Factor price Equalization in Finland

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Abstract

The Heckscher-Ohlin-Samuelson trade model suggests free trade in goods lead to equal absolute or relative factor prices between countries. We test the hypotheses with a Finnish regional data between wages for skilled and unskilled labour. The hypotheses that in international comparisons has often been rejected should a priori lead to better results in regional approach where product prices are even and access to technology symmetric. The Finnish data includes observations of 350 000 individuals with information on education and SITC coding for the employer. The cross-section starting from 1998 is extended backwards to include 12 years back to 1987. The preliminary results show no equalisation in relative factor rewards but instead a persistent higher premium for skilled workers in Helsinki area where the supply of skilled workers is also largest. Grouping for other 12 regions are studied and the results are suggestive for finding higher premiums also in other growth regions, Turku, Tampere and Oulu.

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1. Introduction

According to the basic conclusions of the international trade theories and the backbone of the approach, the Heckscher-Ohlin-Samuelson (HOS) model, free trade in goods should lead to similar factor prices across countries. The theorem is supported neither by a common observation nor by empirical testing
(see survey by Leamer and Levinsohn 1995, Trefler 1993, Davis et al. 1997).

Factor price equalization theorem (FPE) proposes factor prices to be the same in different countries. What is needed for the theorem to hold are some strict assumptions. First, countries are assumed to have access to identical technologies which is described by similar production functions. Second, countries produce the same products, which in the 2x2x2-version of the model is the same two commodities among the same 2 countries and with 2 factors of production. Countries do not fully specialize in one of the products. Third assumption, technical by nature, assumes the ranking of capital-intensity to hold at any factor prices, i.e. there are no factor intensity reversals. Especially the first two assumptions can easily be seen nonplausible. The model also assumes constant returns to scale and perfect competition.

A dynamic version of FPE, suggested by Samuelson (1971) is an attempt to give FPE some empirical content, and it says that as barriers to international trade diminish, factor prices converge (Factor Price Convergence (FPC).

The essential feature of the HOS model consists of producing the link between product prices and factor prices. Product prices also determine the trade pattern and the model is consistent in building the link from trade to national factor prices. The model assumes that changes in product prices should be reflected in factor prices irrelevant of changes in factor supplies which is contradictory to most of the labour market theories. Thus correcting the empirical work starts from first relaxing the model assumptions, then adding other explanations to deviations from the basic model.

Among the most natural attempts to repair the model is to include differences in the total factor productivity into the analysis. When differences in technology are Hicks-neutral by nature, they are directed symmetrically to all factors of production. E.g. Trefler (1993, 1995), by including the Hicks-neutral productivity difference to an additional explanatory apart from factor endowments in explaining trade flows could thus remove a great deal of the 'missing trade'. Under Hicks-neutral productivity differences, the differences in absolute rewards can be explained but even then the relative rewards should equal.

Regional approach within countries for studying FPE should a priori result in more ideal results as access to similar technology is more uniform and product prices are even. Bernard and Schott (BS) (2002) and Bernard, Redding, Schott and Simpson (BRSS) (2002) have studied the regional FPE in the United States and the UK. In both of the studies the hypothesis that all regions within the countries face the same relative factor prices is rejected. In BS, the regional industry mix is found to vary with regional factor prices. In the UK, three distinct relative factor price areas are found. Both of the studies use only a few cross-sections of data.

The HOS model assumes factors of production to be immobile across borders. In the regional approach this feature is against the fact that labour moves more easily within countries and between regions than it moves across the borders. The extensive literature on the effects of immigration to U.S. still confirms the basic result of HOS model that factor prices are rather insensitive to migration (see surveys e.g. Borjas 1994, Friedberg and Hunt 1995, also Borjas, Freeman and Katz 1994, 1996, Hanson and Slaughter 1999). According to the Rybczynski theorem, the increase in factor supply should keep the factor prices intact and all the adjustment should happen through changes in the product mix. Immigration of skilled labour would increase the production of those products that are intensive in using skilled labour and decrease the production in less skill-intensive products. If the world market prices were not affected by these changes in the production which holds for a small country, not any repercussions to factor markets should transmit through changing product prices (Stolper-Samuelson effect). In the HOS framework, migration should have no impact

on factor prices.

Factors of production in the two-country framework are usually labelled as capital and labour. The model can be extended to more than two factors and in this work we study the factor prices between skilled and unskilled labour. The analysis does not exclude other factors like capital to be used in the production process but instead assumes that if factor prices equal between skilled and unskilled equal, the same concerns the relative price of capital. Measuring the price of capital includes several measuring issues which can be left beyond consideration in this approach (see BS).

We test the FPE hypotheses with Finnish data and extend the analysis to a period from 1987 to 1998. This helps us further investigate the dynamic properties of the relative rewards. The data we are using are based on Population Census data consisting of 350 000 observations on Finnish citizens. We limit the analysis to those individuals that have been working full time in private enterprises. The annual observations give preliminary results on the pattern of convergence / divergence in regional factor prices in Finland. Within the period, no large shocks for trade circumstance for Finland can be seen, even though Finland joined the customs union, EU, in 1995. The trade liberalization in manufacturing products had been almost complete within EFTA free trade area already before that. Relative to international markets, regional markets are supposed to have become better integrated to international development.

Our preliminary results confirm the findings of BS and BRSS. Relative factor prices within Finland are not uniform but the premium for skilled workers is clearly higher in Helsinki capital area, where the supply of skilled workers is also most abundant. Other groups of higher premiums can be found in other faster growing large city areas. The annual estimates confirm that, even though there is variation in the premiums, the relative higher premium for Helsinki is persistent and increasing rather than decreasing difference can be found.

This finding should give some policy conclusions for the firm location decisions as well as

good basis for thinking further why skilled individuals find it profitable to gather to areas where the supply of skilled workers is already high. The large supply does not reduce the premium. Either the areas have prerequisites for skill-biased technical superiority or externalities or agglomeration benefits can realize among skilled workers only when their supply is abundant enough. Quite obviously the question of frictions in the product mix and inelastic labour markets are one reason behind the observation. All skilled workers can not start working in the IT-sector.

The paper is organized as follows. In the chapter 2 we present very shortly the basic hypotheses. In chapter 3 we describe the data and its manipulation. In chapter 4 we present the econometric specification in whose deriving we largely rely on BS and BRSS. In chapter 5, we present the results and the preliminary findings from more aggregate grouping of the countries. Chapter 6 concludes are presents some limitations of the study.

2. Theoretical Framework

According to Leamer (1995) the in stating the null and alternative hypotheses can be expressed as:

Proposition 1 The Factor Price Equality Theorem (FPEQ). Regions producing the same mix of products with the same technologies and the same product prices must have the same factor prices for identical factors.

In case of Hicks-neutral region specific productivity differentials the following proposition may still hold even if the previous one would not hold.

Proposition 2 Relative Factor Price Equality Theorem (RFPEQ). Regions with different productivity levels producing the same mix of products with the same product prices must have the same relative factor prices for identical factors.

The cone of diversification in the HOS- model refers to a set of endowment vectors that

leads to the same mix of products. When endowments vary, the product mix varies and factor prices divert. The issue of product mixes is postponed for later analysis from this version of the paper.

3. Data Description

We utilize Population Census of employed labour force by industry in 1987-1998 for the study. We start with an annual cross-section study and extend it to several years. The data includes 350 000 observations based on employment relations. We have limited the study to employees that have worked 12 months per year in the private sector and also abolished those employees whose wage income despite of 12 months working has been below 50 000 FIM in 1998[i]. In the resulting database for 1998 there are some 71 000 observations. Variables on the education level are used for dividing the labour force into skilled and unskilled labour force.[ii] The data is connected with the information on provincial identification as well as the industry coding of the employer. The country is divided into 12 governmental regions (table 1) and the employer coding follows the 4-digit SITC classification. Table 2 summarizes the supply of skilled and unskilled workers, mean wages by group, relative abundance of factors and the average premiums for skilled workers. Skilled workers are more abundant especially in Uusimaa (Helsinki) region, and after that come Oulu, Turku, Häme and Keski-Suomi (Middle-Finland). The share of unskilled workers is largest in north-east parts of Finland: Lappi (Lapland) and Pohjois-Karjala-Kainuu (Northern Karelia). The premium for skilled workers is the largest in Uusimaa.

In building groups where the premiums would follow similar paths we have partly relied on this descriptive data. Larger premiums apart from Uusimaa can be found in Turku, Häme and Oulu named according to their capitals except Häme whose capital is Tampere. The very same areas have been also most rapidly growing areas, showing most of the within country migration (reference). Grouping of the areas will be more carefully explained below in chapter 5.

In building the observations by industries we have counted the average annual salaries

within groups, i.e. by industries and regions. The industry coding has been kept as detailed as possible level resulting in 395 industries in 1998. The amount of original observations by region/industry vary from 1 to several hundreds. To count the premium we have divided the salaries of skilled by those of unskilled in each industry. Missing observations for some of the classes, e.g. in skilled workers, result in losing some of the original observations. In the final database for 1998 we have 2281 regions-industry observations. Of these we have finally dropped 28 observations as outliers as the premium for these observations is larger than 3.

Extending the analysis to years backwards until 1987 included some changes in classification. The regions were fewer, so we followed the earlier classification by regions throughout the analysis, see above. Also the industry coding changed remarkably since 1994 following the SITC1995. Before that the classification was based on SITC88. As our analysis needs no uniform coding for industries this has had no effect on the work so far.

4. Econometric Specification

The main differences with our study compared to the references studies stems from the difference in the source data. Bernard and Schott (ibid.) use the Census of Manufactures which has information on quantities and total payments to two types of labour. Bernard et al. in the UK also use firm level data. The actual observations are wage bills that include information both on the average wages and the amount of employees. Using wage bills instead of wages is well- founded by the derivation where symmetric quality differences towards demand of factors as well as their rewards are shown to disappear (see BS and BRSS). We assume actual individual observations on wages not to include such quality differences.

Subscripts refer to regions and superscripts refer to factors or pairs of factors. Under the null hypothesis for RFPE (Relative Factor Price Equalization), the ratio of the skilled workers' wages to the unskilled workers' wages will be the same across regions within an

industry. This implies that, for an industry j, each regions' average relative wages should equal the value for Finland and as a whole

$$\frac{avgwage_{rj}^{S}}{avgwage_{rj}^{U}} = \frac{avgwage_{sj}^{S}}{avgwage_{sj}^{U}} = \frac{avgwage_{FINj}^{S}}{avgwage_{FINj}^{U}}$$

where S is the skilled workers, U unskilled workers, r,s and FIN regions. FIN is the aggregate of all regions. The simplest test of the null hypothesis is therefore to regress the ratio of average wages for region r relative to the ratio for Finland as a whole on set of region dummies,

$$\ln\left(\frac{RW_{rj}^{SU}}{RW_{UKj}^{SU}}\right) = \sum_{r} a_{r}^{SU} d_{r} + e_{rj}^{SU}$$

where RW_{rj}^{SU} denotes the relative average wages in industry j and region r for skilled vs. unskilled workers, RW_{FINj}^{SU} is the corresponding relative average wages for Finland as a whole; and the α_r are coefficients on the regional dummies d_r. When defining the relative wage bill for Finland as a whole, the own region r could be excluded but not done here for simplicity. Under the null hypothesis of RFPE, a_{r}^{NP} =0 for all regions and factor pairs, and a test of whether the a_{r}^{NP} are jointly equal to zero therefore provides a test of RFPE.

In building the estimate we have largely relied on BS and BRSS. Following BRSS (p. 17): "Relating relative wages to relative average in a base region, i.e. the whole country, is a 'difference in differences' specification and it includes a number of attractive statistical properties. Any industry-specific determinant of relative wage bills that is common across regions is 'differenced-out' when we normalize relative to the base region on the lefthand side of the equations (for example, features of the production technology, compensating differentials across industries, other inter-industry wage differentials, and industry-specific labour market institutions such as the degree of unionization). The analysis thus explicitly controls for observed and unobserved heterogeneity in the determinants of relative wage

bills across industries."

Similarly, the use of relative wages between skilled and unskilled workers 'differences-out' the region-specific determinants that are common to both skilled and unskilled workers. Here potential examples are neutral regional technology differences and compensating differential across regions.

5. Empirical Results

Table 3 presents the results for the original regions in 1998. The base region, whole Finland, could alternatively be kept as a reference regions so that the results would be expressed relative to the country average. Instead we have chosen the Uusimaa area to become the reference region. The premium in the area Uusimaa is clearly above the others and the premium for skilled workers varies from 9 to 17 percent. All signs are significant. Extending the analysis to the years starting from 1987 confirms the Uusimaa result but does not reveal anything related to the temporal development of premiums or on the differences between paths, see figure 1.

5.1. Grouping the regions

To find clearer paths in the pattern of the development we have combined the groups that show similar difference to Helsinki. First we aggregated all the other regions to one just to study the average coefficient compared to Helsinki / Uusimaa. These results are presented in the table 4. The difference is clear and rather showing and increasing trend during the last 12 years.

We have further studied whether areas outside Uusimaa would form more just one group. Based on the descriptive data these areas would be Turku region, Häme region (Tampere) and Oulu region. For some unknown reason, the results for Oulu do not show this but instead suggest Vaasa to be a region for higher premiums. The selection of grouping may seem arbitrary but for other years, not 1998, the grouping seems plausible in terms of

testing the difference in coefficients between growth regions (Turku, Häme and Oulu) and other regions. The preliminary results are shown in the table 5 and the graph in figure 3.

5.2. Differences by industries

Throughout the analysis we have abstracted from the difference in industries by relating the premium to the average premium within the industry. The perhaps most promising area could still be studied though. Unlike the reference studies who use information only on manufacturing industries, we have information on wages in all the economy, both in agriculture, manufacturing as well as services. Exposure to competitive pricing, international trade and domestic regulations may well be different in these areas.

The production structure between regions is also very different and one reason for higher premiums in Helsinki may lie in different product-mix.

6. Conclusions

In this paper we have studied a basic hypotheses derived from Heckscher-Ohlin-Samuelson trade model applied in regional relative wages in Finland. The preliminary results show that the premium for skilled worker is higher especially in Helsinki area. Other groups of higher premiums can also be found. The premium is rather constant and has remained stable. No signs of factor price convergence can be found.

The results in this respect reject the hypotheses. Several limitations are behind our approach, though. One is the hypothesis of multiple cones of diversification. Large supply of skilled labour in Uusimaa area has lead the product mix to be using skill-intensive technologies and due to better prices in those products, also higher wages can be paid. Explanations for the higher premiums in the skill-biased technological change in Uusimaa or externalities / agglomeration effects can also be considered. Why the premiums are persistent can also be explained by fragmented labour markets. Skilled labour in Uusimaa area is not substitutable with labour in Lapland.

The policy conclusions from this kind of analysis can be directed toward industrial policy as well as labour market policies. What we have studied here are relative, not absolute wages. Policies that aim in balancing the relative wages should lead to more balanced labour markets and lesser within country migration that has problems in the use of infrastructure and housing. For individual decision making and the behaviour for skilled people the results are challenging. Why skilled people are relatively better rewarded in areas where the supply of skilled labour is also larger? Can these agglomeration benefits or externalities be transferred to other areas?

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Table 1

REGIONAL DIVISION 1987-1996	
The whole country	00
Uusimaa	01
Turku	02
Häme	03
Kymi	04
Mikkeli	05
Vaasa	06
Keski-Suomi	07
Kuopio	08
Pohjois-Karjala + Kainuu	09
Oulu	10
Lappi	11
Satakunta	12

Table 2 Endowments and mean wages by skills in different regions /partly cleaned data (except the highest premiums)

	Number of obs	Meanwage	Number of obs	Meanwage	Relative abundance	Premium by regions
Region	Unskilled	(1000 FIM)	Skilled	(1000 FIM)	Skilled/Unskilled	Skilled/unskilled
1	14979	143.8817	9903	220.9046	0.66	1.54
2	5198	131.0279	2138	194.4429	0.41	1.48
3	8570	131.6613	3532	176.7064	0.41	1.34
4	3398	146.4926	1173	180.5311	0.35	1.23
5	1254	122.6037	442	148.4253	0.35	1.21
6	3955	126.093	1461	161.1485	0.37	1.28
7	2093	137.2198	860	171.4593	0.41	1.25
8	1709	128.2715	762	164.9895	0.45	1.29
9	1176	125.4005	387	154.9897	0.33	1.24
10	**2788**	132.5265	1309	178.3109	0.47	1.35
11	605	127.1157	199	165.3819	0.33	1.30
12	2325	132.166	825	171.5818	0.35	1.30

Table 3 Coefficients for region dummies in 1998

Source	SS	df	MS	Number of obs =	2256
				F(13, 2242) =	4.68
Model	5.4343762	13	0.4180289	Prob>F	0
Residual	200.40023	2242	0.0893846	R-squared	0.0264
				Adj.R-Squared	0.0208
Total	205.83461	2255	0.0912792	RootMSE	0.29897

lpremind	Coef.	Std.Err.	t	P>t	[95%	Conf.	Interval]
_Iryhma_2	-0.0941449	0.0260114	-3.62	0	-0.1451537	-0.043136	
_Iryhma_3	-0.1117264	0.0295472	-3.78	0	-0.169669	-0.0537837	
_Iryhma_4	-0.0928946	0.0271931	-3.42	0.001	-0.1462209	-0.0395682	
_Iryhma_5	-0.112951	0.0264342	-4.27	0	-0.1647892	-0.0611129	
_Iryhma_6	-0.1251508	0.0289183	-4.33	0	-0.1818602	-0.0684414	
_Iryhma_7	-0.1904152	0.0348163	-5.47	0	-0.2586907	-0.1221397	
_Iryhma_8	-0.1264068	0.0310388	-4.07	0	-0.1872746	-0.065539	
_Iryhma_9	-0.1430958	0.0328506	-4.36	0	-0.2075165	-0.0786751	
_Iryhma_10	-0.1343031	0.0310388	-4.33	0	-0.195171	-0.0734353	
_Iryhma_11	-0.1345833	0.0321281	-4.19	0	-0.1975872	-0.0715794	
_Iryhma_12	-0.0974245	0.030324	-3.21	0.001	-0.1568906	-0.0379585	
_Iryhma_13	-0.1635389	0.0290388	-5.63	0	-0.2204846	-0.1065932	
_Iryhma_14	-0.1355934	0.0338954	-4	0	-0.2020629	-0.0691238	
_cons	0.0341666	0.0167655	2.04	0.042	0.001289	0.0670443	

Figure 1, all regions annually

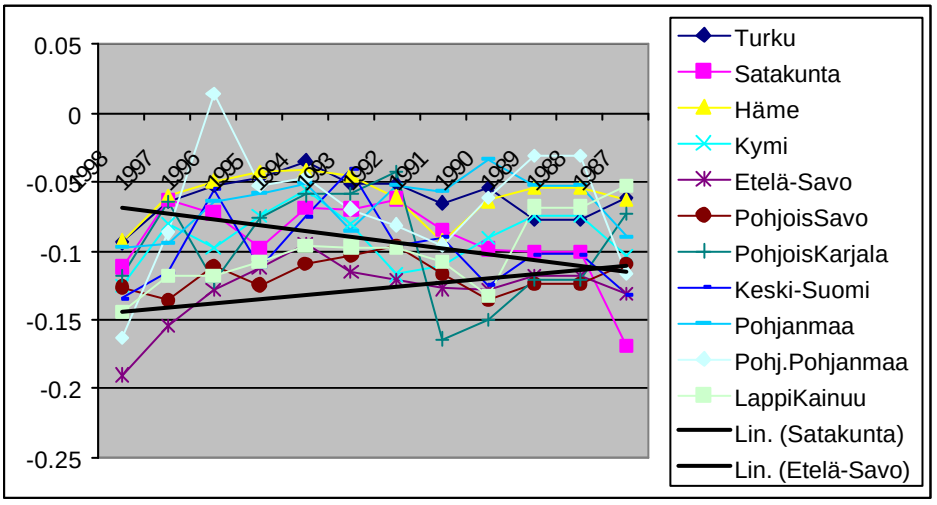


Table 4 Helsinki premium

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	
1/all others	-0.0651	-0.0446	-0.0396	-0.0429	-0.0670	-0.0516	-0.0395	-0.0324	-0.0439	-0.0547	-0.0500	-0.0
F-test 1=all	0	0.003	0.002	0.001	0	0	0.003	0.035	0.002	0	0	0
t-value	-4.76	-3.03	-3.11	-3.27	-4.76	-3.94	-3.02	-2.11	-3.18			

Figure 2 Helsinki premium and trend

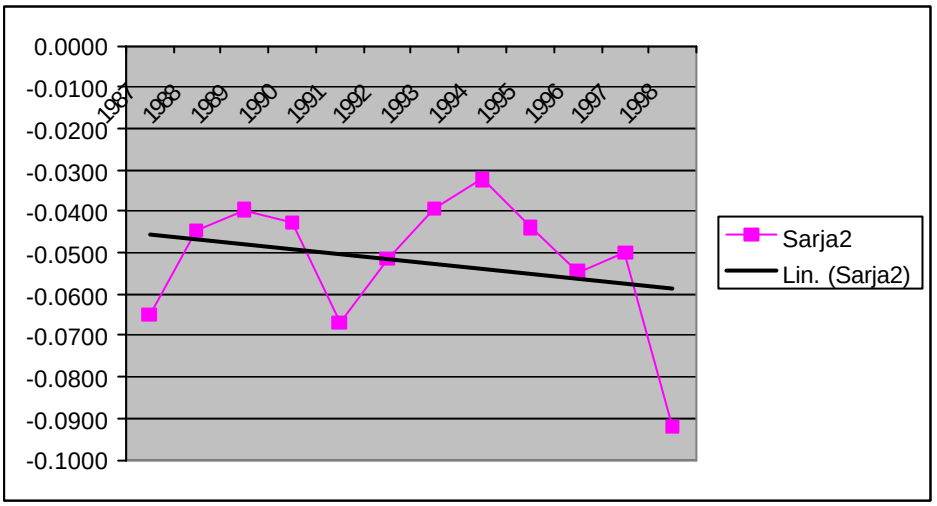
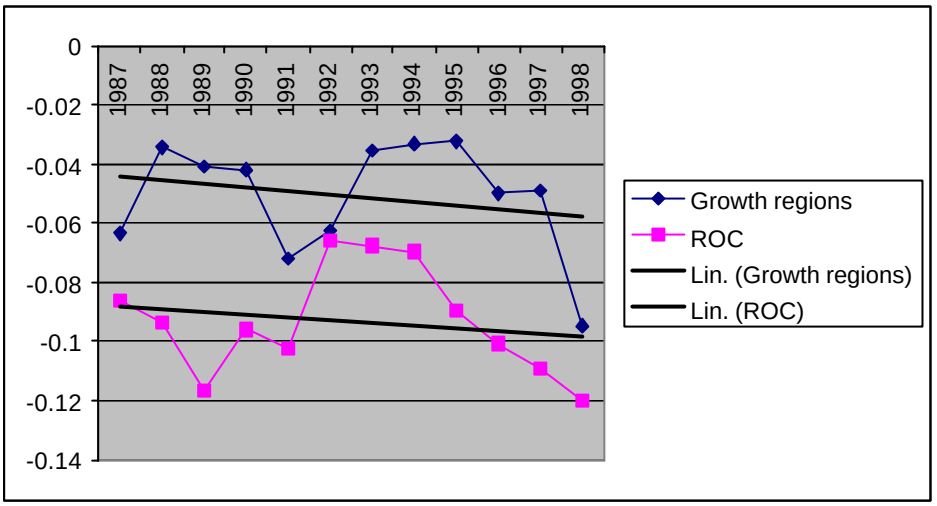


Table 5 Regional coefficients when splitting the country to 3 districts.

	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1
Growth regions	-0.0948	-0.0491	-0.0500	-0.0323	-0.0333	-0.0355	-0.0624	-0.0721	-0.0419	-0.0409	-0.0344	-0.0
ROC	-0.1202	-0.1094	-0.1008	-0.0897	-0.0698	-0.0677	-0.0662	-0.1026	-0.0960	-0.1167	-0.0939	-0.0
F-test 2=3	0.1477	0.0003	0.0048	0.0013	0.0472	0.0506	0.8364	0.1022	0.0020	0.0000	0.0017	0.2

Figure 5 Table 5 as a figure and the trends



[i] Among those individual whose wage income is below 50 000 FIM, the taxable income including capital income varies between 0 and 16 Mio FIM. Part of the sample is thus entrepreneurs, for some the data is simply

missing(12 months working, not any income reported).

[ii] (codes 3 or below as well as missing codes are classified as unskilled, otherwise skilled)