

Within- and Between Industry Changes of Skill Intensity in the U.S. Manufacturing

Illustrating the adjustments of relative labor demand

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Abstract:

The present paper contributes to the discussion about the worsening in the employment perspectives for the less skilled employees in the western economies during the past decades. Berman, Bound and Griliches (1994) introduced an equation, which decomposes the aggregate changes of relative employment in a between industry term, presenting the specialization tendencies on the one hand, and a within industry term, standing for the skill-biased technological change on the other. We use the same methodology, after adjusting it for measuring the annual changes, in order to analyze the adjustments of relative labor demand in the U.S. manufacturing, since 1958. The confirmed significant positive correlation among between- and within-industry changes, especially since the 70s, proves to be an important result: it forces us to reconsider the standard theoretical approaches and to work out the idea of regarding factor-biased technical innovations partly as the reaction of domestic producers according to their “urge to survive”.

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1. Introduction

Since the beginning of the 1990s, the discussion about the steady worsening of employment perspectives for the unskilled workers intensified. Earlier investigations focused on a range of different explanations. Murphy and Welch (1992) for example set off the significance of the ageing of the baby boom and the consequent relative decline in the number of college graduates. Others focused on structural changes in labor markets, such as the weakening of the unions and the relaxing of minimum wage regulations (Blackburn, Bloom and Freeman 1990).

Recently the debate was concentrated on the demand side explanations as both relative wages and employment perspectives moved in favor of the skilled employees, with international trade and the technology's evolution being the two main competitive arguments¹. Latest researches concentrated also on other less obvious ways that globalization affects wages: trade liberalization affecting the "bargaining power" of labor versus capital, trade in intermediate inputs moving segments of production processes abroad (Hummels, Ishii and Kei-Mu Yi, 2001), innovative activity of exporters, which is presumed to be intensive in the use of skilled labor (Manasse and Turini, 2001 and Sener 2001).

The present paper contributes to the discussion about the nature of the worsening in inequality in the western economies, focusing on the origin of skill-intensive technological changes, as we consider the technology's factor bias to be deliberately designed (Goldin and Katz 1998, Acemoglu 1998). We experiment with the annual within and between industry changes, using data from the Census Bureau's Annual Survey of Manufacturers, on the employment of production and non-production workers in the U.S. manufacturing-industries, at the 4-digit SIC, from 1958 till 1995. Our attempt is to find additional and carefully tested evidences for a significant positive correlation of within and between industry changes of skill intensity, which could be an indication for the globalization effects on technology's skill-biased character². Finally, in the second part of the paper, we discuss briefly some theoretical implications, in accordance to the main empirical observances and conclusions.

2. Annual within and between industry changes

The overall annual change in relative employment of non-production employees for manufacturing can be defined as follow³:

$$1. \quad \Delta_t(S/E) = \sum [(S_i)_t / (E)_t] - \sum [(S_i)_{t-1} / (E)_{t-1}]$$

which is equivalent to:

$$2. \quad \Delta_t(S/E) = \sum [(S_i)_t (E_i)_t] / [(E)_t (E_i)_t] - \sum [(S_i)_{t-1} (E_i)_{t-1}] / [(E)_{t-1} (E_i)_{t-1}]$$

After adding in both sides the term $\sum [(S_i)_t (E_i)_{t-1}] / [(E)_t (E_i)_{t-1}]$ and rearranging accordingly, we will get the well known “decomposition equation”⁴, defined for measuring annual changes:

$$3. \quad \Delta_t(S/E) = \sum \Delta_t[E_i/E] [(S_i)_t / (E_i)_t] - \sum \Delta_t[S_i/E_i] [(E_i)_{t-1} / (E)_{t-1}]$$

The first term in the right hand side of “3” measures the changes of overall skill intensity due to specialization tendencies, in other words the **between industry change** (BIC). The second computes the weighted sum of the changes in skill intensity of each specific industry, in other words the **within industry change** (WIC).

Applying the above decomposition on an annual basis from 1958 till 1995 provides us with the picture of within and between industry changes in the U.S. manufacturing in **figure 1**. Table 1 gives the same results, but this time summarized over wider periods⁵.

Table 1: Within and Between Industry Changes in the U.S. Manufacturing

	1958-60	1961-65	1966-70	1971-75	1976-80	1981-87	1989-95
Between Industry Change (BIC/ $\Delta(S/E)$)	-0,0018 (0,63)	-0,0021 (0,65)	0,0006 (0,04)	-0,0021 (-0,25)	0,0024 (0,22)	0,0062 (0,26)	-0,0088 (0,81)
Within Industry Change (WIC/ $\Delta(S/E)$)	-0,0012 (0,37)	-0,0011 (0,35)	0,0156 (0,96)	0,0104 (1,25)	0,0082 (0,78)	0,0174 (0,74)	-0,0020 (0,19)
Total Change of manufacturing’s skill intensity ($\Delta(S/E)$)	-0,0029	-0,0032	0,0162	0,0083	0,0106	0,0236	-0,0108

The figures in table 1 support the findings of Berman, Bound and Griliches (1994), as WIC seems to be by far more important than BIC over the 1970's and the 1980's. Nevertheless, the picture is different from 1958 till 1965 and 1989-1995, where BIC accounts for more than 60% and more than 80% of the overall fall in manufacturing's skill intensity in these periods⁶.

Even more interesting than the relative strength of WIC and BIC, is the fact that almost in all periods (with the exception of 1971-1975) both adjustments are of the same sign. Moreover, if we look at the annual measures, but WIC and BIC seem to be strong positively related. Consistent with the picture in **figure 1** and **figure 2**, the degree of correlation between annual WIC and BIC from 1958 till 1995 comes up to **0,61**. The correlation is especially strong after the beginning of the 1970's. Correlation for period 1958-1970 is **0,20**, while for the rest of the years 1970-1995 it comes up to **0,72**. Although this is not yet clear evidence for the hypothesis that the factor biased character of technological changes depends on the international competition, it forces us to take closer look, testing for the thinkable explanations.

2.1 Considering the Cyclical Effects

The most obvious way for explaining the picture of significantly correlated WIC and BIC is the cyclical effect of expansion and recession periods for the whole economy. Firms adapt the cyclical variations of demand by altering partly their employment level. The unskilled workers could actually be more strongly affected by these adjustments, as the costs for firing and recruiting highly skilled employees are quite substantial. Therefore, one could argue that a short-term reaction of each firm to a recession (expansion) is to increase (reduce) its skill intensity! WIC would be especially sensitive to cyclical movements. Likewise, one has to confirm a similar counter cyclical character for the between-industry term. First, think of the less skill intensive firms to be more harmed by recessions, because of the extraordinary strength of international competition in the less skill intensive products. Additionally, they can adjust more easily their employment, because of the restricted use of skilled employees⁷.

According to the mentioned arguments, business cycle should affect negatively the skill intensity of the production, as both between as well as within industry changes will be generated. Table 2 gives the partial correlation between WIC and BIC, computed through the partial coefficient of determination, for holding the cyclical movements constant. Notice that we use the percentage change of total employment in manufacturing (“E”) as an indicator for the cycle.

Table 2: Partial Correlation of annual WIC and BIC for constant ΔE

	Regression of WIC 1958-1995			Regression of WIC 1970-1995			Regression of WIC 1958-1970		
Variable	% Δ (E)	BIC	Constant	% Δ (E)	BIC	Constant	% Δ (E)	BIC	Constant
Coefficients	-0,0986	1,0018	0,0015	-0,0908	1,1906	0,0011	-0,1213	0,4641	0,0025
Stand.Error	0,0166	0,2890	0,0005	0,0204	0,3300	0,0006	0,0320	0,6558	0,0010
R²(Y.xz)	0,6952			0,7522			0,6305		
R²-adj:	0,6666			0,7151			0,4920		
Variable	% Δ (E)	Constant		% Δ (E)	Constant		% Δ (E)	Constant	
Coefficients	-0,1214	0,0014		-0,1269	0,0009		-0,1229	0,0024	
Stand.Error	0,0176	0,0006		0,0221	0,0008		0,0311	0,0010	
R²(Y.z)	0,5842			0,5987			0,6100		
	Partial Correlation 1958-1995			Partial Correlation 1970-1995			Partial Correlation 1958-1970		
r²(Yx.z)	0,2669			0,3826			0,0527		
r(Yx.z)	0,5166			0,6185			0,2296		

Where: Y represents WIC, x BIC and z represents % Δ (E)

The findings displayed above can be summarized as follow:

- The signs of the coefficients of the variables in the regressions are as expected, negative for the cyclical effects and positive for the effect of BIC.
- In all the cases estimated coefficients appears to be quite significant (compare the relative low standard errors), except the coefficient for the effect of BIC on WIC for the regression in the period 1958-1970!
- In accordance with the last observation, partial correlation of BIC and WIC in the period 1958-1970 is low (0,23). On the contrary, correlation between the two remains significantly high, especially over the 1970's and the 1980's, even after we adjust the measure for the cyclical effects!⁸

2.2 Specialization tendencies derived from technology's evolution

An alternative, reasonable justification of my observations is the following: imagine a given exogenous, generalized path of technology's development, which increases the skill intensity of production, without asking about the underlying reasons. Assume further that these technical innovations fit better and can be utilized easier in the skill intensive industries. It is often argued in the related literature that the more skilled the workers already are, the more effective the adjustment of their abilities to the new higher requirements will be. Consequently, the technical innovations will be mainly applied in the relatively more skill intensive industries, boosting at the same time their attractiveness compared to the other branches and generating specialization tendencies that contributes to the worsening of the inequality. BIC and WIC would move together, simply because the first is a side effect of the second.

In order to test the validity of the last argument, we will be using the following indicator, which organizes the industries in a ranking according to their skill intensity:

$$4. \quad \sigma_i = [(S_i / E_i) - (S_{iL} / E_{iL})] / [(S_{iH} / E_{iH}) - (S_{iL} / E_{iL})]$$

where with capital H (L) we represent the industry with the highest (lowest) skill intensity ratio in the specific period. $\sigma_i \in [0,1]$ by definition.

For the mentioned explanation to be valid, one would expect that the larger changes in S_i/E_i should be observed in the industries with the highest skill intensity ranking. Yet the estimations did not support this view. The degree of correlation between σ_i in 1958 and the measured $\Delta(S_i/E_i)$ over the whole period 1958-1970 was negative, **-0,31** (see the scatter diagram in **figure 3**). By taking a closer look in the periods 1958-1970, 1970-1987 and 1988-1995, the calculated correlation was also negative, **-0,17**, **-0,33**, and **-0,08** respectively (see **figures 4** and **5**)⁹. Concluding, not only we did not find any evidence for skill-biased technological changes to be applied in the relatively skill-intensifier industries, but we saw quite the opposite, especially during the 1970's and the 1980's: the lower was an industry's ranking σ_i , the stronger was the increase in its skill intensity. Notice that this is in accordance to the argument that part of WIC arises also from the pressures of international competition.

2.3 Taking into account the Skill Premium

The final step in searching for an alternative justification for the paradigm of significantly positively correlated WIC and BIC in the relative employment of non-production workers is the consideration of relative wages. For the purposes of the present paper, we can use a quite trivial and simple definition of this variable:

$$5. \quad \omega = [(W_M - W_P) / (E_M - E_P)] / (W_P / E_P) = (W_{NP} / P_{NP}) / (W_P / P_P)$$

where W_M , W_P and W_{NP} represents total annual wage bill for the whole manufacturing, for the production workers and for the non-production employees respectively, while E_M , E_P and E_{NP} are the analogue specifications for annual total employment. ω represents the skill premium, inasmuch as the division among production and non-production employees is acceptable for depicting differences in skills.

Assuming that the developments of ω should have an effect on the relative attractiveness of the different production factors, we apply a regression similar to that presented in table 2, but this time with skill premium being an additional explanatory variable. Table 3 represents the results. The main conclusions can be summarized as follow:

- The signs of the coefficients for the cyclical effects and the effect of BIC are quite similar to those presented in table 1. On the contrary the estimated effect from the percentage change of skill premium is insignificant.
- R^2 -adjusted is not changing after we introduce $\% \Delta \omega$ as an additional explanatory variable. Together with the insignificant estimations of its coefficient it means that $\% \Delta \omega$ is not contributing in the ability to explain the variations of WIC¹⁰!
- In accordance with the last observation, partial correlation of BIC and WIC for holding cyclical variations and the development of the skill premium constant is quite the same to the estimated partial correlation in table 2.

Table 3: Considering the changes in skill premium

	Regression of WIC 1958-1995				Regression of WIC 1970-1995				Regression of WIC 1958-1970			
Variable	%Δ ω	%Δ E	BIC	Constant	%Δ ω	%Δ E	BIC	Constant	%Δ ω	%Δ E	BIC	Constant
Coefficients	0,0092	-0,0989	1,0670	0,0014	0,0142	-0,0904	1,3293	0,0009	0,0052	-0,1227	0,4550	0,0025
Stand.Error	0,0095	0,0167	0,2971	0,0005	0,0094	0,0198	0,3335	0,0006	0,0753	0,0395	0,7079	0,0011
R²(Y.xzj)	0,7038				0,7775				0,6307			
R²-adj:	0,6656				0,7306				0,4197			
Variable	%Δ ω	%Δ E	Constant		%Δ ω	%Δ E	Constant		%Δ ω	%Δ E	Constant	
Coefficients	0,0014	-0,1217	0,0014		0,0038	-0,1279	0,0008		0,0142	-0,1266	0,0024	
Stand.Error	0,0108	0,0180	0,0006		0,0119	0,0228	0,0008		0,0716	0,0378	0,0010	
R²(Y.zj)	0,5844				0,6007				0,6117			
	Partial Correlation 1958-1995				Partial Correlation 1970-1995				Partial Correlation 1958-1970			
r²(Yx.zj)	0,2873				0,4427				0,0491			
r(Yx.zj)	0,5360				0,6654				0,2216			

Where: Y represents WIC, x BIC, z %Δ(E) and j represents %Δω.

2.4 Summarizing the empirical conclusions

The well-documented specialization tendency in the western economies towards skill intensive branches (BIC in the former pages) is clearly part of the wider “international labor sharing” developments, arising due to the internationalization of the economy. Berman, Bound and Griliches (1994) try to investigate the origin of BIC by dividing the economy into three different sectors: imports and exports, defense industry and domestic consumption industry. After calculating separately the adjustments, they conclude that the role of trade in shifting employment across the industries is smaller than the expected (less than 30%). Nevertheless, this approaching is questionable. It is truly very difficult to imagine a branch that staid completely unaffected from any importing or exporting activity. Even if certain firms do not operate in distant markets and / or do not face the direct competition of imported goods in the domestic market, it does not necessarily imply that they stay untouched from the development in the global competition. Alone the fact that an economy adjusts its production structure towards industries, characterized by an intensity of using a specific production factor, is enough to convince us about the thinkable reasons for this development.

Acknowledging BIC as the response to the evolving international competition induces us to think of the skill-biased adjustments within each specific industry as being caused by the emerging globalization as well, especially after considering the two

striking observations that summarize the above brief empirical discussion: First, between industry and within industry adjustments of the skill intensity proves to be significantly allied during the 1970's and the 1980's, even after we take into account the cyclical effects¹¹. Second, again during the same period, the lower an industry lies in the "skill intensity ranking", the stronger are the adjustments towards the use of less production workers.

There are in fact several ways of arguing that WIC follows the pressures of international competition: First, we can think of the "**hidden between industry changes**" or "**hidden specialization tendencies**" argument. Specialization tendencies among subcategories within the same industry, as enterprises move within each branch from relatively unskilled to relatively more skilled intensive products, falls into the changes in the skill intensity of the wider industry. For the present paper we used industries from a 4-digit breakdown. Yet, the Annual Survey of Manufacturers provided us with data on the 2- and 3-digit SIC from 1988 till 1995. **Figure 7** enable a brief comparison of the estimated WIC and BIC by using the different levels of desegregation. The differences are convincing especially regarding the 2-digit breakdown. Bernard and Jensen (1997) base their analysis on a similar argument. They examine plant level data for the U.S. manufacturing sector during the 1980's. Their results are dramatically different than those from Berman, Bound and Griliches: The major shifts in the relative employment of non-production workers are associated with between plants movements. They conclude that the increases in the skill intensity and the associated increases in the wage gap can be attributed substantially to international trade¹².

"Hidden between-industry changes" can be also supposed as an additional factor by letting each production being fragmented into discrete activities with differences in the relative use of the production factors. Enterprises could react to the increasing competition from countries with relatively cheaper unskilled employees by pushing the relatively less skill intensive activities abroad (through FDI or international cooperation) and concentrate on more sophisticate tasks as R&D, Customer Relations & Services, Design & Quality planning, Marketing strategy etc¹³.

Finally, one can argue for a **deliberate skill biased technological change** in force, designed as a response to the increased competition from regions with low paid unskilled workers¹⁴. Wood (1994) regards defensive labor-saving innovation partially as the reaction of domestic producers according to their “urge to survive”. Northern manufacturers of less skill intensive goods seek for new production techniques that economize the use of unskilled labor¹⁵. Acemoglu and Zilibotti (2001) based their argumentation on technologies designed for making optimal use of the prevailing factors and conditions in advanced economies, in order to explain the large cross-country productivity differences. Moreover, several papers focused lately on the skill-biased organizational changes, as a specific aspect of technological change, which is even easier to be considered as a deliberate response of the western firms to the international competition¹⁶.

3. Theoretical Implications

The standard Heckscher-Ohlin model has significant difficulties in explaining the observed distributional effects. Let us for instance try to reproduce the recent developments by using the usual paradigm of new competitors emerging in the international markets, coming from regions with relative strong abundance in unskilled employees. The price of the unskilled-labor intensive product will fall in relative terms, generating an analogue rise of the skill premium, and thereby, a specialization tendency towards skill intensive branches. At the same time, skill intensity decreases in all productions, in order to make available the skilled workers needed to expand the skill-intensive sector. Nevertheless, this is not exactly what happened during the last decades. Recent developments in the western economies imply the following:

- i. a rising skill-premium,
- ii. specialization tendencies toward the skill intensive productions and
- iii. a generalized tendency of increasing skill intensity in all branches (Francois and Nelson, 1998 and Berman, Bound and Griliches 1994).

Many authors claim that the only thinkable reason for a rising skill premium and an accompanied increase of the skill intensity is a skill biased technological change. Nevertheless, this scenario misses the phenomenon of specialization tendencies toward the skill intensive productions. The skill biased technological change induces a boost in the relative demand for skilled employees, which would be balanced by an increase in skill premium and a relative vivification of the less skill intensive branches¹⁷. The standard approach has significant difficulties in explaining the simultaneous appearance of the mentioned three key observances: *restricted by the full-employment assumption, denies the possibility of parallel within- and between-industry adjustments*. Regardless of which is the underlying reason, international trade or factor biased technical changes; *between- and within-industry changes should be of an opposite sign*.

In the following, we will be dealing with a proposed new theoretical approach, which attempts to incorporate specialization tendencies as well as deliberate factor-biased technological changes, as the two ways that globalization affects wages. Our aim is not to present the model in his extensive form, but to shed light on the initial

assumptions, the scenario and the theoretical implications. (For a more detailed presentation see Zarotiadis 2003.) We pay attention to a small economy, with three production factors (capital, skilled and unskilled labor) and a range of separated industries. Assuming that there is a world demand, strong enough to absorb the fluctuations of home supply, the country allocates its production endowments between the several industries, according to the internationally defined prices. Suppose further that all industries produce with a linear limitational technology¹⁸. The produced output is determined by capital and the industries differ in the intensity of using skilled and unskilled labor. The allocation of capital among the industries, or in other words the country's specialization structure depends on domestic and foreign relative wages, as the latest affects the international relative prices for the output if the different industries¹⁹.

In addition, domestic and foreign international wages induce factor-biased adjustments of the technology. We let innovations to arise only in the highly developed and relatively skill abundant regions, although they spread automatically around the world, being established in all other regions. Furthermore, we assume that domestic firms in the western countries are completely aware of this fact! Imagine now a decrease in foreign wages of the unskilled workers. Through the effect on international prices, firms in all industries experience a decrease in the attainable profits. This worsening however will be stronger for the less skill intensive sectors, inducing capital to move and generate between-industry increases in the overall relative use of skilled employees. However, domestic investors have an additional reaction possibility for improving their attainable revenues. They can concentrate some of their resources in order to improve the efficiency of their production and to regain a part of their missing profits. Given that domestic firms anticipate the fact that technical changes will be applied sooner or later by all competitors, they will attempt to reduce the relative use of the unskilled labor, beside the improvement of production's efficiency²⁰.

Putting it all together, the gap among domestic and international relative wages determines the employment perspectives of the different types of employees. Given an exogenous rise or fall in the relevant international wage, the reaction of domestic investors generates pressures towards the relative labor demand. To some extent the

domestic relative wage will be adjusted accordingly, while at the same time employment perspectives for the relative more expensive factor relative employment will be altered to. In other words, all three main recent developments in the western economies, rising skill-premium, skill-biased specialization tendencies and technological changes present the different domestic absorption mechanisms²¹.

Despite that the above listed model reproduces the recent observations (simply because it is deliberately designed), it yields some interesting theoretical inferences. First, focusing on the actual specialization structures as the only sign of the effect from international trade on domestic distribution patterns underestimates the significance of global economic developments. Not only it does not consider the deliberate skill-biased technological adjustments, but also it ignores a notable part of the entire impact on the dynamics of specialization tendencies, regardless which the final outcome is. For certain circumstances, skill-biased technological adjustments could be exceptionally strong, preventing the emergence of any actual specialization tendencies at all²².

International trade is indeed a powerful engine of wealth creation. At the same time, theory denotes that even if trade liberalization improves national welfare, this does not necessarily imply that all economic actors will gain. Supporters of liberalization policies usually refuse the thoughts that commercial relationships with developing countries could have a significant negative impact on the jobs in the advanced countries, because they see in these arguments the danger of protectionism. Certainly, protectionism cannot be the answer for the discussed inefficiencies. At the same time, the severe developments for wider groups of population in the western economies are an unquestionable fact. Ignoring them or disregarding the significance of international competition is not helping us in finding the appropriate answers. According to the present discussion, international conditions affect the decisions of domestic investors, changing thereby the picture of relative labor demand and generating adjustments in relative wages and employment perspectives.

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Endnotes

¹ Leamer (2000), Deardorff (2000) and Panagariya (2000), carry on with the considerable question about the value and the meaning of the factor-content-of-trade analysis and the subsequent discussion about the importance of trade and technology.

² Previous empirical observations (Zarotiadis, 2001) provide us with significant signs that there is an obvious positive correlation among within- and between-industry adjustments of relative labor demand in the Austrian, Hellenic and British manufacturing. Additional comparisons indicate that skill biased technical changes were mostly applied in the industries with the relatively lower skill intensity.

³ “E” means total annual employment in manufacturing and “E_i” total annual employment in industry *i*, while “S” means annual employment of non-production employees in manufacturing and “S_i” the equivalent for industry *i*.

⁴ Berman, Bound and Griliches, 1994 and Bernard, Jensen, 1997.

⁵ The results have been summarized for 5-years periods, except the last 15 years: I distinguish two periods around 1988, because of discontinuity in the data (see footnote 8).

⁶ On the contrary Berman, Bound and Griliches (1994) report a superiority of WIC also for the first years, simply because they refer to the period 1959-1973, as they were focusing on changes between business cycle peak years.

⁷ Notice that this second argument has the same content that we used to justify counter cyclical within-industry changes.

⁸ In a former work (Zarotiadis 2001) I was trying to exclude the short run cyclical effect by applying moving averages in the time series of WIC and BIC for the manufacturing of United Kingdom, Austria and Hellas. Also there, adjusted annual WIC and BIC remained significantly correlated.

⁹ The reason for choosing to break the sub period in 1988 and not lets say 1990, is that in the specific year the cases surveyed in the Census of Manufacturers probably changed, so that we have data on industries that did not occur in the previous years, generating discontinuity in the data.

¹⁰ An acknowledged weakness in the present form of the paper is that we do not check for the possibility of having a lagged effect of ω on WIC. It is something that has to be done in the following versions of the analysis.

¹¹ In the following appendix we provide a detailed discussion for the possibility of having WIC and BIC interrelated by definition. Although, within industry adjustments of skill intensity could affecting the between industry term, as they alter the relative differences in skill intensity among the various industries, the sign of this relation is proved to be unforeseen and ad hoc, depending on various parameters and variables. In other words, there is no need for taking the positive correlation between WIC and BIC for granted.

¹² Nevertheless, measuring the WIC and BIC by using this exhaustive microeconomic data set may have the reverse bias as using data at fairly high levels of aggregation: closing of plants with outdated technologies and opening new plants with the latest, skill biased capital will be measured as a between plant adjustment, even if the newly produced output will be covering similar needs as before. The term measuring the “between” adjustments will be overestimated, including cases, which are far more likely to result from a skill biased technological change than from a trade induced product demand shift.

¹³ Literature on “outsourcing” relies on that conception (see Feenstra and Hanson 1995, 1996 and 1999).

¹⁴ Notice, that the present argument is more suitable for justifying the long-term correlation of between- and within industry changes and not so much the annually association.

¹⁵ The question “to what extent does the innovation process respond to economic incentives by economizing on inputs that become relative more expensive” is certainly an old one. Newell, Jaffe and Stavins (1999) pay attention to a similar matter by focusing on the energy-saving technological changes.

¹⁶ Bresnahan, Brynjolfsson and Hitt (2002) as well as Caroli and Van Reenen (2001) offer support to the hypothesis of skill-biased organizational changes and the effects on the skill premium.

¹⁷ For a more detailed theoretical discussion of those arguments see in Zarotiadis, 2003.

¹⁸ The reason for doing this is to distinguish among the variations of relative labor demand due to shifts between and within industry.

¹⁹ Supposing internationally common technologies and demand preferences, the definition of the country’s specialization structure is similar to that rising from the standard Heckscher-Ohlin approach.

²⁰ Notice that in the context of this framework skill-biased innovation can be either defensive or aggressive.

²¹ The degree of changes in skill-premium or in employment perspectives depends on the country's special characteristics. For instance, the U.S. labour market exhibits a stronger adjustment of relative wages, while in Europe unskilled employees suffer mainly from the worsening in their employment perspectives.

²² Notice that the presented framework allows an overall «perverse» effect of foreign relative wages on specialisation structure, even if the «shift-effect» will be a normal one (Zarotiadis 2003).

Figure 1: Annual Within and Between Industry Changes in US Manufacturing

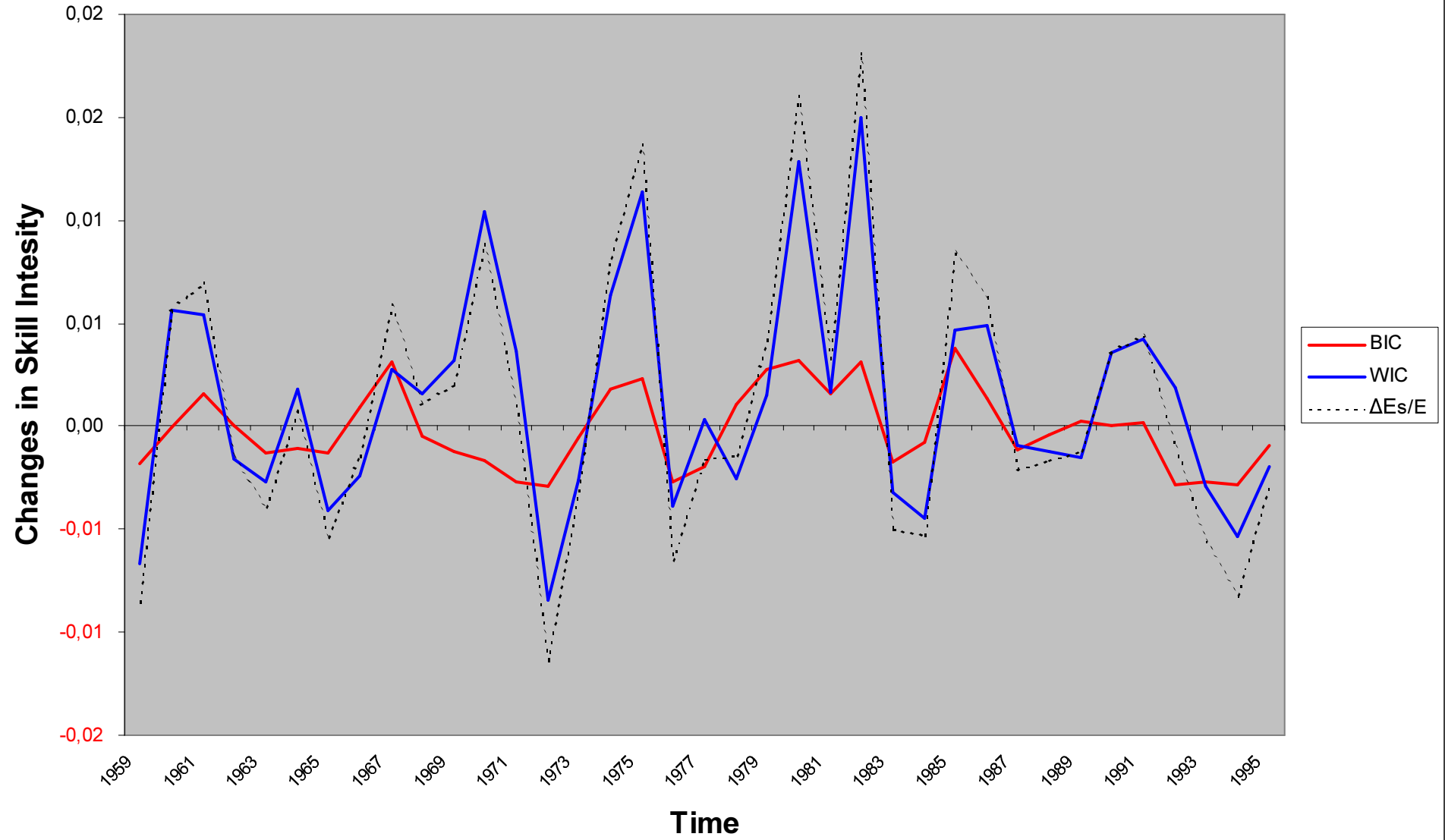


Figure 2: Scatter Diagram of annual BIC and WIC

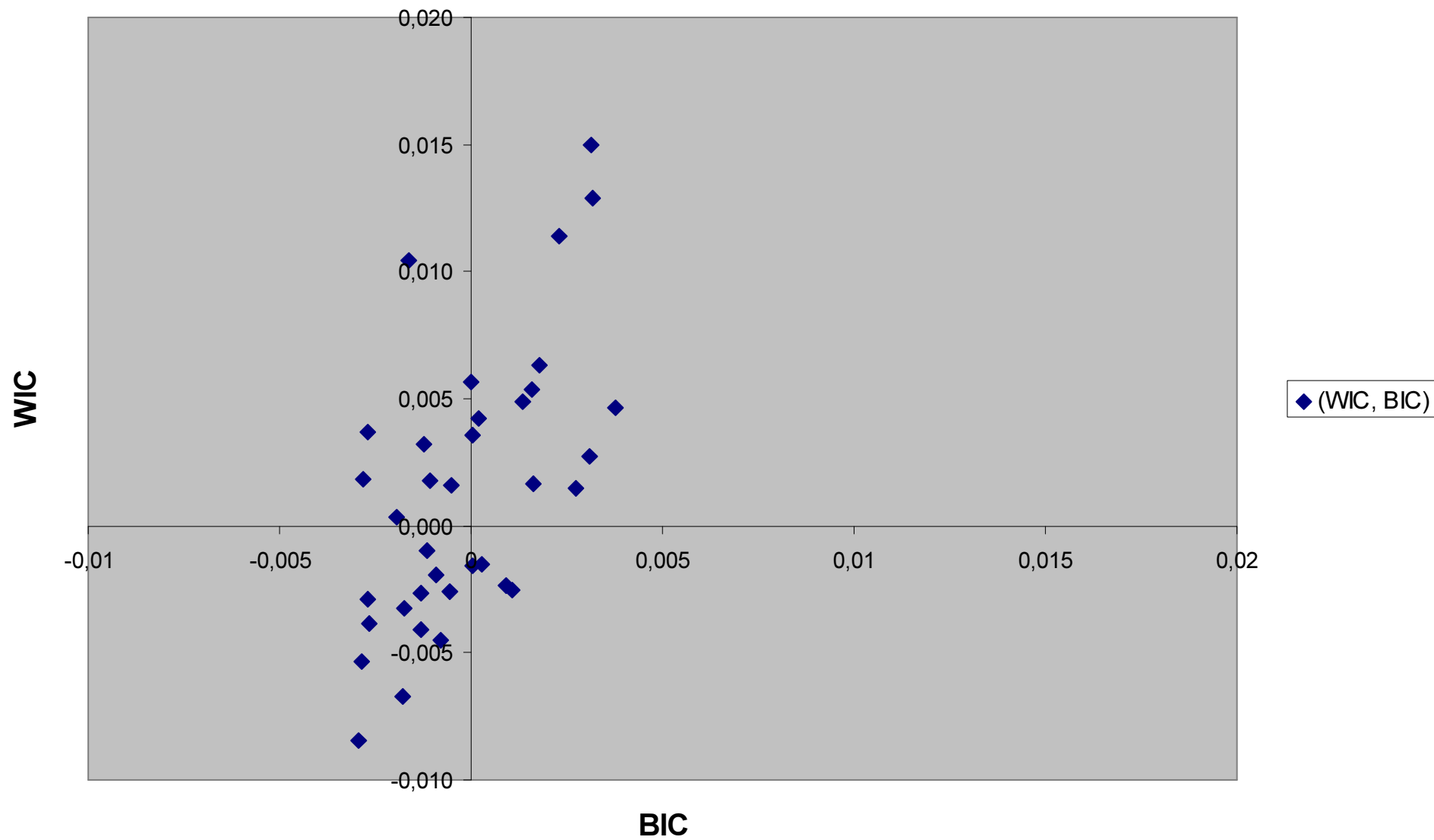


Figure 3: Initial Skill Intensity and subsequent changes of it (1958-1995)

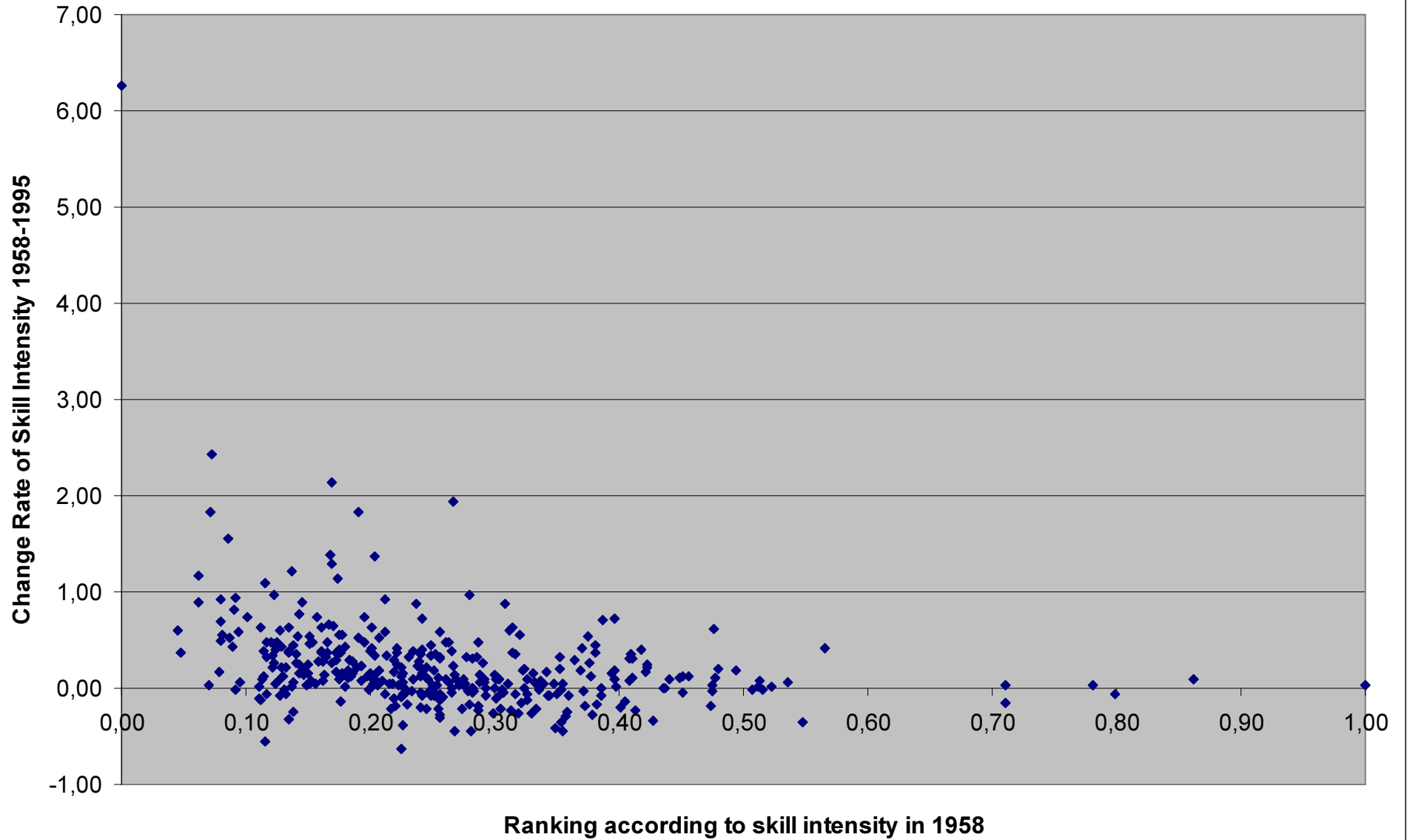


Figure 4: Initial Skill Intensity and subsequent changes of it (1988-1995)

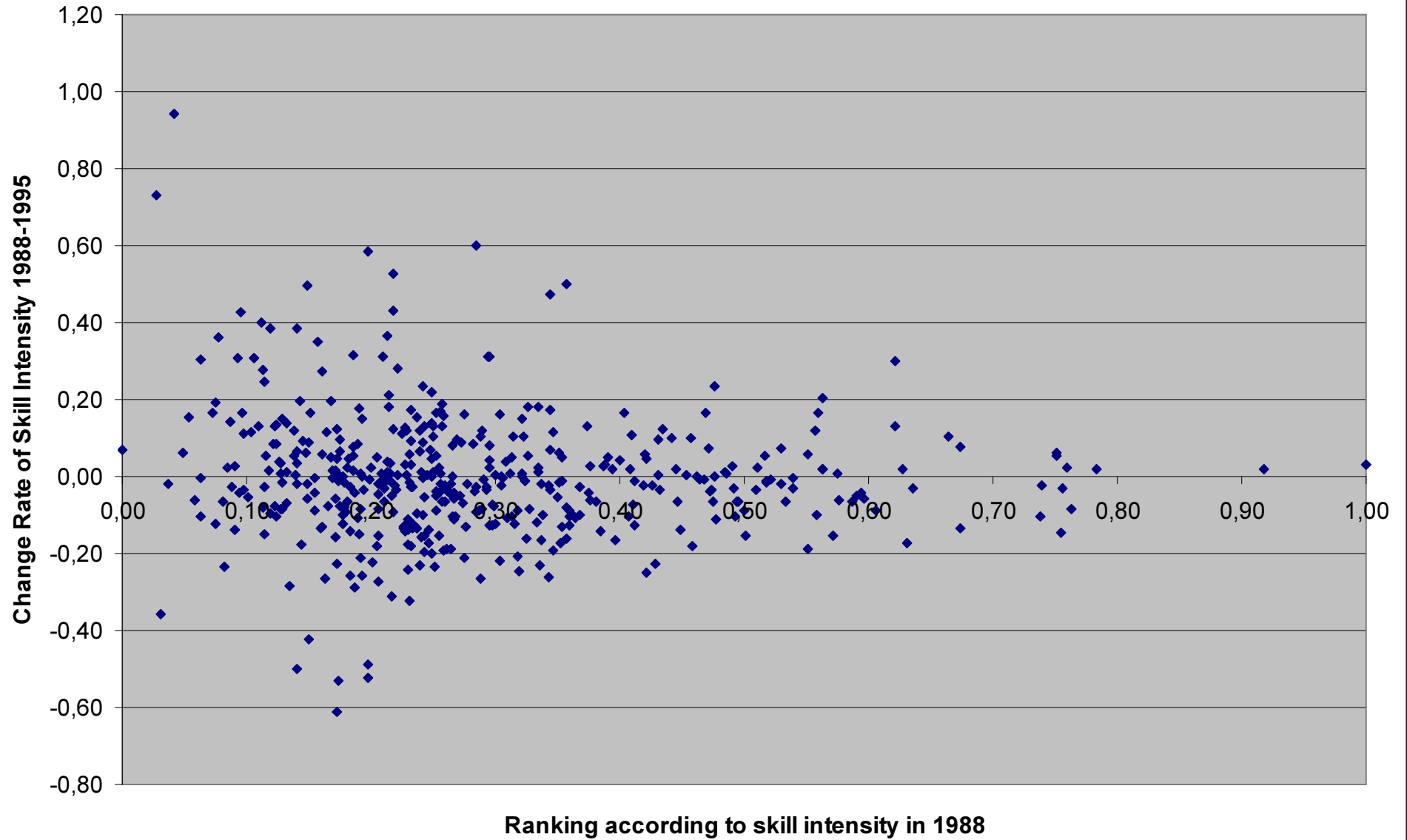


Figure 5: Initial Skill Intensity and subsequent changes of it (1970-1987)

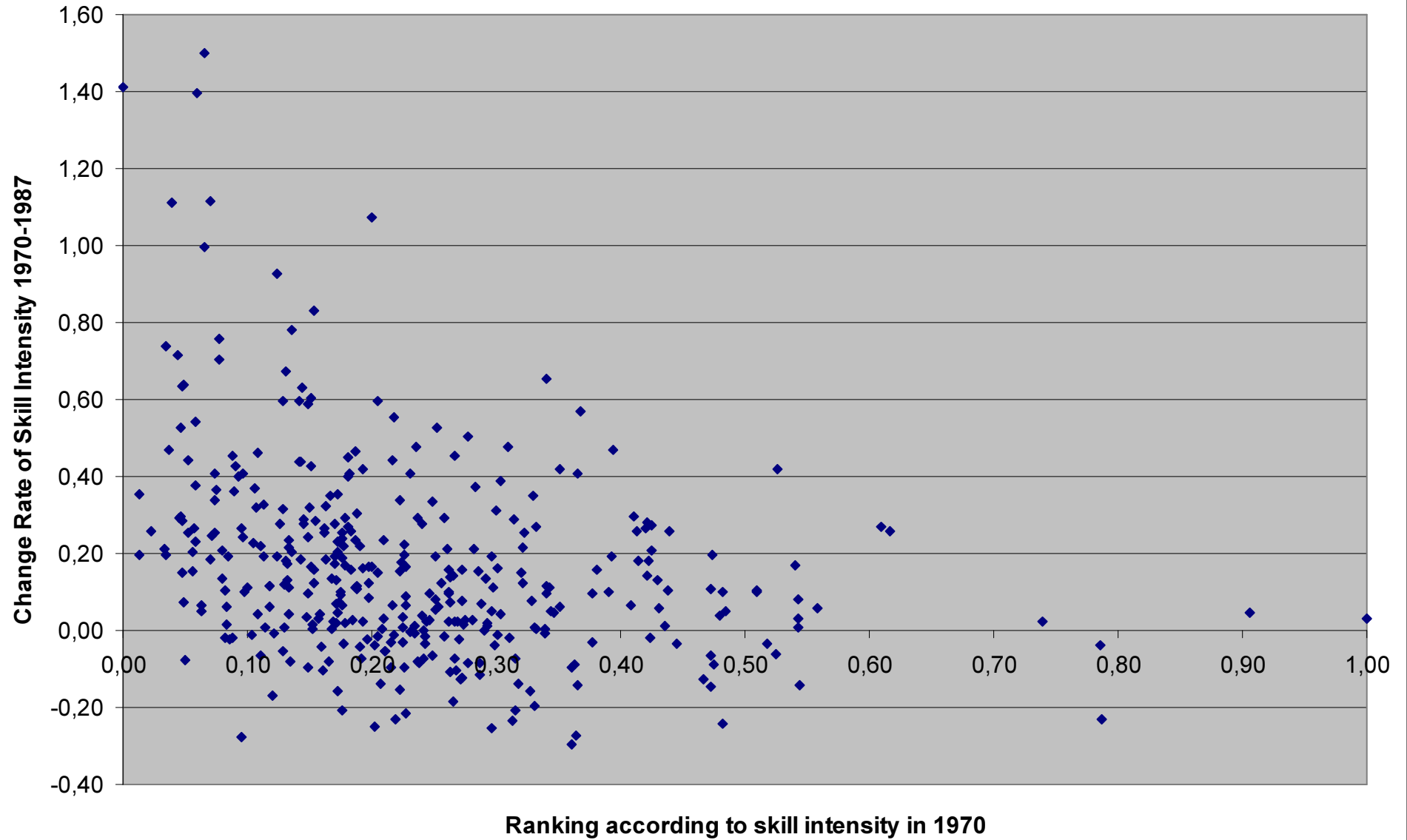


Figure 6: Percentage Annual Changes in Skill Premium and in Relative Employment

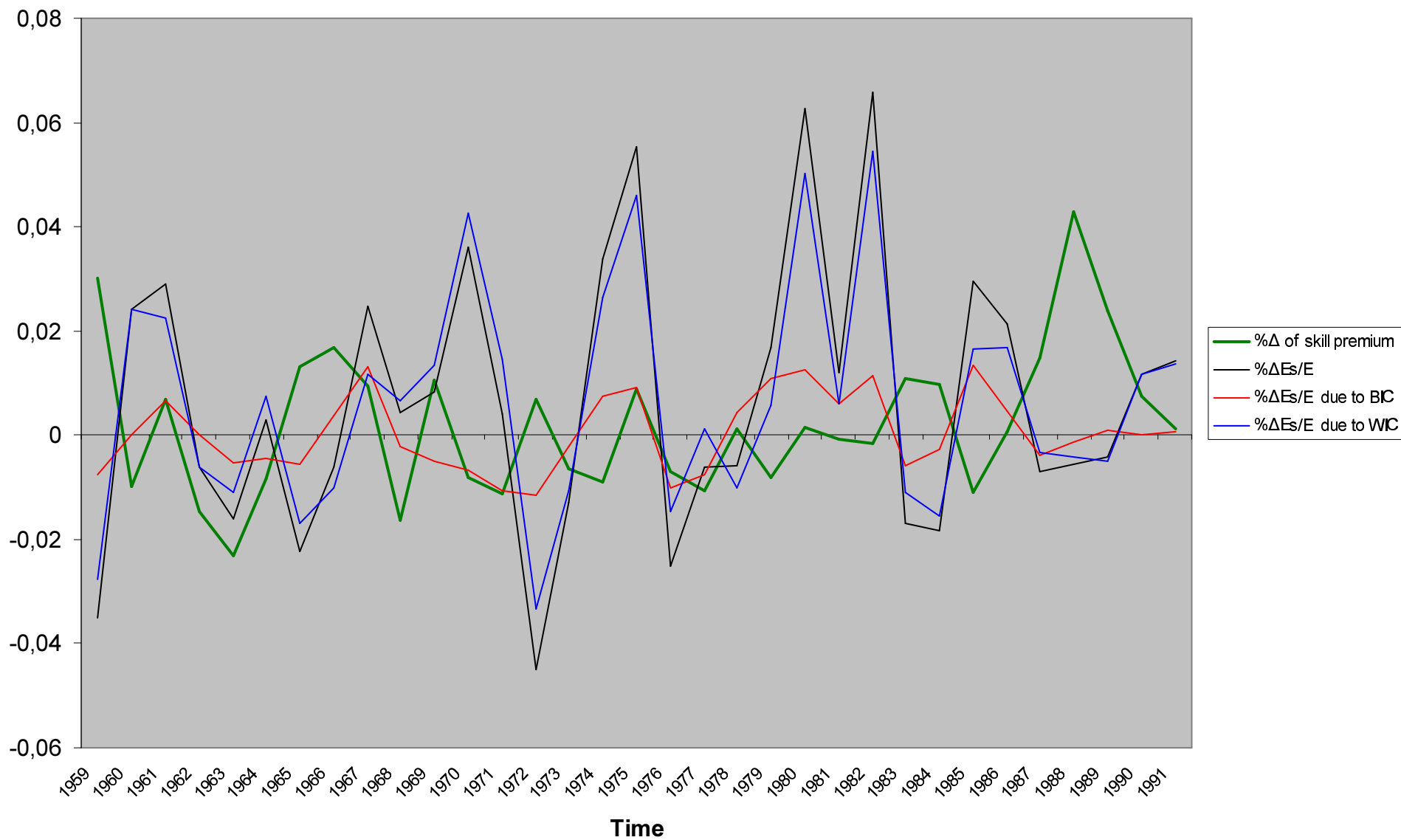


Figure 7: Comparing WIC and BIC calculated at the 2-, 3- and 4-digit SIC

