THE EFFECT OF PRODUCT DEMAND ON INEQUALITY: EVIDENCE FROM THE US AND THE UK

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January, 2012

TASKS 2 workshop, Bonn

MOTIVATION 1

- ▶ Explain contemporaneous rise of supply of skilled workers and of the skill premium. Most popular explanations: Skill biased technical change; Trade; Decline of institutions. None of these explanations is exhaustive.

- ▶ New literature on polarization: computers substitute routine tasks and favor jobs at the top ad at the bottom of the skill distribution.

- ▶ Additional mechanism: If skilled and richer workers prefer to consume more skill intensive goods, then an increase in the relative supply of skilled workers will induce an increase in relative demand for skill intensive products and relative demand for skilled labor.

MOTIVATION 2

► Recent renewed interest in product demand shifts. Models of unbalanced productivity growth generate second round product demand effects driven by changes in relative prices that depend on the elasticity of substitution between goods in consumption (Autor and Dorn (2010); Goos, Manning and Salomones (2010)). These effects are small.

► Models that predict changes in relative product demand because preferences are non-homothetic (income effects) or because educated workers substitute domestic chores for market-provided household services when income inequality rises (Manning (2004); Mazzolari and Ragusa (2007)). These effects are large.

WHAT I DO IN THIS PAPER

1. Do skilled and richer workers consume more low-skill intensive or more high-skill intensive goods? I will show correlations between the "skill-content" of different goods and their relative demand by people with different incomes or education.

2. Quantify the effect: how much can this mechanism explain of the total shift in the relative demand for labor? Parametrization of a simple general equilibrium model with non-homothetic preferences.

PREVIEW OF THE RESULTS

1. The results indicate large education and income elasticities for high-skill-intensive services like education, health and professional services but also for very low-skill-intensive services like food preparation, cleaning, repair services. U-shaped relationship between elasticities and the skill intensity of the producing industry.

2. there is correlation at the state level (city level?) between predicted consumption growth and the employment and wage share growth of those non-tradable services

3. Parametrization of a simple model with non-homothetic preferences indicates that education and income elasticities in favor of high-skill-intensive goods can explain about 6 percent of the total shift in relative labor demand in the US and a similar proportion of the total shift in the UK.

OUTLINE

- ► Contribution of the paper

- ► The model

- ► The empirical strategy: matching consumption and industry skill intensity data

- ► Results: a) correlations of income elasticities and skill intensity of producing industries; b) correlations of predicted consumption growth and employment and wage share growth of producing industries at the state level
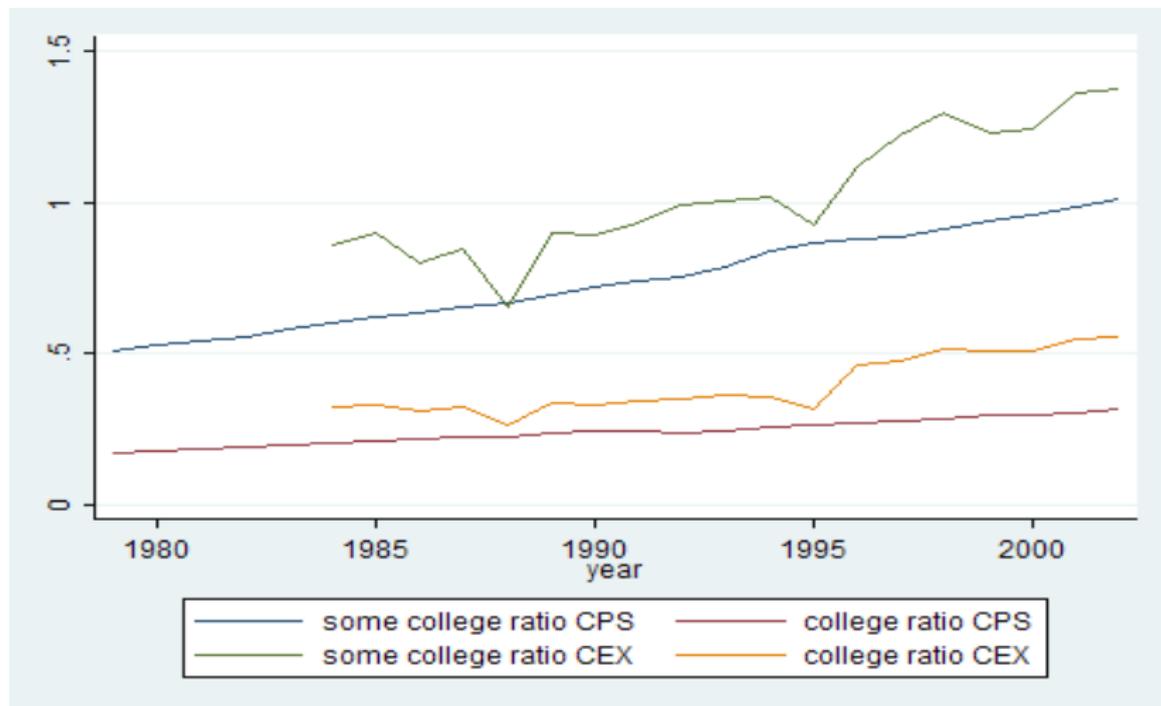
- ► Quantify the income effect

CONTRIBUTION OF THE PAPER (1)

- ► Autor and Dorn (2010) and Goos, Manning and Salomons (2010) only find a limited impact of changes in relative product demand whereas Mazzolari and Ragusa (2007) argue these effects are important. I think this paper sheds some light on this discussion.

- ► Literature on structural change: Colin Clark (1957), Ngai and Pissarides, (2007); Buera and Kaboski (AER 2010) income elasticity and the expansion of the service sector. I contribute with micro estimates and highlight the role of the growth in education as well as income.

CONTRIBUTION OF THE PAPER (2)

- ▶ The canonical model of Katz and Murphy (1992) cannot explain why wages of low-educated workers have decreased in the US until mid 1990s given the increase in H/L (q-complements). Allowing for task replacing rather than skill augmenting technological progress Acemoglu and Autor (2010) explain both the decline of the wages of the unskilled and the polarization of employment and wages.
- ▶ The increase in educational attainment is largely absent in Acemoglu and Autor (2010) whereas it is the single factor driving change in this model. In this model the wage of low-educated workers may decline in the presence of an adverse product demand change for goods intense in low-educated labor. The model - extended to three sectors - is consistent with observed polarization if elasticities favor consumption of goods and services at the top and at the bottom of the skill intensity distribution.

THE GROWTH OF EDUCATION ATTAINMENT

THE SIMPLEST MODEL OF WAGE INEQUALITY WITH INCOME EFFECTS (1)

► Two-sector model: non-homotetic demand of high skill intensive goods y_1 and low skill intensive goods y_2 depends on income and education:

$$p_1 Y_1 = H y_1^h(\frac{p_1}{p_2}, w_h) + L y_1^l(\frac{p_1}{p_2}, w_l)$$
$$Y_2 = H y_2^h(\frac{p_1}{p_2}, w_h) + L y_2^l(\frac{p_1}{p_2}, w_l)$$

► Hypothesis: Standard CES production $Y_1 = F_1(H_1, L_1), Y_2 = F_2(H_2, L_2)$. No technical progress.

THE MODEL WITH INCOME EFFECTS (2)

Solution of model:

$$\frac{d\log w_h}{d\log H} = \frac{(1-a_2)\{(\lambda_H - \lambda_L)[R_1 - (1-R_1)\frac{H}{L}] - [1 + \lambda_H + \frac{H}{L}(1+\lambda_L)]\}}{(\lambda_L \sigma_1 + \sigma_2) + (\lambda_H - \lambda_L)(1-a_1)\sigma_1 - (\lambda_H - \lambda_L)T}$$

$$T = R_1[(a_1 - a_2)\varepsilon_{1p}^h + (1-a_2)\varepsilon_{1m}^h] + (1-R_1)[(a_1 - a_2)\varepsilon_{1p}^l - a_2\varepsilon_{1m}^l]$$

- ► $a_1 = \frac{w_h H_1}{p_1 F_1(.)}$ is the wage bill share of skilled labor in sector h. $\lambda_H = \frac{H_1}{H_2}$ is the ratio of skilled labor employed in sector h and l.

- ► $R_1 = \frac{H y_1^h(.)}{H y_1^h(.) + L y_2^l(.)}$ is the share of expenditure on the high-skill-intensive commodity h by skilled workers.

- ► ε_{1m}^h is the income elasticity for the high-skill-intensive commodity h by skilled workers.

THE MODEL WITH INCOME EFFECTS (3): INTUITION

▶ Sign and magnitude depend not only from substitution elasticities in production but also on income elasticity and education elasticities. Differently from the Katz and Murphy (1992) key equation $\log \frac{w_h}{w_l} = \alpha + \beta t + \gamma \log \frac{H}{L}$, in this model the γ is a mix of technological substitution and the effect that relative quantities have on relative wages through product demand shifts following the increase in H/L. Different from Acemoglu and Autor who use task replacing technological change.

THE MODEL WITH INCOME EFFECTS (3)

- ▶ The education elasticity effect comes in through $[R_1 - (1 - R_1)\frac{H}{L}]$ if H and L have the same demand for H-intensive goods then $R_1 = \frac{H}{H+L}$ and the term disappears.

- ▶ The income effect comes through T and if $\varepsilon_{1m}^l = \varepsilon_{1m}^h = 1$ the term disappears.

- ▶ in this case we are back to the Katz and Murphy model with two sectors and homothetic demand

ISSUES IN ACEMOGLU AND AUTOR (2010)

To address the issues in Acemoglu and Autor (2010):

- ► $w_l = p_l \beta L^{\beta-1}$ declining absolute wage of the unskilled L
- ► polarization of wages

assume 2 sectors each of which produces with one factor only
$Y_h = H^\beta$, $Y_l = L^\beta$. Relative wages $\frac{w_h}{w_l} = p_h(\frac{H}{L})^{\beta-1}$.
$\frac{d \log \frac{w_h}{w_l}}{d \log \frac{H}{L}} < 0$ however p_h may increase if change in demand for good h is greater than change in supply

$$\frac{p_h Y_h}{Y_l} = \frac{H y_1^h(\frac{p_1}{p_2}, w_h) + L y_1^l(\frac{p_1}{p_2}, w_l)}{(w_h H + w_l L) - [H y_1^h(\frac{p_1}{p_2}, w_h) + L y_1^l(\frac{p_1}{p_2}, w_l)]}$$

$$d \log p_h = d \log \frac{Y_l}{Y_h} + d \log \frac{D_h}{D_l}$$

ISSUES IN ACEMOGLU AND AUTOR (2010)

$R_1 = \frac{H y_1^h(.)}{H y_1^h(.) + L y_1^l(.)}$ share of expenditure of the skilled in total expenditure for good $h =$ education elasticity in the estimates. ε_{1m}^h and ε_{1m}^l the income elasticities for good h (relative to good l ie $\varepsilon_{1m}^h + \varepsilon_{2m}^h = 1$ and $\varepsilon_{1m}^l + \varepsilon_{2m}^l = 1$).

$$
\begin{aligned}
d \log \frac{D_h}{D_l} &= R_1[\varepsilon_{1m}^h d \log w_h + d \log H] + (1 - R_1)[d \log L + \varepsilon_{1m}^l d \log w_l] - \\
&\quad - R_2[\varepsilon_{2m}^h d \log w_h + d \log H] - (1 - R_2)[d \log L + \varepsilon_{2m}^l d \log w_l]
\end{aligned}
$$

If $H \uparrow$

- education preference effect $(R_1 - R_2) d \log H$
- income effect $(R_1 \varepsilon_{1m}^h - R_2 \varepsilon_{2m}^h) d \log w_h$
  $+ [(1 - R_1)\varepsilon_{1m}^l - (1 - R_2)\varepsilon_{2m}^l] d \log w_l$
- plus potentially a negative price elasticity effect
- $d \log \frac{D_h}{D_l}$ is positive only if $R_1 - R_2 >> 0$ ie H workers have strong preference for H-intensive goods and within education group $\varepsilon_{1m}^l > \varepsilon_{2m}^l$ ie income elasticities are higher for skill intensive goods

ISSUES IN ACEMOGLU AND AUTOR (2010)

The two points of Acemoglu and Autor (2010)

- $w_l = p_l \beta L^{\beta-1}$ if p_h may increase (may decrease less than it would have) then p_l may decrease (here is numeraire)
- polarization: assume 3 sectors
  $w_l = p_l \alpha L^{\alpha-1}, w_m = p_m \alpha M^{\alpha-1}, w_h = p_h \alpha H^{\alpha-1}, p_m$ may decrease if adverse income elasticities.

THE MODEL WITH INCOME EFFECTS (4): PREDICTIONS

- The model has predictions about the evolution of wages and employment shares by sector. In the skill intensive sector 1 average wages are given by $\overline{w}_1 = \frac{w_h H_1 + w_l L_1}{H_1 + L_1}$ and the employment share of sector 1 is $e_1 = \frac{H_1 + L_1}{H + L}$.

- The effect of an increase in $d \log H$ on $\overline{w}_1$ is ambiguous because there is a negative supply effect combined with with a positive demand effect, the effect on e_1 is positive.

THE DATA

Empirical question: do educated and rich consumers prefer expenditure on education and health services and/or on low-skilled personal services?

1. Consumption data except housing and durables: time period in mid of increase in inequality
   - CEX 1994-1997 list of 39 non-durable consumption items consistently recorded (NBER data).
   - FES 1994-1997 list of 39 non-durable consumption items consistently recorded.

2. Industry skill-intensity data:
   - CPS list of 39 manufacturing industries
   - LFS list of 39 manufacturing industries

DESCRIPTIVE STATISTICS: CONSUMPTION DATA

CEX data 1994-1997, N=23247				
Expenditure Shares	mean	sdt dev	min	max
Food Off-Premise	0.147	0.091	0	0.994
Food On-Premise	0.044	0.046	0	0.799
Tobacco Products	0.012	0.026	0	0.969
Alcohol Off-Premise	0.006	0.014	0	0.397
Alcohol On-Premise	0.005	0.015	0	0.405
Clothing and Shoes	0.039	0.042	0	0.727
Clothing Services	0.006	0.010	0	0.255
Some college educ.(dummy)	0.522	0.500	0	1
Age of head	45.608	17.903	15	94
Sex of head (female=1)	0.408	0.492	0	1
Number of children	0.842	1.166	0	10
Number of earners	1.330	0.937	0	12
Family size	2.500	1.511	1	28
% single	0.488	0.499	0	1
% spouse with some college educ.	0.244	0.429	0	1
Log total hh exp. (price=1997)	9.760	0.958	4.695	12.524

THE MATCH: LOW SKILL INTENSIVE GOODS

CEX consumption item	CPS Industry name
Food Off-Premise	Food and kindred products
Food On-Premise	Eating and drinking places
Tobacco Products	Tobacco manufactures
Alcohol Off-Premise	Beverage industries
Alcohol On-Premise	Eating and drinking places
Clothing and Shoes	Apparel and finished textile prod.
Clothing Services	Repair Services
Jewelry and Watches	Watches, clocks, clockwork devices
Barbershops, Beauty Parlors etc.	Personal Serv., Except Private Housh.

THE MATCH: HIGH SKILL INTENSIVE GOODS

CEX consumption item	CPS Industry name
Airline Fares	Air transportation
Books and Maps	Printing, publishing
Magazines, Newspapers, Toys, etc.	Newspaper publishing and printing
Recreation and Sports Equipment	Professional and photo equipment
Other Recreation Services	Entertainment and Recreation Serv.
Higher education	College and university
Elementary and Sec. Education	Elementary and sec. schools
Other Education Services	Other educational Services
Religious and Welfare Activities	Social Services

ESTIMATION: BENCHMARK TOBIT ESTIMATE

CEX data 1994-1997, N=23247

$$\omega_{ij} = b_j X_i + \gamma_j' ed_i + \sum \delta_{jp} d_p(\log x_i) + \varepsilon_{ij} \qquad \text{for } j = 1, .., 39$$

- $omega_{ij}$ exp. share; ed_i dummy education of the head
- X_i age and sex of the head, the number of earners, of adults and of children under 18

$$\widehat{\eta}_j^{ed} = \frac{\widehat{\gamma}_j * \overline{ed}}{\overline{\omega}_j} \qquad\qquad \widehat{\eta}_{jp}^{budget} = \frac{\widehat{\delta}_{jp}}{\overline{\omega}_j} + 1$$

ELASTICITIES OF LOW SKILL CONSUMPTION ITEMS

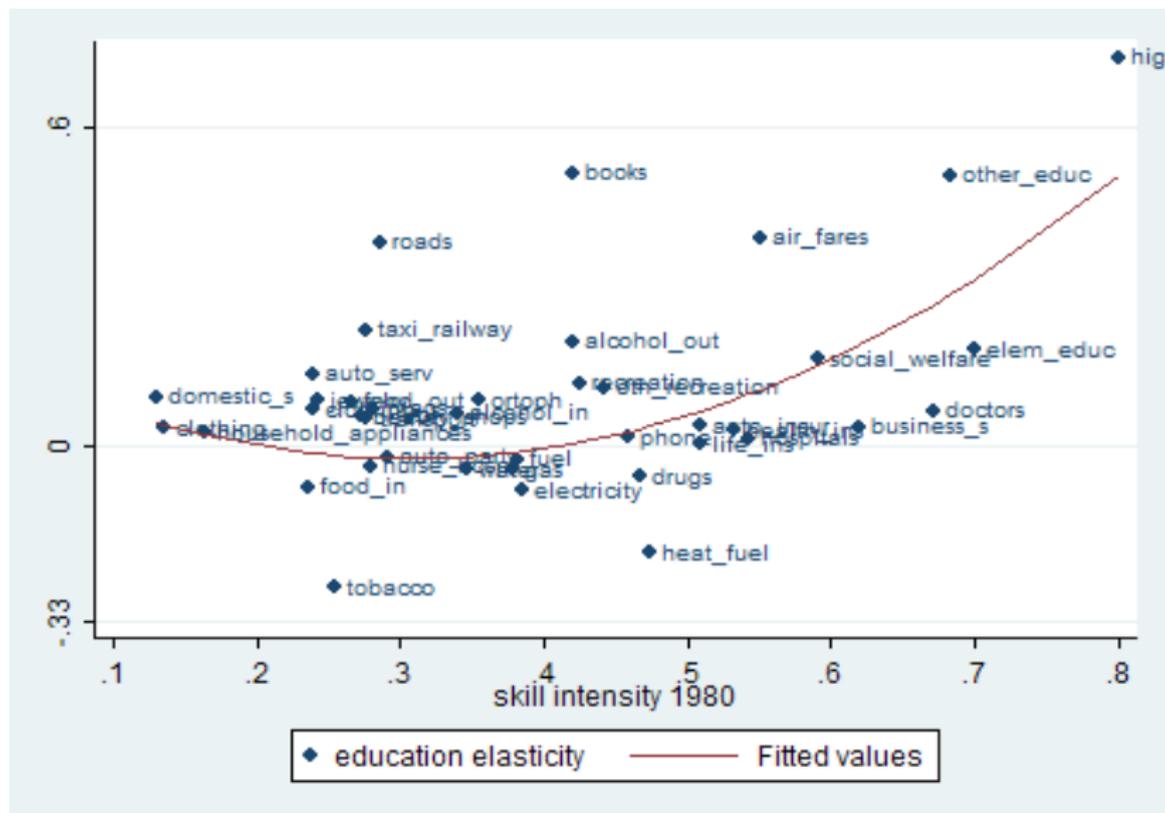|	education elasticity	std. error	income elasticity	std. error	skill int.1980
Domestic Service	0.092	0.018	1.497	0.092	0.131
Clothing and Shoes	0.033	0.008	1.051	0.061	0.136
HH. Supplies	0.024	0.016	1.439	0.089	0.163
Food Off-Premise	-0.078	0.004	0.759	0.034	0.236
Clothing Services	0.067	0.018	0.837	0.112	0.239
Repair etc.	0.136	0.015	1.646	0.089	0.240
Jewelry and Watches	0.085	0.076	1.660	0.470	0.242
Tobacco Products	-0.267	0.040	0.920	0.235	0.255

ELASTICITIES OF HIGH SKILL INTENSIVE CONSUMPTION ITEMS

	education elasticity	std. error	income elasticity	std. error	skill int.1980
Health Insurance	0.029	0.016	1.101	0.101	0.531
Hospitals	0.013	0.069	1.161	0.219	0.543
Airline Fares	0.391	0.076	1.656	0.377	0.550
Religious, Welfare Act.	0.164	0.051	1.617	0.325	0.590
Business Services	0.034	0.034	1.695	0.193	0.620
Physicians, Medical Pr.	0.066	0.020	0.987	0.098	0.671
Other Education Serv.	0.508	0.288	1.551	1.227	0.684
Nursery,Elem.,Sec. Ed.	0.180	0.238	1.533	1.583	0.699
Higher education	0.730	0.260	1.690	1.084	0.800

CORRELATIONS BETW. ELASTICITIES AND SKILL INTENSITY
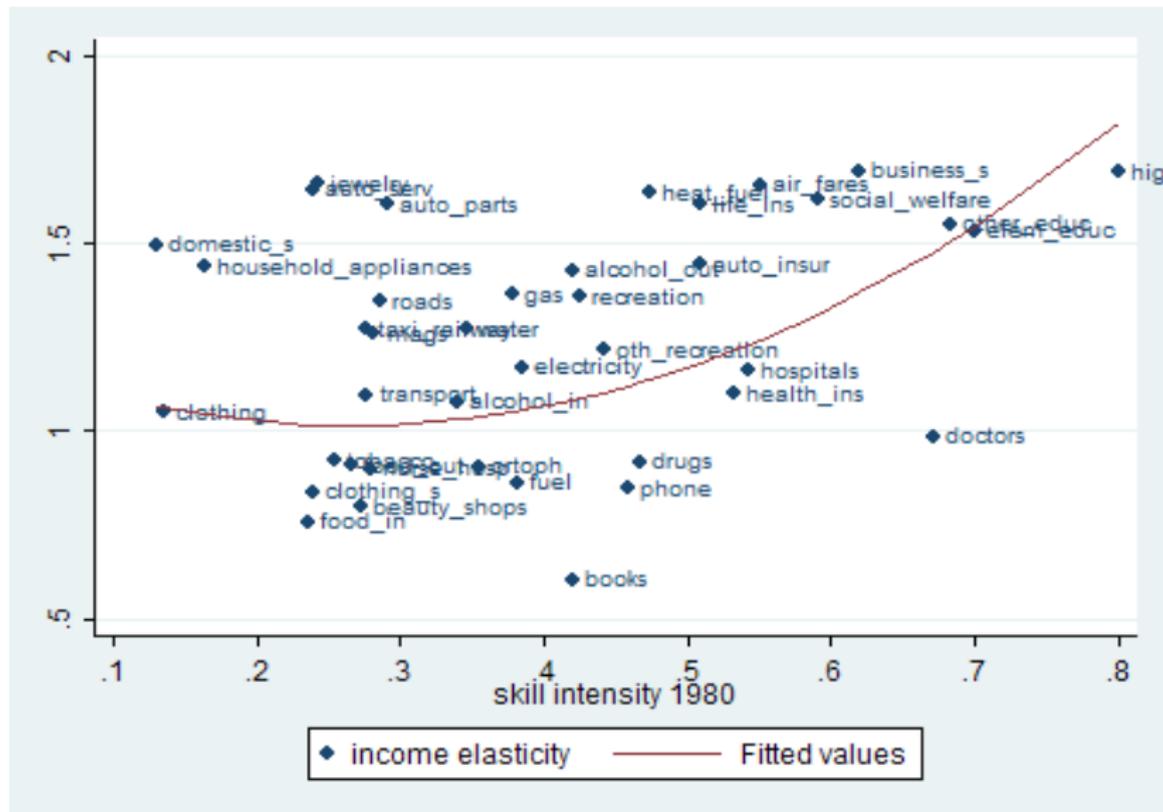
$$\widehat{\eta}_{jt} = \alpha + \beta_1 z_j + \beta_2 z_j^2 + \varepsilon_j \qquad \text{N=156 weighted by mean share}$$

Dependent variable	education elasticity	income elasticity	90th perc. income elast	10th perc income ela
		Panel A		
skill intensity 1980	-1.145***	-1.231*	-3.444***	-0.608
	(0.229)	(0.733)	(0.995)	(0.635)
skill intensity 1980 sq.	1.850***	2.309**	5.837***	1.188
	(0.278)	(0.892)	(1.211)	(0.772)
Constant	0.166***	1.145***	1.476***	1.052***
	(0.0444)	(0.142)	(0.193)	(0.123)
R-squared	0.371	0.125	0.267	0.053

EDUCATION ELASTICITIES

INCOME ELASTICITY

INCOME ELASTICITY 90TH PERC.

INCOME ELASTICITY 10TH PERC.

INCOME ELASTICITY BY EDUCATION

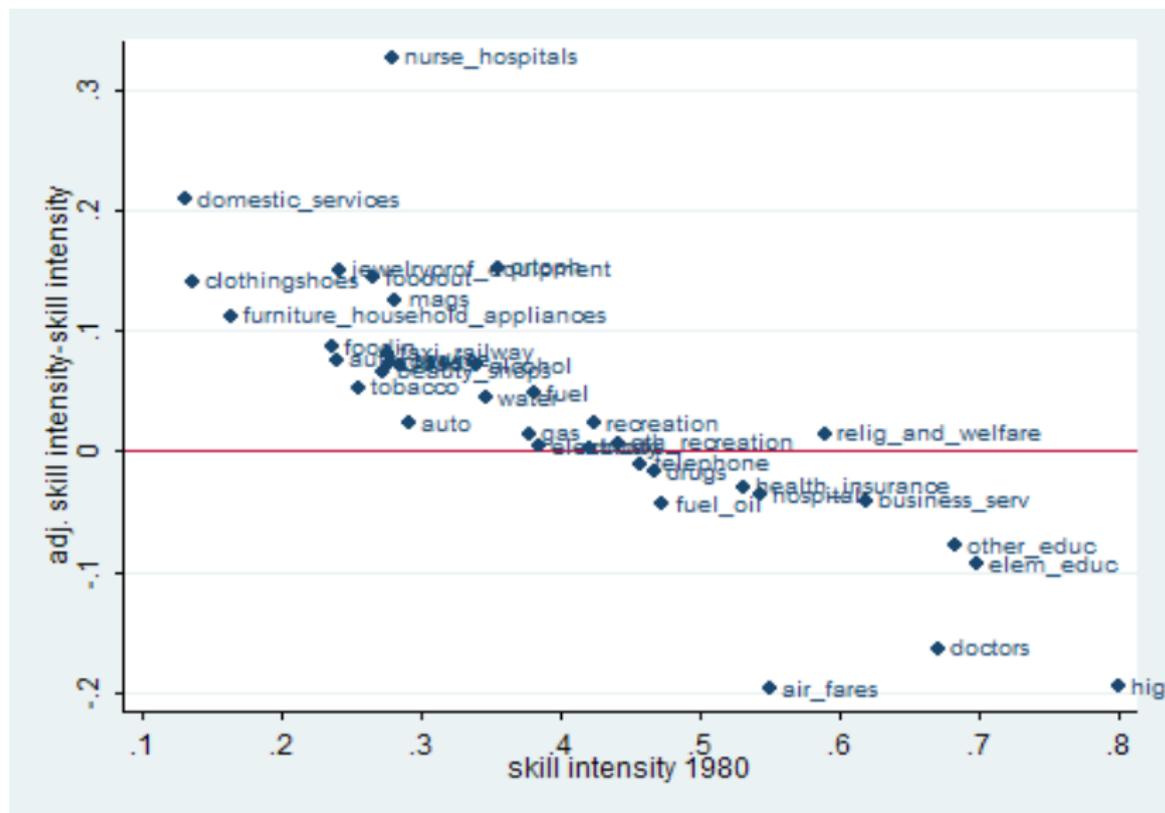# INCOME ELASTICITY OF ALL

low and high educated

INPUT OUTPUT TABLES

- ► The 39 matched goods represent only 25% of the total economy

- ► Intermediate goods+retail sector: Skill intensity=weighted average of skill intensity of industries that produce intermediate goods $z_j^A = \sum_i \frac{l_{ij}}{\Sigma_i l_{ij}} z_i$

- ► Import and export: Skill intensity multiplied by import penetration of industry $z_j^B = z_j^A * NX_j$, reduces the skill intensity of the importing sectors

ADJUSTED SKILL INTENSITY (1)

CPS Industry	(1) skill intensity	(2) adj. skill intensity interm. goods	(3) adj. skill intensity import penetration
Food production	0.216	0.283	0.260
Eating places	0.252	0.378	0.378
Tobacco	0.214	0.266	0.238
Beverage	0.320	0.378	0.378
Bars and drinking places	0.252	0.421	0.419
Apparel	0.122	0.244	0.133
Repair	0.239	0.293	0.293
Jewelry and toys	0.198	0.350	0.321
Personal services	0.259	0.315	0.315
House supplies	0.160	0.246	0.206

ADJUSTED SKILL INTENSITY (2)

ROBUSTNESS TO MEASURES OF SKILL INTENSITY

Dependent variable	education elasticity	income elasticity	90th perc. inc elast	10th perc. inc elast
adj. skill int. (interm. goods)	-2.674***	-6.950***	-16.90***	-2.942
	(0.823)	(2.363)	(3.165)	(2.091)
adj. skill int. (interm. goods) sq.	3.875***	9.723***	22.72***	4.335*
	(0.971)	(2.788)	(3.733)	(2.467)
Constant	0.447***	2.191***	4.061***	1.447***
	(0.169)	(0.486)	(0.651)	(0.430)
R-squared	0.266	0.179	0.331	0.072
	Panel B			
adj. skill int. (imp. goods)	-1.579***	-3.377***	-7.437***	-2.075*
	(0.418)	(1.214)	(1.673)	(1.067)
adj. skill int. (imp. goods) sq.	2.693***	5.800***	12.14***	3.510**
	(0.544)	(1.578)	(2.174)	(1.386)
Constant	0.217***	1.435***	2.065***	1.257***
	(0.0790)	(0.229)	(0.316)	(0.201)
R-squared	0.286	0.185	0.297	0.092

ROBUSTNESS OF ELASTICITY ESTIMATES

- ▶ (i)outliers: three expenditures on education, elementary, high education and other education; they are all very skill intensive and have a high elasticity with respect to income

- ▶ (ii)multicollinearity: estimate education and income elasticity separately

- ▶ (iv) use college educated or more (rather than some college) as definition of skilled heads; (v) use only working age heads (75 perc. of sample); (vi) calculating total real expenditure with $\log P_i = \sum_j w_{ij} \log p_j$ is the Stone price index where w_{ij} is the expenditure share of commodity j of household i

- ▶ (vii) use OLS instead of Tobit; (viii) log total expenditure is instrumented using log total household net income; (ix) use semiparametric models.

	exclude expenditure on education		separate education and income	
	edu elast	income elast	edu elast	income elast
adj. skill int.	-0.401	-8.280***	-5.571***	-7.469***
	(0.831)	(2.781)	(1.257)	(2.370)
adj. skill int. sq.	0.897	11.46***	7.770***	10.44***
	(1.007)	(3.371)	(1.483)	(2.795)
Constant	0.034	2.451***	0.956***	2.282***
	(0.167)	(0.559)	(0.259)	(0.488)
R-squared	0.095	0.155	0.325	0.199

	educ. dummy: strictly college education		sample of heads aged 18-60	
	edu elast	income elast	edu elast	income elast
adj. skill int.	-1.191***	-6.886***	-2.740***	-8.256***
	(0.409)	(2.355)	(0.814)	(2.341)
adj. skill int. sq.	1.706***	9.602***	4.049***	11.22***
	(0.482)	(2.778)	(0.961)	(2.761)
Constant	0.204**	2.186***	0.446***	2.462***
	(0.0841)	(0.485)	(0.168)	(0.481)
R-squared	0.211	0.174	0.306	0.192

ROBUSTNESS: ESTIMATION METHOD

	OLS		2SLS		ed
	edu elast	income elast	edu elast	income elast	
adj. skill int.	-2.198**	-6.131***	-2.869***	-4.340	
	(0.910)	(1.727)	(0.899)	(3.010)	(
adj. skill int. sq.	3.253***	8.377***	4.036***	6.199*	
	(1.074)	(2.037)	(1.061)	(3.550)	(
Constant	0.344*	1.932***	0.474**	1.603**	
	(0.187)	(0.355)	(0.185)	(0.619)	(
Observations	156	156	156	156	
R-squared	0.192	0.203	0.211	0.059	

TIMING

▶ There are two issues that we can address. The first is the timing of polarization: Autor and Dorn (2009) claim that wage polarization appeared in the nineties but it is not in the data in the '80s. We find no evidence of changes over time in the correlations between elasticities and skill intensity. The income elasticities are very stable over time but the fact that there is no polarization in the '80s does not mean that product demand is not a plausible explanation. As Autor and Dorn (2009) write regarding their technology-based explanation, the task-replacing effect of technology was there also in the '80s but the bottom tail of the distribution did not appear because there were still plenty of manufacturing jobs in the middle of the distribution which later disappeared.
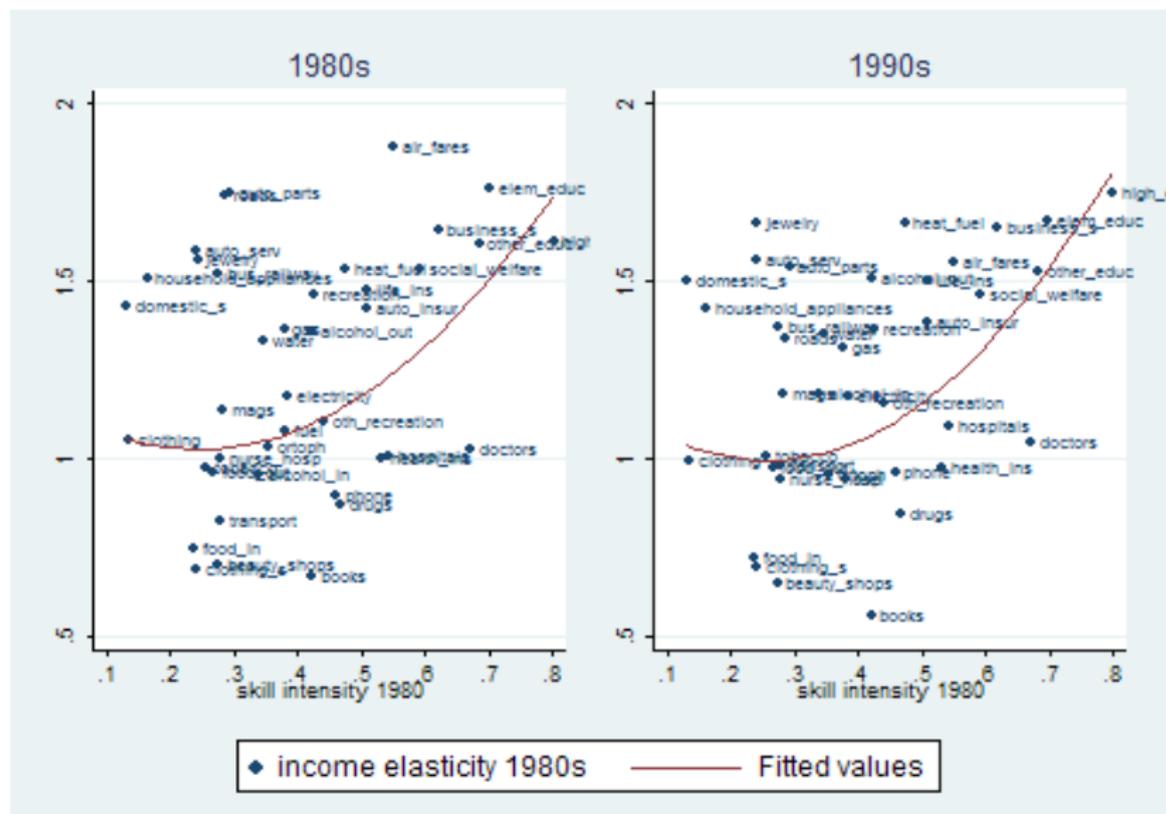
AUTOR AND DORN

Real Log Wage Changes by Wage Percentile 1980-1990 and 1990-2000

EDUCATION ELASTICITIES OVER TIME

INCOME ELASTICITIES OVER TIME

FAMILY COMPOSITION

► The second issue is whether the increase in consumption of low-skill intensive goods is due to the increasing education particularly of females. If the explanation lies in the opportunity cost of time, it is plausible that the large increase in education attainment among women may have played a role (Black and Spitz-Oener, 2009; Cortes and Tessada, 2011). Aguiar and Hurst (2007) document that more educated women spend fewer hours working at home over time and that differences across educational groups have increased from 1985 onwards. To this extent I estimate different regressions for singles, families with low-educated spouses, families with high educated spouses.

FAMILY COMPOSITION

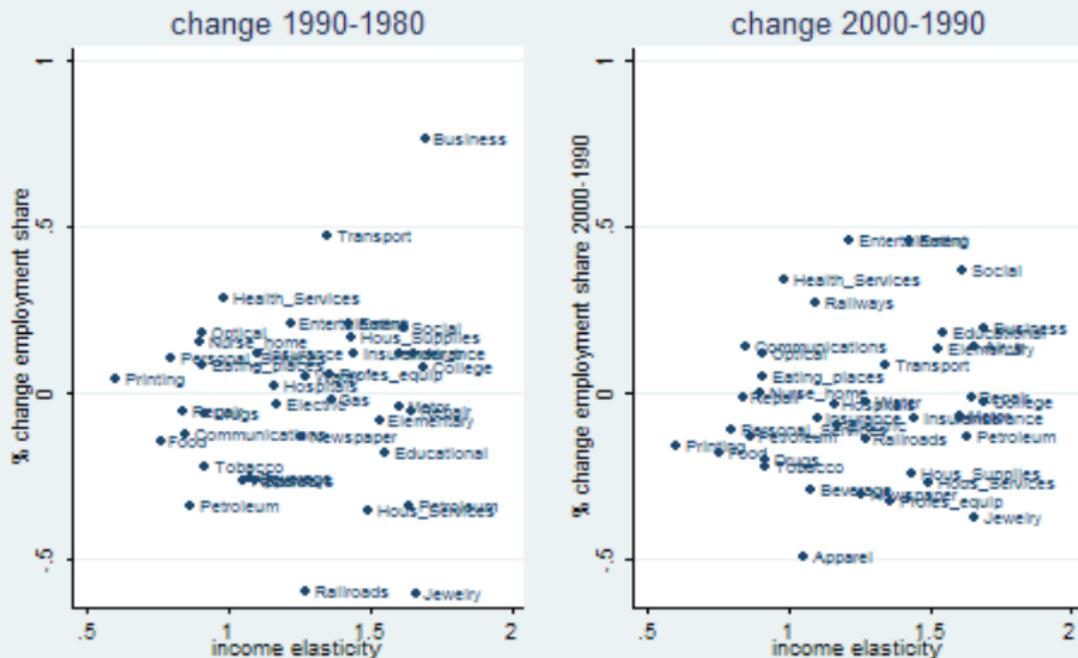| Dep var	singles		families wife less than college		families wife some college	
	educ elast	income elast	educ elast	income elast	educ elast	income elast
skill int	-1.546**	-2.144*	-1.295**	-1.998	-1.095**	-2.794
	(0.626)	(1.243)	(0.519)	(1.298)	(0.478)	(1.689)
skill int sq.	2.638***	3.977**	2.132***	3.730**	1.607***	4.338**
	(0.751)	(1.490)	(0.632)	(1.578)	(0.575)	(2.032)
Constant	0.208*	1.293***	0.175*	1.260***	0.149	1.323***
	(0.118)	(0.234)	(0.0965)	(0.241)	(0.0889)	(0.314)
Obs	39	39	39	39	39	39
R-squared	0.447	0.372	0.395	0.320	0.243	0.187

IMPLICATIONS FOR SECTORIAL WAGES AND EMPLOYMENT

▶ The J-shaped correlation between elasticities and initial skill intensity ("consumption polarization") across industries implies that the relative derived demand for the most skilled workers relative to middle skilled workers must have increased following an increase in H/L. In this simple model with two sector there is no polarization but there are implications with respect to employment shares (positive) and sectorial wages (ambiguous).

▶ Expect a positive correlation across industries between employment share growth and elasticities because of the positive supply effect and the consequent positive product demand effect. The correlation between wage growth and education or income elasticities is less clear because the supply and consequent demand effect work in opposite direction for the most skill intensive industries.

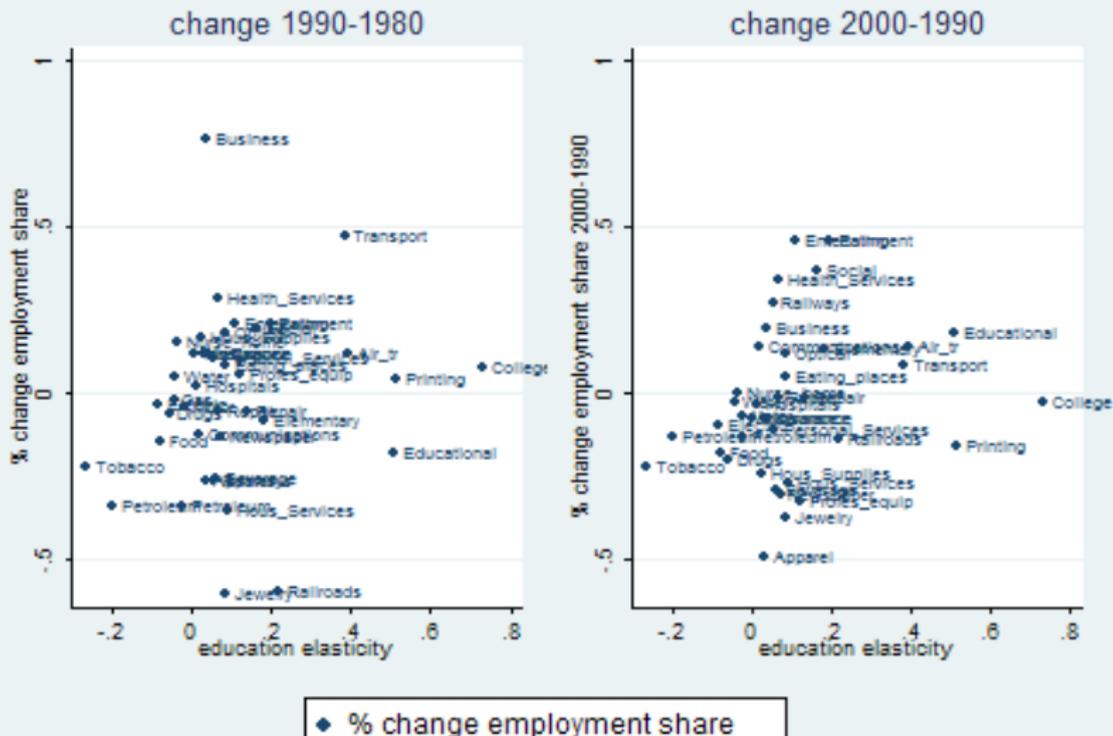## IMPLICATIONS FOR SECTORIAL WAGES AND EMPLOYMENT

$$\Delta EmpShare_{ist} = \alpha + \beta(\Delta hourlywage_{st} * \widehat{\eta}_i) + \delta s + \gamma t + e_{ist}$$

Use CEX elasticities to predict changes in employment and
wages of industries at the local level on the basis of the local
change in education and income (in this sense the model
underestimates the income effect because looks only at
changes in education while changes in income are
endogenous) Here we try to make them exogenous. Take the
sample of census in 1980, 1990 and 2000. By state calculate
the change in average income 2000-1990 and 1990-1980,
multiply by income elasticities and see if producing industries
(only non tradables) are increasing employment and wages in
those States where income and education are growing more.
Use Bartik instrument.

CHANGES IN EMPLOYMENT SHARES ON INCOME ELASTICITIES

% change employment share

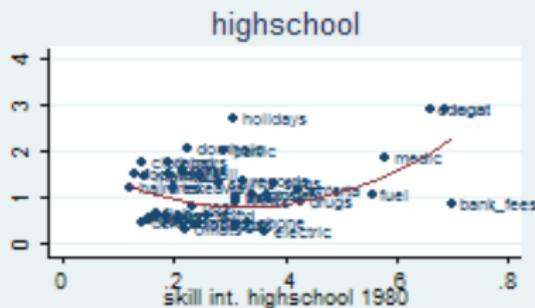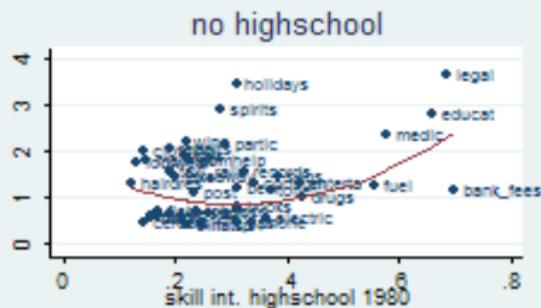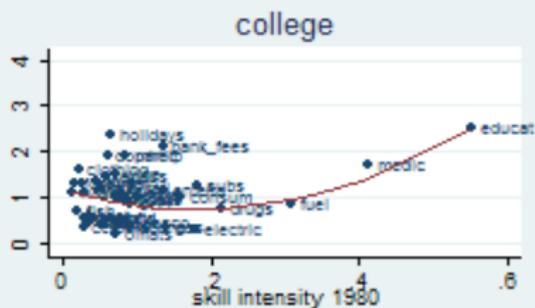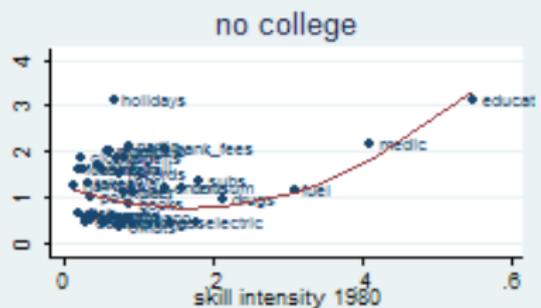# CHANGES IN EMPLOYMENT SHARES ON EDUCATION ELASTICITIES

Caption: % change employment share

INDUSTRY EMPLOYMENT SHARES IN STATE S: 14 NON TRADABLE SECTORS

predicted consumption change	0.002 [0.000]***			-0.005 [0.040]
predicted consumption change at 10th percentile		0.002 [0.000]***		
predicted consumption change at 90th percentile			0.001 [0.000]***	
Constant	-0.001 [0.001]	-0.002 [0.001]*	-0.002 [0.001]**	-0.008 [0.037]
Observations	1327	1327	1327	1319
R-squared	0.23	0.22	0.21	

INDUSTRY WAGE SHARES IN STATE S: 14 NON TRADABLE SECTORS

predicted consumption change	0.002			0.021
	[0.000]***			[0.072]
predicted consumption change at 10th percentile		0.002		
		[0.000]***		
predicted consumption change at 90th percentile			0.001	
			[0.000]***	
Constant	-0.002	-0.002	-0.004	0.015
	[0.001]**	[0.001]**	[0.001]***	[0.065]
Observations	1327	1327	1327	1319
R-squared	0.26	0.26	0.24	

UK RESULTS

UK RESULTS

UK RESULTS(1): LAD REGRESSION

Dependent variable	education elasticity	income elasticity	90th perc income elast
adjusted skill int. (interm. goods)	0.152	3.664***	3.245***
	(0.112)	(0.778)	(0.999)
Constant	-0.0192	-0.463***	-0.463***
	(0.0181)	(0.120)	(0.153)
R-squared	0.055	0.081	0.099

ROBUSTNESS EXERCISE UK (2)

	OLS		semiparametric	
	edu elast	income elast	edu elast	income elast
adj. skill int.	0.116	1.790**	0.136	2.660**
	(0.0903)	(0.862)	(0.160)	(1.250)
Constant	-0.0154	-0.318**	-0.0211	-0.408**
	(0.0150)	(0.140)	(0.0234)	(0.178)
Observations	156	156	156	156
R-squared	0.124	0.034	0.090	0.081

ROBUSTNESS EXERCISE UK

	sample of heads age 18-60		elasticities in year 1988	
	education elasticity	income elasticity	education elasticity	income elasticity
adj. skill int.	0.168***	4.083***	0.214***	3.384***
	(0.0575)	(1.226)	(0.0305)	(0.803)
Constant	-0.0299***	-0.519***	-0.0306***	-0.440***
	(0.00946)	(0.187)	(0.00461)	(0.119)
Observations	156	156	156	156
R-squared	0.111	0.213	0.099	0.130

QUANTIFY THE EFFECT: PARAMETERIZE SOLUTION OF MODEL

▶ Model solution:

$$\frac{d \log w_h}{d \log H} = \frac{(1 - a_2)\{(\lambda_H - \lambda_L)[R_1 - (1 - R_1)\frac{H}{L}] - [1 + \lambda_H + \frac{H}{L}(1 + \lambda_L)]\}}{(\lambda_L \sigma_1 + \sigma_2) + (\lambda_H - \lambda_L)(1 - a_1)\sigma_1 - (\lambda_H - \lambda_L)T}$$

▶ Result:

$$\frac{d \log w_h}{d \log H} = -0.67$$

PARAMETER ESTIMATES

▶ Substitution elasticity in production σ =1.4 is from Katz and Murphy (1992).

▶ Labor market aggregates λ_H, λ_L, a_1, a_2 and $\frac{H}{L}$ are estimated using CPS.

▶ Income and price elasticities ε_{1p}^h, ε_{1p}^l, ε_{1m}^h, ε_{1m}^l, R_1 are estimated using CEX. Elasticities with respect to the low skill sector.

SYSTEM ESTIMATES OF INCOME AND PRICE ELASTICITIES

- ε_{1m}^h and ε_{1p}^h, are obtained pooling the expenditure shares of the 20 high-skill intensive goods and the 20 low-skill intensive goods in a system of two equations and introducing fixed effects for each commodity. Impose homogeneity and symmetry.

$$
\begin{aligned}
\omega_{1ij} &= \alpha_1 X_i + \beta_1 \log(\frac{X}{P})_i + \theta_1 \log p_1 + \phi_1 \log p_2 + \zeta_{1j} + \varepsilon_{1ij} \\
\omega_{2ij} &= \alpha_2 X_i + \beta_2 \log(\frac{X}{P})_i + \theta_2 \log p_2 + \phi_2 \log p_2 + \zeta_{2j} + \varepsilon_{2ij}
\end{aligned}
$$

SUMMARY OF US PARAMETERS

$\lambda_H = \frac{H_1}{H_2}$	λ_L	$a_1 = \frac{w_h H_1}{p_1 F_1(.)}$	a_2	$\frac{H}{L}$	σ
2.21	0.6	0.65	0.37	0.57	1.4
ε_{1m}^h	ε_{1m}^l	ε_{1p}^h	ε_{1p}^l	$R_1 = \frac{Hy_1^h(.)}{Hy_1^h(.) + Ly_1^l(.)}$	
0.86	1.21	-1.36	-1.01	0.66	

COUNTERFACTUAL NO INCOME EFFECT: US RESULTS

▶ Counterfactual: would have happened without the education and income effect in favor of high-skill-intensive goods. The same model solved with identical demand functions for skilled and unskilled workers and no income effects: two-sector version of Katz and Murphy (1992).

$$\frac{d \log w_h}{d \log H} = \frac{-(1 - a_2)[1 + \lambda_H + \frac{H}{L}(1 + \lambda_L)]}{(\lambda_L + 1)\sigma + (\lambda_H - \lambda_L)(1 - a_1)\sigma - (\lambda_H - \lambda_L)\varepsilon_{1p}(a_1 - a_2)}$$

▶ Result:

$$\frac{d \log w_h}{d \log H} = -0.73$$

COUNTERFACTUAL RESULTS: US AND UK

	(a) model with income and educ effect	(b) model without income and educ effect	(c) diff (a)-(b)	(d) demand shift $\frac{w_h}{w_l}$
US CEX				
$\frac{d \log w_h}{d \log H}$	-0.67	-0.73		
% terms	(-0.67*0.59)=-39%	(-0.73*0.59)=-43%	4%	(43%+22%)=65%
UK FES				
$\frac{d \log w_h}{d \log H}$	-0.78	-0.85		
% terms	(-078*0.88)=-68%	(-0.85*0.88)=-74%	6%	(74%+14%)=88%

The actual skill ratio $\frac{H}{L}$ increased by 59% between 1984 and 2002. The skill premium $\frac{w_h}{w_l}$ increased by 22% in the CEX.

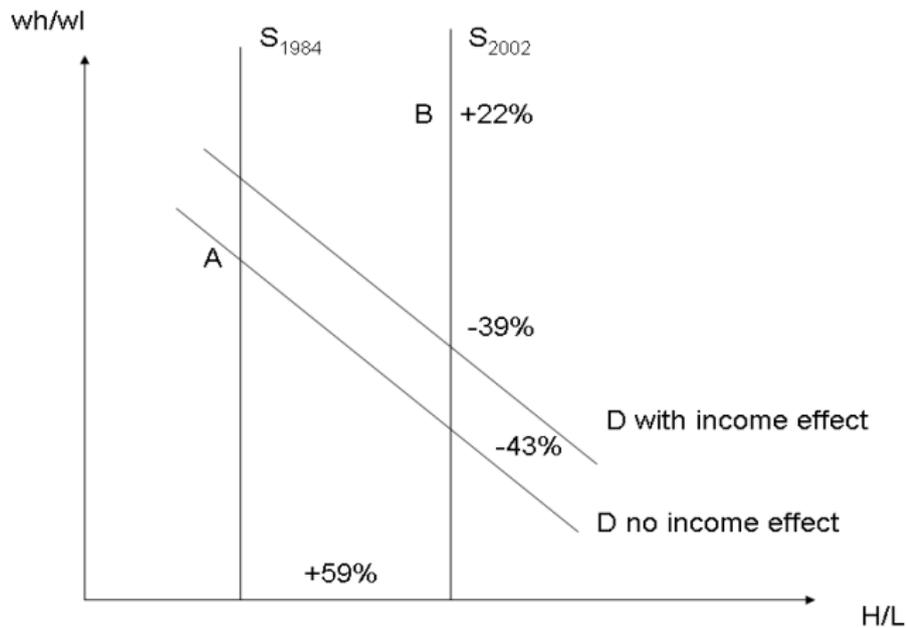## COUNTERFACTUAL (2)

▶ The model with education and income effect in favor of skill-intensive goods implies that $\frac{w_h}{w_l}$ should have fallen by 39% (-0.67*0.59=-0.39) as a result of an increase in $\frac{H}{L}$ of 59%.

▶ The counterfactual model with no income effect implies a fall of $\frac{w_h}{w_l}$ by 70% (-0.73*0.59=-0.43). Therefore the income effect in favor of skill-intensive goods reduces by 4% the fall of the relative wage (39% instead of 43%).

COUNTERFACTUAL (3)

► How much of the actual increase in wage inequality can the income effect explain? The total demand shift is obtained summing the implied decrease of $\frac{w_h}{w_l}$ along the relative demand curve of the counterfactual model (-43%) to the actual increase between 1984-2002 in $\frac{w_h}{w_l}$ in the US=22%. The total is 43+22=65%.

► The income effect in favor of skill-intensive goods reduces by 4% the fall of the relative wage (39% instead of 43%) and 4% points constitute about 6% of the 65% total shift in the relative labor demand.

CONTRIBUTION TO US INEQUALITY

CONCLUSIONS

1. Consumers with higher income and education tend to consume both more low skill intensive and more skill intensive goods.

2. The U-shaped relationship between education and income elasticities and skill intensity is robust to correction for intermediate goods, retail sector and import-export. It is robust over various years, to age groups, and to estimation methods.

3. The education and income effect can explain about 6% of the total shift of the relative demand for skilled labor. In the debate between Mazzolari and Ragusa, (2007) and Autor and Dorn, (2009) the product demand effects seems to be small.