_{YX}(p_Y, p_I, w_H).X = Y_X \tag{13}$$

$$a_{IX}(p_Y, p_I, w_H).X = I_X \tag{14}$$

$$Y_C^{marsh.}(p_Y, 1, w_L L + w_H H) + Y_X = \bar{L} \tag{15}$$

$$I_X = I_M \tag{16}$$

This system is obtained from Eqs.1-8 by transforming Eq.1 to an inequality (costs exceed marginal revenue) and setting $L_y = L$. We have one equation and one variable (L_Y) less. Suppose now that w_L continues falling or it remains constant. A similar reasoning as in the previous Section will lead us to a contradiction. If w_L falls or remains constant, then w_H must rise (Eq.11). The composite theorem cannot be applied now because the fall in P_I and p_Y is not proportional. However, in any case both intermediate inputs, Y and I, become cheaper relative to skilled

labor. This should lead to an increase in both Y_X and I_X unless there are extreme substitutability/complementarity patterns in the production of good X, which I ruled out by assumption. Consumption demand for good Y must rise as before due to the income effect (we have still a terms-of-trade improvement and we assumed that the relative price of good Y does not rise). But if both consumption demand, $Y_C^{marsh.}(.)$, and input demand, Y_X, for good Y rise, then its output must also rise. However, this is not possible because the output of good Y is fixed by the endowment with unskilled labor, see Eq.15. Since we arrived to contradiction assuming that w_L falls or remains constant it follows that w_L must rise during that phase.

Note that the imports of intermediate goods grow continuously due to the falling price. However, consistent with the presented evidence, the model implies an important difference in the rate of growth of intermediate imports during the two adjustment periods. During the initial phase of restructuring the imports of intermediate goods increase for two reasons: (i) to account for the increased total domestic usage of traded intermediates and (ii) to compensate for the fall in domestic production. By contrast, during the next phase of specialization the second effect, the substitution of domestic production, is lacking. This suggests that we should interpret the slowdown in the imports of parts and components apparent in Figure 2 as evidence of a nearly-completed restructuring of the manufacturing sector.

4 Conclusion

The early literature analyzing the sharp inequality increases of the 1980s proposed three major, not necessarily mutually exclusive explanations: changes in labor market institutions, skill-biased technical change and international trade. The slowdown in wage inequality that followed in the next decade appears consistent with the first of these but poses problems for the other two. Nevertheless, the debate on the role of these three factors is far from being settled. Responding to the proponents of the institutional explanation Autor, Katz and Kearney (2006) have recently shown that the skill-biased-technical-change-hypothesis can be refined, so that it can fit quite well the changing dynamics of wage inequality over the last decades. The present paper shows that the trade-hypothesis can fit these trends as well.

Overall the model and the evidence presented here suggest the following interpretation. The 1980s were a period of rapid substitution of domestically produced inputs for analogous, but foreign-produced inputs in industrial production. This substitution was accompanied by a restructuring of the manufacturing sector whereby the unskilled labor was gradually shifting towards activities less susceptible to relocation. The capacity for further relocation of unskill-intensive activities abroad had been apparently exhausted to a large extent by the end of the 1980s, which explains why both inequality and the imports of parts and components slowed down their growth rate at that time. This interpretation

supports the view that alongside with technical change and labor market institutions, international trade was an important determinant of inequality over the last decades.

References

Autor, D., Katz, L. and M. Kearney (2005): Trends in U.S. Wage Inequality: Re-Assessing the Revisionists, *NBER Working Paper 11627*

Autor, D., Katz, L. and M. Kearney (2006): The Polarization of the U.S. Labor Market , *American Economic Review*, vol.96, No. 2, p. 189-194.

Bartelsman, E. and W. Gray (1996): The NBER Manufacturing Productivity Database. *NBER Technical Working Paper* no. T0205, NBER, Cambridge, MA

Beaudry, P. and D. Green (2005): Changes in U.S. Wages, 1976-2000: Ongoing Skill Bias or Major Technological Change? *Journal of Labor Economics*, vol. 23, p. 609648

Card, D. and J. DiNardo (2002): Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles, *Journal of Labor Economics*, vol. 20, no. 4, p. 733-783

Gottschalk, P. and T. Smeeding (1997): Cross-National Comparisons of Earnings and Income Inequality, *Journal of Economic Literature*, vol. 25, p. 633-678

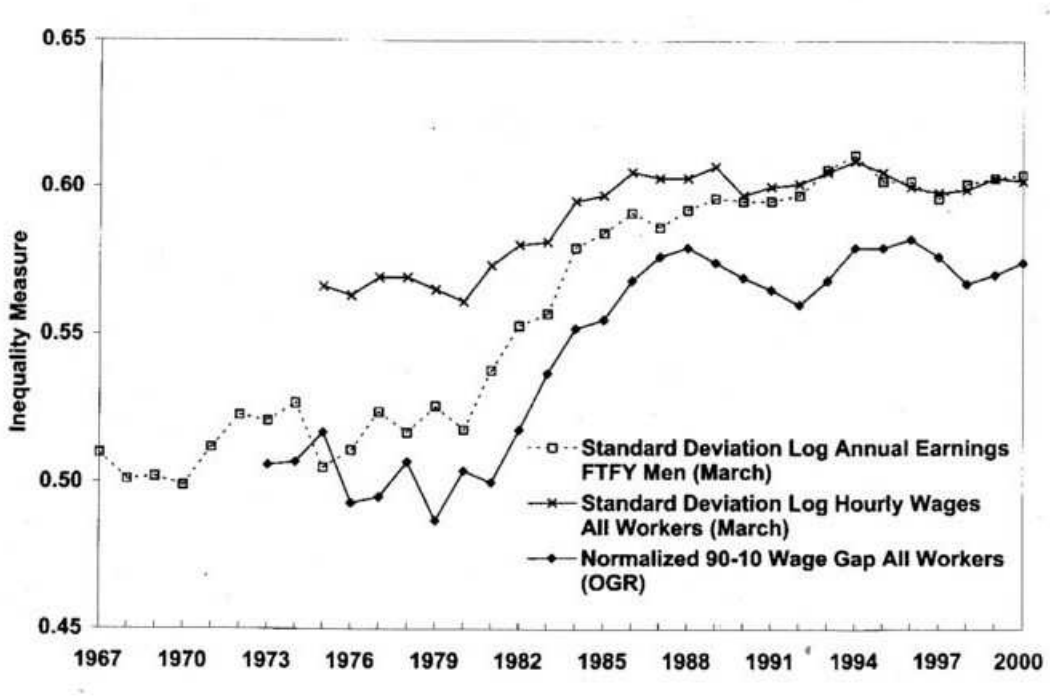
Katz, L. and D. Autor (1999): Changes in the Wage Structure and Earnings Inequality, In: Ashenfelter O. and D. Card *Handbook of labor economics*, vol. 3, p. 1463-1555

Lemieux, T. (2006): Increasing Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill?, *American Economic Review*, vol.96, No. 3, pp. 1- 64.

Schott, P. (2004): Across-Product Versus Within-Product Specialization in International Trade. *Quarterly Journal of Economics*, vol. 119, no. 2, p. 647-678

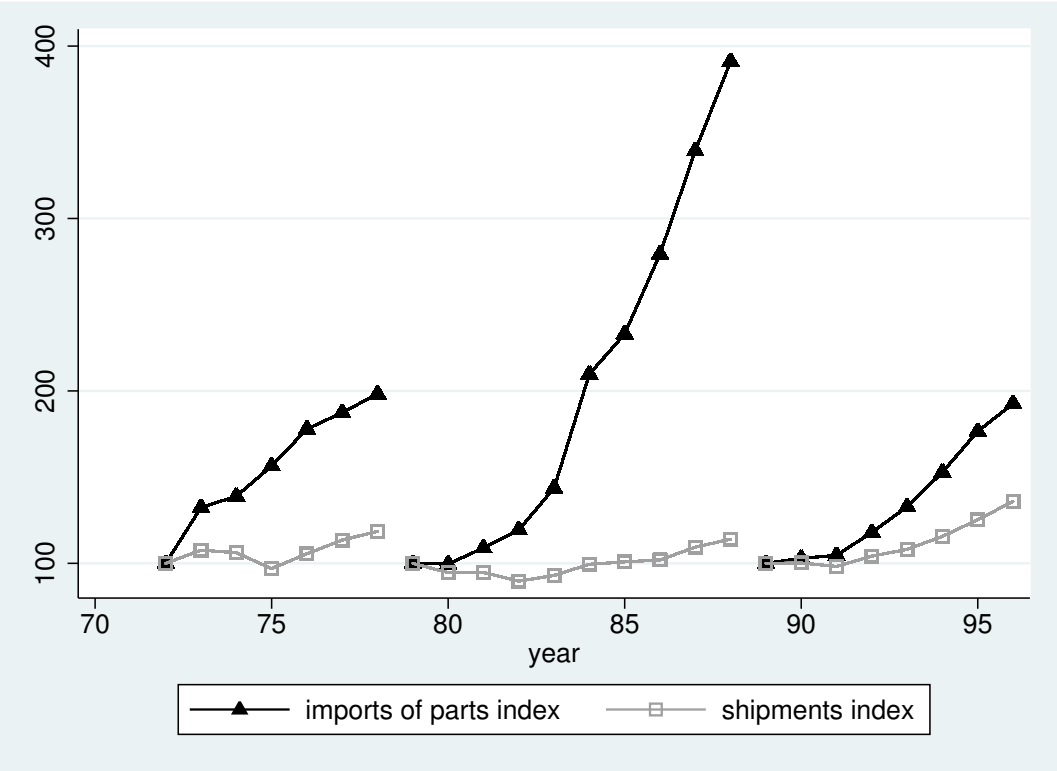
Tchipev, A. (2006): Technological Change and Outsourcing: Competing or Complementary Explanations for the Rising Demand for Skilled Labor during the 1980s? Working Paper, Department of Economics, University of Lugano

Figure 1: The time path of wage inequality - alternative measures from Card and DiNardo (2002)



Notes: This Figure is reprinted from Card and DiNardo (2002:747, Figure 2). FTFY = full-time-full-year occupation. March = Data from the March Current Population Survey. OGR = Outgoing Rotation Group (since Jan 1979 a monthly supplement to the Current Population Survey). See Card and DiNardo (2002) for more details on the sample and the variables definitions

Figure 2: Indices of real imports of parts and components and real output



Notes: imports of parts index = 100x(total real imports of parts)/(the value in the base year), shipments index = 100x(total real value of shipments)/(the value in the base year). The base years are 1972, 1979 and 1989 respectively. Points with the same base year are connected. Totals are computed as a sum over all industries in the sample treating missing values as zeros. Nominal imports of parts are converted to real using the deflator for non-energy inputs defined in in the text, see footnote 2. Sample: 459 manufacturing industries (SIC 1987 version). Sources: Bartelsman and Gray (1996), Schott (2004).

QUADERNI DELLA FACOLTÀ

I quaderni sono richiedibili (nell'edizione a stampa) alla Biblioteca universitaria di Lugano
via G. Buffi 13 CH 6900 Lugano
e-mail: biblioteca@lu.unisi.ch

The working papers (printed version) may be obtained by contacting the Biblioteca universitaria di Lugano
via G. Buffi 13 CH 6900 Lugano
e-mail: biblioteca@lu.unisi.ch

Quaderno n. 98-01

P. Balestra, *Efficient (and parsimonious) estimation of structural dynamic error component models*

Quaderno n. 99-01

M. Filippini, *Cost and scale efficiency in the nursing home sector : evidence from Switzerland*

Quaderno n. 99-02

L. Bernardi, *I sistemi tributari di oggi : da dove vengono e dove vanno*

Quaderno n. 99-03

L.L. Pasinetti, *Economic theory and technical progress*

Quaderno n. 99-04

G. Barone-Adesi, K. Giannopoulos, L. Vosper, *VaR without correlations for portfolios of derivative securities*

Quaderno n. 99-05

G. Barone-Adesi, Y. Kim, *Incomplete information and the closed-end fund discount*

Quaderno n. 99-06

G. Barone-Adesi, W. Allegretto, E. Dinenis, G. Sorwar, *Valuation of derivatives based on CKLS interest rate models*

Quaderno n. 99-07

M. Filippini, R. Maggi, J. Mägerle , *Skalenerträge und optimale Betriebsgrösse bei den schweizerische Privatbahnen*

Quaderno n. 99-08

E. Ronchetti, F. Trojani, *Robust inference with GMM estimators*

Quaderno n. 99-09

G.P. Torricelli, *I cambiamenti strutturali dello sviluppo urbano e regionale in Svizzera e nel Ticino sulla base dei dati dei censimenti federali delle aziende 1985, 1991 e 1995*

Quaderno n. 00-01

E. Barone, G. Barone-Adesi, R. Masera, *Requisiti patrimoniali, adeguatezza del capitale e gestione del rischio*

Quaderno n. 00-02

G. Barone-Adesi, *Does volatility pay?*

Quaderno n. 00-03

G. Barone-Adesi, Y. Kim, *Incomplete information and the closed-end fund discount*

Quaderno n. 00-04

R. Ineichen, *Dadi, astragali e gli inizi del calcolo delle probabilità*

Quaderno n. 00-05

W. Allegretto, G. Barone-Adesi, E. Dinenis, Y. Lin, G. Sorwar, *A new approach to check the free boundary of single factor interest rate put option*

Quaderno n. 00-06

G.D.Marangoni, *The Leontief Model and Economic Theory*

Quaderno n. 00-07

B. Antonioli, R, Fazioli, M. Filippini, *Il servizio di igiene urbana italiano tra concorrenza e monopolio*

Quaderno n. 00-08

L. Crivelli, M. Filippini, D. Lunati. *Dimensione ottima degli ospedali in uno Stato federale*

Quaderno n. 00-09

L. Buchli, M. Filippini, *Estimating the benefits of low flow alleviation in rivers: the case of the Ticino River*

Quaderno n. 00-10

L. Bernardi, *Fiscalità pubblica centralizzata e federale: aspetti generali e il caso italiano attuale*

Quaderno n. 00-11

M. Alderighi, R. Maggi, *Adoption and use of new information technology*

Quaderno n. 00-12

F. Rossera, *The use of log-linear models in transport economics: the problem of commuters' choice of mode*

Quaderno n. 01-01

M. Filippini, P. Prioni, *The influence of ownership on the cost of bus service provision in Switzerland. An empirical illustration*

Quaderno n. 01-02

B. Antonioli, M. Filippini, *Optimal size in the waste collection sector*

Quaderno n. 01-03

B. Schmitt, *La double charge du service de la dette extérieure*

Quaderno n. 01-04

L. Crivelli, M. Filippini, D. Lunati, *Regulation, ownership and efficiency in the Swiss nursing home industry*

Quaderno n. 01-05

S. Banfi, L. Buchli, M. Filippini, *Il valore ricreativo del fiume Ticino per i pescatori*

Quaderno n. 01-06

L. Crivelli, M. Filippini, D. Lunati, *Effizienz der Pflegeheime in der Schweiz*

Quaderno n. 02-01

B. Antonioli, M. Filippini, *The use of a variable cost function in the regulation of the Italian water industry*

Quaderno n. 02-02

B. Antonioli, S. Banfi, M. Filippini, *La deregolamentazione del mercato elettrico svizzero e implicazioni a breve termine per l'industria idroelettrica*

Quaderno n. 02-03

M. Filippini, J. Wild, M. Kuenzle, *Using stochastic frontier analysis for the access price regulation of electricity networks*

Quaderno n. 02-04

G. Cassese, *On the structure of finitely additive martingales*

Quaderno n. 03-01

M. Filippini, M. Kuenzle, *Analisi dell'efficienza di costo delle compagnie di bus italiane e svizzere*

Quaderno n. 03-02

C. Cambini, M. Filippini, *Competitive tendering and optimal size in the regional bus transportation industry*

Quaderno n. 03-03

L. Crivelli, M. Filippini, *Federalismo e sistema sanitario svizzero*

Quaderno n. 03-04

L. Crivelli, M. Filippini, I. Mosca, *Federalismo e spesa sanitaria regionale : analisi empirica per i Cantoni svizzeri*

Quaderno n. 03-05

M. Farsi, M. Filippini, *Regulation and measuring cost efficiency with panel data models : application to electricity distribution utilities*

Quaderno n. 03-06

M. Farsi, M. Filippini, *An empirical analysis of cost efficiency in non-profit and public nursing homes*

Quaderno n. 03-07

F. Rossera, *La distribuzione dei redditi e la loro imposizione fiscale : analisi dei dati fiscali svizzeri*

Quaderno n. 03-08

L. Crivelli, G. Domenighetti, M. Filippini, *Federalism versus social citizenship : investigating the preference for equity in health care*

Quaderno n. 03-09

M. Farsi, *Changes in hospital quality after conversion in ownership status*

Quaderno n. 03-10

G. Cozzi, O. Tarola, *Mergers, innovations, and inequality*

Quaderno n. 03-11

M. Farsi, M. Filippini, M. Kuenzle , *Unobserved heterogeneity in stochastic cost frontier models : a comparative analysis*

Quaderno n. 04-01

G. Cassese, *An extension of conditional expectation to finitely additive measures*

Quaderno n. 04-02

S. Demichelis, O. Tarola, *The plant size problem and monopoly pricing*

Quaderno n. 04-03

F. Rossera, *Struttura dei salari 2000 : valutazioni in base all'inchiesta dell'Ufficio federale di statistica in Ticino*

Quaderno n. 04-04

M. Filippini, M. Zola, *Economies of scale and cost efficiency in the postal services : empirical evidence from Switzerland*

Quaderno n. 04-05

F. Degeorge, F. Derrien, K.L. Womack, *Quid pro quo in IPOs : why book-building is dominating auctions*

Quaderno n. 04-06

M. Farsi, M. Filippini, W. Greene , *Efficiency measurement in network industries : application to the Swiss railway companies*

Quaderno n. 04-07

L. Crivelli, M. Filippini, I. Mosca, *Federalism and regional health care expenditures : an empirical analysis for the Swiss cantons*

Quaderno n. 04-08

S. Alberton, O. Gonzalez, *Monitoring a trans-border labour market in view of liberalization : the case of Ticino*

Quaderno n. 04-09

M. Filippini, G. Masiero, K. Moschetti, *Regional differences in outpatient antibiotic consumption in Switzerland*

Quaderno n. 04-10

A.S. Bergantino, S. Bolis, *An adaptive conjoint analysis of freight service alternatives : evaluating the maritime option*

Quaderno n. 05-01

M. Farsi, M. Filippini, *An analysis of efficiency and productivity in Swiss hospitals*

Quaderno n. 05-02

M. Filippini, G. Masiero, K. Moschetti, *Socioeconomic determinants of regional differences in outpatient antibiotic consumption : evidence from Switzerland*

Quaderno n. 06-01

M. Farsi, L. Gitto, *A statistical analysis of pain relief surgical operations*

Quaderno n. 06-02

M. Farsi, G. Ridder, *Estimating the out-of-hospital mortality rate using patient discharge data*

Quaderno n. 06-03

S. Banfi, M. Farsi, M. Filippini, *An empirical analysis of child care demand in Switzerland*

Quaderno n. 06-04

L. Crivelli, M. Filippini, *Regional public health care spending in Switzerland : an empirical analysis*

Quaderno n. 06-05

M. Filippini, B. Lepori, *Cost structure, economies of capacity utilization and scope in Swiss higher education institutions*

Quaderno n. 06-06

M. Farsi, M. Filippini, *Effects of ownership, subsidization and teaching activities on hospital costs in Switzerland*

Quaderno n. 06-07

M. Filippini, G. Masiero, K. Moschetti, *Small area variations and welfare loss in the use of antibiotics in the community*

Quaderno n. 06-08

A. Tchipev, *Intermediate products, specialization and the dynamics of wage inequality in the US*