

**SILLOVERS FROM HOUSEHOLD PRODUCTION
TO WAGE AND PROFIT FORMATION**

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To my parents

Preface

Co-operation with Asbjørn Rødseth in 1978 at the Institute of Industrial Economics in Bergen reinforced my interest in these topics. This encouraged an application to the Norwegian Research Council for Science and the Humanities for a position as a Research Fellow. As such I was affiliated to the Department of Economics (UiB) in the early 1980's under the supervision of Tor Rødseth. The appendix paper of this thesis is written during this period (1983). After ten years of hardships, both professionally and personally, an assistant professorship in economics at Agder University College (HiA) offered me a new start in 1993. Later that year I was admitted to the Doctoral Programme at the Norwegian School of Economics and Business Administration. My thesis committee has been: Rolf J. Brunstad (supervisor), Steinar Holden (University of Oslo) and Agnar Sandmo.

Participation in a workshop for doctoral students at Uppsala University in 1997 with Gary Solon and Stephen Nickell was the actual start, and a sabbatical at AUC 1997-8 made concentration possible without classes to prepare for and administrative responsibilities. AUC has granted me funds and highly valued flexibility to pool research efforts. Access to databases in my office and the library services have been a good help. A related project financed by the Research Council of Norway, the Programme committee for Research in Tourism and Travel, 1998-9, also generated ideas and research resources. Participation in various committees in the Research Council of Norway has increased my insight in the social sciences. Various resources have financed presentations of papers at conferences of organisations such as EEA, EALE, ESPE and IAFFE. Over time I have benefited from discussions with colleagues in Women studies and Labour economics from Norway, the other Nordic countries and elsewhere. The library services at the School of Economics and Business Administration have been most helpful during my visits to Bergen. I am grateful for the positive support of my colleagues, for discussions with Theis Theisen and the good-spirited support of women in a male dominated work place. The task as a co-ordinator of the undergraduate programme in economics and business administration in Kristiansand made this research less solitary and more of a leisure activity than planned. Lately, I benefited from a 7-week stay as an Affiliated Visiting Scholar at Scancor at Stanford University. I am grateful to Elizabeth Griffiths for improving my oral English, and to Ian Hocking for his efforts to make this thesis readable.

My thesis committee has given many valuable comments at various stages. I thank Rolf J. Brunstad for lending me support for decades and for making this thesis possible by accepting to become my supervisor. I thank Steinar Holden for his critical and constructive comments that have increased the quality of these essays. Last, but not least, I thank Agnar Sandmo for his valuable suggestions and his positive interest that encouraged the completion of the thesis.

I thank my mother for the way she raised me, including in-the-home training. Her background from domestic and nursery programmes made me acknowledge household skills. I thank my father for his confidence in me, which has strengthened my self-confidence and make me look ahead. I thank my sons, Helge and Torbjørn, for all the joy and distracting moments, for their patience when I worked long hours, and for showing that in-the-home training on PC's create skills that are also useful to other family members. Finally, I thank Geir for his support during thirteen years, and for his quick responses to my questions wherever he was.

Kristiansand, October 2002
Kristin Dale

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ESSAY 1
INTRODUCTION
TO
SPILOVERS FROM HOUSEHOLD PRODUCTION
TO WAGE AND PROFIT FORMATION

by

Kristin Dale

1.1 Summary

The aim of this introduction is to present the findings of this thesis and relate them to labour economics and human capital theory. The central idea of these five essays is that household production affects wage and profit formation in industries with production processes that are similar to household production so-called 'substitute household production'. Household skills raise productivity in household production and are learnt at home through 'in-the-home training', a new concept I introduce to highlight this process of skill formation. Household skills are job skills in substitute household production. Household skills play an important part in these five essays. The influence of household production on capital costs is addressed in terms of the low entry costs of new firms in Essay Four and the regional distribution of family-based businesses in Essay Five. Each essay focuses on one aspect of the spillover process from household skills and real capital into factor supply and remuneration.

Essay Two introduces in-the-home training and models the manner in which household skills may affect the choice of education and occupation. Essay Three investigates how various types of higher education affect household productivity. I describe a model that shows how an occupational education, which promotes household skills to a greater degree, *ceteris paribus*, increases a graduate's household productivity and creates an occupation with shorter working hours and a lower wage rate. This is a novel explanation for the low wages of pre-school teachers and nurses in comparison to engineers and business economists with an equally long education. Essay Four presents a model demonstrating that industries producing substitutes for home made goods and services will typically pay lower wage rates and create lower profits than other industries. The model assumes that entry costs for nascent firms in household-related industries are lower and that employees with household skills are in abundant supply. Essay Five presents a model of two regions and two industries where rural areas have a cost disadvantage and the manufacturing industry has a fixed regulated wage rate in all firms. Under these assumptions family firms become more important to employment in the rural region because they pay lower wage rates than the industry with regulated pay.

1.2 Motivation

Despite decades of theoretical and empirical research on wage formation, the economic literature on wage formation contains substantial discrepancies between enduring empirical findings on wage differentials and the explanatory power of theoretical models. One important research question is: why are hourly wage rates higher in larger firms, in certain industries and in male dominated occupations (after controlling for other factors)?

Current research on wage formation proceeds on two fronts. Empirical studies have become refined thanks to new data sources such as panels and better econometric models that help overcome the problem of unmeasured variables like worker ability. New theoretical explanations have been developed for the concepts in the wage equation. My dissertation belongs to the second line by contributing some new explanations.

My previous research (Titlestad and Rødseth, 1980; Rødseth and Titlestad, 1984) lead to the following question: Does the 'gender' component of a wage equation measure a 'pure' gender effect or an effect that has not been disentangled from the different roles of women and men in the household sector of the total production system? From the estimates of wage equations (Dale 1988; 1994) I was surprised by the relatively low hourly wages of car-repairer workers compared to other workers in the iron and metal industry. The explanation cannot be that car-repair is dominated by women! Is the hidden explanation a resemblance to household production? Car mechanics can keep the family-cars running and exchange services with others. Returns may also stem from income from informal markets for car-repair. Thereby, car mechanics receive returns on their human capital (acquired through 'in-the-home training', education, apprenticeship or 'on-the-job training'). However, an alternative explanation of lower wages is that the car-repair industry is more competitive than, say, the steel industry, because the lower entry costs of new firms result in more garages.

1.3 Stylised facts: household production and the labour market

Some patterns are common among OECD-countries: occupational sex segregation, gendered division of unpaid household production, and the characteristics of high and low wage occupations and industries. Therefore, these patterns can be exemplified by data from countries like Norway and the USA. I will use the examples to raise issues and questions that will subsequently be discussed in these essays.

1.3.1 The magnitude of household production

Aslaksen and Koren (1996) report that the value of unpaid household work represented a 38 per cent addition to Gross Domestic Product (GDP) in Norway in 1990, the larger share of which, 25 per cent, was contributed by women, and 13 percent by men.

Household production constitutes a large part of total production in modern industrialised countries, and even more so in developing countries. Cloud and Garrett (1996) use a series of strong assumptions and make approximations of the value of production and maintenance of human capital – largely corresponding to household production – on a country-by-country basis for 132 countries in 1990. The smallest percentage gain in Gross National Product (GNP) was 21 in Finland and the USSR. The largest was 90 per cent in Bangladesh. Sweden gained 25 per cent, Denmark, Hungary and China 26 per cent and Norway 30 per cent. France and the US gained 32 per cent, while Australia, the UK and Japan gained 36 per cent. Portugal, Turkey and Korea gained 42 per cent. Italy and Nepal gained 46 per cent. Indonesia gained 49 per cent, Brazil 54 per cent and India 57 per cent. Pakistan gained 80 per cent, Jordan 84 per cent, Egypt 86 per cent and Algeria 87 per cent. Developing countries gain a high share of GNP by adding household production. Communist countries and Scandinavian welfare states gain low percentages because female labour force participation is high and child-care and care for the elderly are publicly funded. The strength of this study is that it provides comparable, worldwide (132 countries) estimates of household production that total approximately \$8 trillion or 36 per cent of GNP. These results illustrate that home-made commodities represent a major contribution to people's consumption and wellbeing.

1.3.2 Occupation, gender and household production

The manager in a catering firm called my attention to household skills as job skills when he told me: *'Only housewives do a proper cleaning job, but young women are qualified for catering'* (Dale and Eskedal, 1985). This illustrates that various kinds of household skills may be useful in obtaining some jobs in the labour market. Is the pattern of gender segregation similar in household production and the labour market? In the labour market, do women use female household skills and men use male household skills? Reskin and Padavic (1994) report the division of household tasks by gender for full-time workers in the USA for 1987. The heavily female-dominated tasks are laundry and ironing, house cleaning, and preparing meals. Washing dishes and shopping are also female-dominated activities. Bills-payment and driving

are almost gender neutral. Automobile maintenance and outdoor tasks are heavily male-dominated. Bergmann (1986, Table A-1, p.317-28) ranks 335 occupations by the percentage of female workers (in the USA in 1984). A total of 19 occupations have more than 90 per cent women: dental hygienists; child-care workers; pre-kindergarten and kindergarten teachers; secretaries; receptionists; dental assistants; typists; licensed practical nurses; private household cleaners and servants; registered nurses; health record technologists and technicians; teacher aides; dieticians; welfare service aides; textile sewing machine operators; telephone operators; personnel clerks (except payroll and timekeeping); data-entry workers; bank tellers. With the exception of secretarial work, the tasks involved in these jobs are typically part of household production, particularly where a family has small children or other dependants. Bergmann includes 28 occupations that have more than 99 per cent men: garbage collectors; excavating- and loading-machine operators; railroad brake-, signal-, and switch-operators; power plant operators; water and sewage treatment operators; boilermakers; mine workers; oil well drillers; structural metal workers; sheet-metal duct installers; roofers; insulation workers; concrete and terrazzo finishers; plasterers; electrical power installers and repairers; brickmasons and stonemasons; supervisors of electricians and power plant installers; farm-equipment mechanics; heavy-equipment mechanics; firefighting-related occupations; aerospace engineers; heating, air conditioning and refrigeration mechanics; bus, truck and stationary engine mechanics; supervisors; helpers, construction trade; operating engineers; automobile mechanics. A few of these occupations require tasks involved in household production, such as garbage collection and car- and home-repair (according to time-use studies, these tasks are typically performed by men). The conclusion is that there seems to be a gendered division of various household skills, and these spill over into the labour market.

1.3.3 Low wage industries and occupations

Results from some of my studies of Norwegian manufacturing industries (Dale, 1994 and Dale et al.1993) illustrate the traditional explanation of low wages in certain occupations and industries. In Table 1.1 manufacturing industries are sorted by estimated industry wage differential, ranging from high to low. The estimated wage differentials by industry in Table 1.1 approximate percentage differentials in reference to the group of low wage industries (textiles, apparel, leather and footwear). These estimates of industry wage differentials have been controlled for gender as well as firm size, region and the worker's status as skilled, semi-

skilled or unskilled. Years of education and capital intensity were not controlled for because this information was not available. Information about years of education and capital intensity for these industries has been entered from other sources (Tables 8.3 and 8.8). The last column of Table 1.1 indicates industries that produce substitute household production to a large degree according to my assessment.

Table 1.1. Differentials by industry from Norway 1986 and 1990

Industry differentials from Norway 1990/1986					
Wage differentials (1986) and female share, education and capital (1990)					
Industry (manufact.& extrac.)	Wage diff	Female %	Years of edu.	Cap./worker	Substitute
	Tab. 5.1	Tab.8.5	Tab.8.3	Tab.8.8	househ.prod.
342 Printing & publishing	0.38	37	11,17	487	
353 Petroleum refining	0.34G	16	12,00	14668	
354 Man. of other petro.p.	0.34G	13	10,42	3943	
22 Crude petroleum&n.gas	0.32	24	12,68	n.a.	
21 Coal mining	0.17G	35	10,50	2596	
23 Metal ore mining	0.17G	18	10,57	2438	
29 Other mining	0.17G	12	10,02	1822	
383 Electrical apparatus	0.17	30	11,04	851	
371 Iron and steel	0.15	13	10,57	2558	
3841 Ship building	0.13	10	10,61	416	
382 Machinery	0.12	13	11,04	670	
390 Other manufact. ind.	0.11	41	11,21	641	
381 Metal products	0.09	16	10,38	588	
314 Manufact. of tobacco	0.09G	52	10,03	1447	
313 Manufact. of beverage	0.09G	20	10,52	1439	
311 Other food manufact.	0.09G	37	10,44	1194	X
3114 Fish products	0.09G	51	9,85	642	X
352 Other chemicals	0.08	38	10,85	1288	
372 Non-ferrous metals	0.08	17	10,92	3348	
331 Wood	0.08G	15	10,07	1061	
332 Furniture and fixtures	0.08G	27	10,07	626	X
351 Industrial chemicals	0.06	14	11,15	3720	
341 Paper & pulp	0.06	17	10,39	3227	
323 Leather	0G	45	9,70	489	
321 Textiles	0G	60	9,86	862	X
324 Footwear	0G	58	9,56	310	
322 Apparel	0G	84	9,82	306	X

Source: Dale et al(1993, 1994) G=group estimate. 0=basis=lowest wage. Wage diff.=%

Table 1.1 shows that industries that produce substitutes for household production are low wage industries. They have many female workers and a short average education length. Are female household skills relevant in the production of clothes, textiles and food? Are male household skills relevant in the production of furniture? In addition, capital intensity is

relatively low in the manufacturing industries that produce substitute household production. Is this an indication of the low entry costs for new firms? The standard interpretation by Bergmann (1974) is that employer discrimination towards female workers accounts for low female wages, while Polachek (1976) argues that low wages are due to shorter female education. Suggested policy measures have been to tackle employer discrimination by legislation and educate workers to raise formal skills and wage rates.

1.4 Household production and the household production function

As this thesis contains no literature survey or essay on household production in itself, this section explores the reasons that underpin my use of the household production function proposed by Gronau, together with his division of time into three categories: leisure, wage work and unpaid household work.

Models of wage formation and wage equations arise in the extension of *consumer theory*. In microeconomic theory a dichotomy is normally assumed to exist between agents. Thus, individuals consume in households and employees produce in firms. This division neglects household production and consumer aspects of employment. In recent years, production theory has also influenced wage equations. Nickell et al. (1994) introduce product market power and demonstrate that market power has a positive influence on wage rates. Hildreth and Oswald (1997) show that changes in profitability lead to lasting changes in wages.

Reid (1934) is a seminal work on the economics of household production. It was revived in the works of Gronau and others. The theory of home production, as surveyed by Gronau (1986), points to household production as important for five issues: '*... the theory [models with explicit household production], the allocation of time, the allocation of goods, the value of time and the value of home production.*' Gronau (1997) highlights the enlarged body of literature along these lines during the last ten years. The theory of household production has had a direct effect on the understanding of female labour force participation and the amount of hours for household production, paid work and leisure. It has also encouraged work to estimate the value of produced (and consumed) household production. Studies have tried to assess the magnitude of household production at a national level (related to paid production measured by GNP) for many industrialised and developing countries.

I find it puzzling that current economic thinking treats household production and industrial production with quite different approaches and concepts. For instance, the production of bread is dealt with differentially according to whether or not the loaf is later eaten by the family that produced it (household production) or by strangers (bakery production, which is analysed by production and market theories). The association of a household with a consumption unit has created a theory of the allocation of time and household production that partly hides the parallel between production processes in firms and in households. A notable exception is Leibowitz (1974, p.246), who uses time-budget data and household resources like appliances and schooling to estimate time spent on laundry. *'For example, the housewife who uses a non-automatic washer spends thirty-nine minutes more in washing than one who uses an automatic washer. More educated women have more and better quality capital goods, but even with these factors held constant in the regression, education still serves to decrease time inputs to laundry work.'*

In the household sector, much of the theory has failed to distinguish between market inputs of raw material and those of production capital (like the flour and the oven in bread production). Lancaster (1966) introduced a new consumption theory, and Becker (1965) introduced time and commodities as sources of utility in a slightly different consumption theory. Gronau (1986, p.275) comments on the difference in approaches: *'On the face of it, the difference between Becker and Lancaster (ignoring the one between the nature of inputs) may seem merely semantic. But as pointed out by Pollak and Wachter (1975) and Atkinson and Stern (1979), the differences go much further; they relate to the nature of the production process converting market inputs into characteristics of commodities. The focus is on the degree of 'jointness' in production: whereas Lancaster assumes perfect 'jointness', Becker rules out 'jointness' in production. While the characteristics approach regards goods as 'public inputs', whose marginal productivity in the production of any given characteristic is not affected by its serving as inputs in the production of another characteristic, Becker's approach derives much of its analytical power from the assumption that goods serving as inputs in the production of one commodity cannot be utilised in the production of another. These two extreme assumptions on 'jointness' in production lead to two completely different sets of conclusions.'* Blaug (1992, p.149) concludes for Lancaster's theory of consumer behaviour: *'There is little doubt that the Lancaster theory is richer in content than the old, which is hardly surprising since it includes the old as a special case, but it is far from clear that this increase in generality is accompanied by new substantive results of a testable kind.'*

Becker (1965) has inspired various researchers. For example, Michael (1970) models how education shifts the production function of consumption (also mentioned by Becker, 1975, p.67), but Gronau (1986, p.67) criticises Michael's empirical testing. Cigno (1990) starts from Becker (1965) and makes one-person and two-person models of the allocation of time. In the intuitive introduction, Cigno (1990, p.7) considers time for household production and consumption: *'For example, a meal at home requires various ingredients and appliances to prepare it, and time in which to prepare and consume it.'* Cigno divides total time into two categories, market labour and home time. However, he concludes on p.16: *'In a two person household, however, it is possible that one member will have a wage rate higher than the shadow-wage rate (common to both members of the household) and will thus specialise completely in paid work. Leaving all the domestic chores to the other.'* Considering that home time contains time spent in household production and leisure (in Gronau's division of time), I think the implication of Cigno's result is more severe than simply leaving household production to the spouse. It also seems to imply that the person has no home time in the sense of consumer time (leisure). Starting from the standard model of consumer theory, where time is divided into paid work and leisure, Rupert et.al. (2000, p.576) concludes: *'Our results suggest that life cycle studies that ignore home production can lead to biased parameter estimates. Estimates of the intertemporal labour supply elasticity based on models that take home production explicitly into account are significantly larger than those from models that ignore home production.'* Rupert et.al. (2000, p.560) explicitly mentions that the dichotomous characterisation of time use masks some important features of how time is allocated across activities, and therefore they explicitly include time spent in home production. Neither Cigno (1990) nor Rupert et al. (2000) references any work by Gronau. I consider the approach of Gronau (1973, 1977) to be very efficient. He categorises time into wage work, leisure and 'home' production, and introduces production functions of household production, where time spent in household production is the only argument. Gronau (1986, footnote 13), using H to denote the time in 'home' production and X_H for output in such production, mentions: *'It is often argued that an increase in home productivity always increases work at home [Chiswick, 1982]. This is true if the productivity coefficient k is multiplicative [i.e. ... $X_H = kf(H)$]. It need not necessarily be true if the productivity change is resource saving [i.e. $X_H = f(kH)$].'* Therefore I use Gronau's approach with a multiplicative coefficient that produces unique theoretical results.

1.5 The scope of the thesis

An enormous amount of capital and working hours contribute towards household production on a world scale. I intend to show that this has important implications for equilibrium wage rates of different types of competence. Household skills influence wage formation for the so-called unskilled and educational choices of individuals. Occupational wage formation depends upon the degree to which education raises household productivity. Increased competitiveness from an abundant supply of household skills and low entry costs for new firms will lower wages and profits in industries producing substitutes for household production. Family-based industries using household skills and household capital become relatively more important to rural areas when (i) those rural areas face cost disadvantages and (ii) wages in large-scale industry are regulated. Below is a brief outline of the four essays of the thesis.

1.5.1 In-the-home training, household skills and low wages

‘Learning by doing’, in the context of household skills, takes place in the household sector. In some models, learning by doing in household production increases productivity in household production, and intensifies the division of unpaid and paid work between spouses, as in Lommerud (1989). Essay Two goes one step further and formulates that learning by doing in household production is a kind of ‘in-the-home’ training that fosters household skills. Household skills raise productivity in tasks in household production and in similar tasks in paid work. Thereby ‘in-the-home’ training and household skills ‘spill over’ into labour supply and wage formation. ‘In-the-home’ training consists of activities that involve either participation in household production or watching it. Everybody has a degree of these household skills. When Oulton (1996) uses ‘no qualifications’ for people with compulsory schooling, he underestimates the basic skills acquired from upbringing, compulsory schooling and household production. Because Schultz (1961) defined human capital by returns and not by expenditure, in-the-home training escaped the theory of human capital formation. Bowman’s (1966) criticism that this position failed to account for ‘the capacity to do it yourself’ had little impact.

Essay Two contains a formal model of how in-the-home training and household skills may influence educational choice, *ceteris paribus*. It models both long run labour supply and labour demand, and shows how the wages for labour services with household skills and higher education influence the choice of education and occupation. This model predicts that

individuals with much in-the-home training and household skills will not proceed into higher education because of the job opportunities from household skills, and the loss of low wage earnings and own household production. It predicts that individuals with little in-the-home training and household skills will proceed into higher education. It also predicts greater hourly wage differences between individuals with advanced household skills and those with higher education than standard human capital theory. This is due to the loss of household production during higher education and later. For example, this means that girls who have spent a lot of time taking care of children during childhood and youth will tend to drop higher education and take on jobs as a child-care workers, while girls who have spent less time caring for children will enter a teacher programme in higher education. Boys who spent a lot of time repairing bikes and cars during childhood and youth will start to work in a garage or look for an apprenticeship as a car-mechanic. Boys with less household skills will enter programmes in higher education, such as economics. If these new explanations hold, male-dominated occupations that employ household skills are also predicted to offer low wages. While Essay Two concerns the influence of household skills on entering a job or a programme of higher education, Essay Three is concerned with how various types of higher education develop household skills to various degrees, and examines the implications for occupational wage differentials between, for instance, nurses and engineers.

1.5.2 Lower wages when occupational education increases household productivity

The aim of this essay is to discuss variation in wage rates and labour supply among occupations that employ individuals with higher education of equal lengths. The new idea is that variation in wage rates can be partially explained by the observation that educational programmes raise household productivity to various degrees.

There is no doubt that home economics education raises household productivity. However, other kinds of education can have an influence too: (Becker, 1991, p.27): *'...the incentive to invest in [human] capital that mainly raises household productivity is greater when more time is spent in the household sector, and the incentive to invest in [human] capital that mainly raises market productivity is greater when more time is spent at work. Some investments, such as on-the-job training, mainly raise the productivity of market time; others, like classes in child care, cooking, or art history, mainly raise the productivity of household time.'*

However, educational programmes with the aim of producing nurses or pre-school teachers also increase household productivity, and more so than many other kinds of education.

A formal model shows how variation in raising household productivity, *ceteris paribus*, influences recruitment of students, labour supply and wage formation by occupation. The model indicates that occupational education that yields higher household productivity, leads to lower occupational equilibrium wage rate and, consequently, more hours are spent in unpaid household production and fewer hours in the labour market. This is a new explanation of the phenomenon that female-dominated occupations such as nursing and pre-school teaching offer lower wages and supply fewer hours than other occupations with equally long periods of education. Homes can be regarded as demanders for unpaid work and more so the higher the household productivity of the family members. These results have implications for public policy measures concerned with the size of educational programmes. Educational programmes that raise household productivity to a large extent should be dimensioned so as to cover both the demands from the labour market and from household production.

1.5.3 Lower wages in industries producing substitutes for household production

How do firms and employees get compensated when they produce market substitutes for household production? That is the concern of Essay Three. Lately, production theory has influenced estimations of wage equations. Nickell et al. (1994) demonstrate that market power has a positive influence on wage rates. Hildreth and Oswald (1997) show that changes in profitability lead to lasting changes in wages. Going from concentration to entry cost is a small step within industrial organisation. When a specific kind of production takes place in many households, the necessary appliances for household production must have a rather low price for most households to afford them. Small firms that produce substitutes for household production may also be established with household appliances. This would, in turn, lead to cheap capital equipment and low entry costs. Many kinds of household production (food preparation, clothing, laundry, child-care) are common throughout the world and technologies are widespread. Essay Four introduces substitute household production as a contributing factor towards low entry costs and employees with well-developed household skills. Restaurants are good examples of this. But can low wages be explained by low entry costs alone, so that the notion of household skills is redundant? If so, it could be argued that lawyers who start a business from a flat with phone and a PC (household real capital) should

earn low wages. This example illustrates that high wages can be earned even if entry costs are low, and indicates that household skills play a part.

Essay Four presents a formal model of the effects of different entry costs and different availability of labour on profit and wage formation. It introduces a three-stage model where a firm's entry costs become sunk upon entry and monopoly unions set wages. This theoretical model is the core of the essay. The following results are obtained from a three-stage game: In a given industry, high entry costs of new firms lead to few large firms, high profits and high wages in that industry. If industries with substitute household production have low entry costs, they have more and smaller firms than other industries, obtain lower profits and pay lower wages. Essay Four refers to empirical results from the USA, Japan and Norway, in particular those presented in Krueger and Summers (1988) and Dickens and Katz (1987). These estimates are reorganised according to wage level and indicators of entry costs for all industries or manufacturing industries. It transpires that many low wage industries have low entry costs and produce substitutes for household production. These findings support the theoretical model and raise the question: Is degree of substitute household production a hidden dimension of the 'dual economy'? Policy issues include self-employment programmes and minimum wages.

1.5.4 Lower rural wages and profits from home-based entrepreneurs

Rural areas have an industry mix that differs in comparison to urban areas. Shops, restaurants, inns, farms, and so on, are often family-run businesses. Essay Five analyses the mix of wage employment and family self-employment in rural and urban areas. The model has two sectors (wage employment and family self-employment) and two regions (rural areas with a cost disadvantage and urban areas). The model predicts an increased importance of family-run employment in rural areas when manufacturing wages are regulated nation-wide and, in addition, rural capital intensity is maintained through investment subsidies. Empirical results from Norway support these results to some extent.

Regional policies that subsidise capital, together with policies that treat family-members and other employees differently, may reinforce rural self-employment and reduce the demand for regular employees. This conforms to a mobility pattern where people move from rural to urban areas for wage employment and return to rural areas for retirement. Discussions in

regional economics mostly concern demand phenomena. For example, urban areas give more alternatives to individuals with specific occupational skills and can centralise the supply of, say, two-career couples. In the literature discussions do not address the rural bias towards self-employment (both in primary and other industries), which means that a person may have to invest not only human capital but also physical capital to acquire a rural job. Formally, this implies that the division between the capitalist and the worker is not evidenced in rural areas. To have a job with a shadow price similar to the market wage, you must be your own capitalist and receive low profits. This relates to the argument that regional wage differentials may be too small. Unemployment policies and rural development policies that encourage entrepreneurs may reinforce the lack of wage employment opportunities in rural areas in the long run.

1.6 Applications to an industry: tourism

The aim of this section is to illustrate how the findings of the thesis can be applied to one particular household related industry. I will use tourism. Do similarities between tasks in household production and tourism enhance labour supply, the number of firms and competition in tourism? Can we apply the models of these essays to explain how household skills and household capital influence production for tourist markets, and reduce wages and profits in tourism-related industries producing accommodation and meals? The accommodation industry, and the tourism segment in particular, has low entry costs for new firms and utilises household skills as job skills. Bed-and-breakfast establishments constitute the segment that incorporates substitute household production using household skills as job skills and household real capital as a basis for income generation.

In Essay Two I argue that in-the-home training begins in childhood. Some youths with a large amount of in-the-home training and good household skills may choose a job that utilises these household skills instead of entering additional occupational education. According to Baum (1995, p.124-5) many people have had part-time, casual or seasonal work in sectors of the tourism and hospitality industries during their school or college years. Some firms build their human resource policies upon young, transitory staff. Moreover, Lucas (1995) concludes that the hotel and catering industry employ, for the most part, young people. According to Stringer (1981) it is an implicit assumption that the occupation as a bed-and-breakfast landlady requires no training or specific education. In Essay Two, the model concludes that the supply

of labour with household skills, such as chambermaids, depends upon the relative wages of the various jobs that require different types of qualification. These relative wages are also influenced by the demand for different types of skill by various industries. The model shows that jobs with household skills earn relatively low wage rates and supply shorter hours in waged work. More unpaid household production is undertaken by people in order to compensate for the lower earnings in household skilled jobs. As a modelling component 'household skills' provides a novel alternative to the standard 'lack of skills' explanation for the low wage-rate in tourism jobs. According to Riley (1991), the labour force in the hotel and catering sectors consists of 14 per cent managerial and supervisory staff, 22 per cent skilled crafts workers, and 64 per cent semiskilled and unskilled operatives. As indicated by Hammes (1994), real wages did not rise during the development of a large-scale tourism resort in Hawaii because of an elastic labour supply. According to Maher (1995), management rhetoric in the British hospitality industry concerns the value of human resources while the British hospitality industry has high turnover of employees. Studies of the use of household skills as job skills in the tourism and hospitality industries may help to determine the degree to which a lack of household skills is responsible for such high turnover, and whether or not improved screening of household skills or additional on-the-job training are relevant measures.

Consider restaurants as an example of firms with low entry costs. Household food production makes entry costs of real capital low, both to settle down and to establish oneself in business. If it is possible to start a small restaurant with no more equipment than one uses at home for preparing and serving food, the condition for low entry cost is met by the restaurant industry. Low entry costs of real capital for a new restaurant, and the use of employees with household skills, increase the number of new entries and the total number of restaurants. In keeping with the model in Essay Four, competition is therefore high within the industry, and profits and wages are low. Some industries belong to the so-called 'dual' economy and some jobs to the so-called 'secondary' labour market. For firms in the accommodation industry, entry costs may be low for the same reason. This is especially true for small units with fewer facilities, where entry costs are reduced because they are sunk cost to the family in the form of their dwelling or farm. Stringer (1981) reports that the majority of bed-and-breakfast landladies had started business primarily for economic reasons, and that it was chosen because it enabled them to continue living in a large house and because they enjoyed the advantages of being able to work at home. Baum (1995) remarks that it is fair to say the European tourism and

hospitality industry is characterised by small businesses, generally family-owned and managed.

Essay Four presents a three-stage game model that utilises the assumptions of a varying entry costs of firms in different industries and a varying alternative value of workers. This model shows that a lower entry cost for new firms, along with low alternative value of workers, lead to an equilibrium with a higher number of firms in the specific industry, less concentration, lower profits and lower wage rate compared to industries with higher entry cost. If catering and accommodation have relatively low entry costs for new firms, the model predicts that these industries will be less concentrated than other industries, have lower profits, and pay lower wages. The study of the wages and profits of different segments of the tourism and hospitality industry may provide some interesting insights. One could try to measure the degree to which the wage level and profits are related to (i) the entry costs of new firms in each segment and (ii) the share of employees that only require compulsory education and household skills. According to Skalpe and Nysveen (1996), the Norwegian tourism industry experienced four years of growth both in earnings and sales volume in 1991-94 (particularly in the accommodation and catering industries) while profits in the tourism industry were lower than in other private businesses.

The urban-rural dimension is useful because firms in many industries, including tourism, have lower productivity in rural than urban areas. The reasons underlying this difference may be the higher transport costs for rural areas or regional differences in the functioning of the labour and the capital markets. To increase profitability in rural economic activities, and increase rural employment, many countries have regional programmes that subsidize regions and industries. Raising collateral and obtaining a loan may prove particularly difficult for new investments in rural areas. This problem is one of the reasons for capital subsidies in rural areas. Higher transport costs for production from rural areas, or a lack of employees with the necessary skills from vocational and higher education, may be other underlying factors in the rural disadvantage. There are signs that family self-employment in agriculture and other industries such as tourism are more frequent in rural areas than urban areas. One explanation is that wages in manufacturing, and some other industries, are regulated on a national basis, preventing rural labour costs from compensating for other rural cost disadvantages. In this way, regulated wage employment is reduced in rural areas.

In Essay Five, I address the situation where rural areas have a different industrial mix than urban areas. Farms, bed-and-breakfast establishments, inns, restaurants, and so on, are often family-based businesses. The model in Essay Five analyses the mix of wage employment and family-based self-employment in rural and urban areas. The model has two sectors (one with wage employment, the other representing family-based employment) and two regions (rural areas with a cost disadvantage for transport and urban areas). Introducing regulated wages in wage employment while maintaining the rural capital intensity by public capital subsidies, the model predicts increased importance of family-based employment in rural areas. This implies that family-based tourism should be of particular importance to rural areas.

1.7 Methodological aspects

The essays contain formal models where I hold that some assumptions are fulfilled; the mathematical model deduces a statement about an event whose explanation I seek. Such events are 'lower wage rates for some groups' and 'lower profits for some industries'. These essays are written within the hypothetical-deductive model of explanation (see Blaug, 1992, p.4). The propositions of these four essays are, in principle, intersubjectively testable and may be falsified, which is the key criterion for scientific work according to Popper (1965). However, these essays contain no econometric work that can be tested in such a manner. This is because the data sets do not contain the necessary longitudinal information about individual activities at home, in education and in the labour market. Time budget surveys are available. They report the amount of hours spent in various tasks in household production by adults. But, apart from this, data on household production are scarce. However, measurement problems also influence empirical studies of on-the-job training. Blaug (1992, p. 211) discusses training and concludes that '*All in all, it can hardly be said that the human capital approach to training has yet been put to a decisive empirical test.*' He points to the inherent difficulty in empirical work of distinguishing costless on-the-job learning from both informal and formal off-the-job but in-the-plant training. Social scientists collect data sets for studies of regional development, touristic development and so on. By relating the concept of in-the-home training to tourism as discussed in Section 1.6, these new proposals may be evaluated in studies with individual data from interviews and questionnaires. This may start the *ex post*, ordinal comparison of a theory to assess its qualitative 'degrees of corroboration' (Popper, 1965).

The phenomena modelled in these essays have alternative explanations in the economic literature: ‘unskilled’ for Essay Two, ‘compensating wage differentials’ for Essay Three and ‘efficiency wages’ for Essay Four. Therefore, these essays do not reflect *the irrelevance-of-assumptions thesis* of Friedman (1953), which states that the only relevant test of the validity of a hypothesis is a comparison of its predictions with experience. Still, the assumption ‘as if the firm maximises profits’ is used in Essay Four’s model. In this thesis, I differentiate household skills, entry costs, and so on, to explain the extent of low wages and profits more precisely than the alternative theories.

Blaug (1992, p. 206-219) treats human capital theory as a cluster of interconnected theories or as a scientific research programme in the sense of Lakatos (1978). Blaug (p. 217-8) criticises human capital theory and points to five issues, two of which are addressed by my essays: *‘There are certainly grounds for thinking that the human capital research program is now in something of a ‘crisis’: ...; its account of post-school training continues to underemphasize the role of costless learning-by-doing as a simple function of time, ...; its rate-of-return calculations repeatedly turn up significant differences in the yields of investment in different types of human capital but its explanation of the distribution of earnings nevertheless goes on blithely assuming that all rates of return to human capital formation are equalized at the margin.’* Essay Two addresses aspects of costless learning-by-doing by introducing in-the-home training and household skills. Essay Three addresses wage differential with different kinds of equally-long education. The five essays in my thesis yield novel hypotheses concerning how wage and profit formation are influenced by household production, and shed light on some old stylised facts of wage differentials, thereby making this programme theoretically progressive. If the new empirical content is corroborated at a later stage, the human capital and household production programmes are empirically progressive in the sense of Lakatos (1978).

These essays contain partial equilibrium models in the positive, not normative, tradition. However, research output feeds into societal debate of policy measures. For instance, many job vacancies for nurses over a long period make the public sector interested in measures that increase labour supply by nurses. The results of available studies enter the public debate and the decision process for policy measures. If research models do not address the considerations that influence labour supply of nurses, the suggested policy measures are probably not the most effective and efficient.

1.8 Topics outside the thesis

There are various spillovers from household production to wage and profit formation. To concentrate I exclude several issues. I do not address the question of household skills screening, how household production influences demand for market commodities, how the tax system raises household production, the spillovers from household production in developing countries, and arguments that concern the division of consumption, work and leisure within the family. Below I explain why I have chosen to exclude these issues, and point to economic literature where such issues are treated.

Household skills are a type of human capital. As with other kinds of human capital, skills enhancement and the screening of household skills are hard to separate. It cannot be stated a priori whether a problem stems from lack of skills or a lack of recognition. Schools take on skills enhancement and screening tasks. Students get marks in various subjects; these are signals of productivity and useful screening devices for employers according to Spence (1973). Firms screen job skills and on-the-job training and use such information in hiring and promotion decisions. Household skills and in-the-home training have no similar screening. Why trust a paper from a parent stating a high level of household skills of herself or her youngster? This is probably why parental certificates of household skills do not exist. The failure to recognise in-the-home training and household skills (indicated by the term 'unskilled' for jobs and employees) in the economic literature, may be a reason why household skills have not been acknowledged. Lack of recognition of household skills may help explain low wages in substitute household production. Though the issue of household skills screening is highly relevant and interesting, I address the human capital aspect, not the screening of household skills, in this thesis. Therefore I assume that household skills are correctly assessed.

The role of household production is to reduce monetary spending and demand for market commodities at the expense of increased time-use. Families that consume their own bread do not buy loaves from the shop, but flour. Household production is a substitute for market products that reduce potential demand for finished products and raise demand for raw materials and energy. Aslaksen and Koren (1996) report that an uneven distribution of disposable income among groups will often turn into a more even distribution of extended income when the value of unpaid household work is added. They discuss how consumption

expenditures can be allocated to various kinds of household activities, using data from time-budget analyses and consumer expenditure surveys. Since most families may produce a loaf of bread or take care of their own children but are not able to build a television set, demand for products and services are influenced to various degree by household production. However, the influence of household production on this product-specific demand is not an issue in this thesis.

Because unpaid household work and home made commodities are not taxed, while production in firms is subject to pay-roll and value-added taxes, and wage earnings are reduced by income tax, the tax system is crucial to the economic trade off in households between 'make' or 'buy'. The economic literature contains several contributions on the tax wedge between paid and unpaid work. Examples are Boskin (1975), Sandmo (1990), Apps and Rees (1999a, 1999b, 1999c) and Kolm (2000). In Dale (1984) I illustrate the magnitude by which the Norwegian tax system raises returns to 'doing-it-yourself' and contributes to the high level of household production in Norway. In the discussion of the allocation of time in Essays Two and Three, the relevant wage rate is the wage rate after deduction of income tax and the product price includes value-added tax. Still, I have excluded taxes as an issue in this thesis.

Presumably, spillovers from household production to wage and profit formation are more important in developing countries. This is because in-the-home training becomes more important for adults and working children when education is non-universal. A lack of credit systems will reinforce entry into household related businesses where entry costs are small. Family and other businesses escape various kinds of labour regulations. Family businesses like farming, tourism, retailing, homeworking, and so on, constitute a larger share of production. Modern economies typically have higher GNP per capita and wealth per capita. Therefore, the formalisation of the household production function in this thesis, omitting appliances and housing, assume a condition that is more often binding in developing economies. Discussions in several of my essays rely on the assumptions that perfect substitutes for household production are available in the markets for commodities, and that all adults can acquire some kind of job in the labour markets. In an absolute sense, these assumptions are probably not fulfilled anywhere, but the functioning of modern economies comes closer to fulfilling these assumptions than those of most developing countries. Lack of money for basic necessities and, thus, starvation are more frequent in developing countries. Therefore, the formalisation of the household production function used in this thesis, omitting

expenditures for raw materials, is better suited for a modern economy with effective labour markets and social security. The combination of farming and household production is the primary way of living for a larger share of the population in developing countries. Because of the wider scope of 'household production' when farming is added, and realities like child labour and starvation, there is a large supplementary literature that would have to be considered to address spillovers. There is also likely to be a difference in the type of technology used in household production. I have therefore decided to omit findings from developing countries. However, I think that concepts like in-the-home training, household skills and low entry costs for new firms in substitute household production are most important in the understanding of wage and profit formation in developing countries.

The thesis focuses on different kinds of spillovers between unpaid and paid work in individual human capital and household real capital. I address human capital formation by children where the childhood family is central. To this end, I include an appendix to justify that I omit the broad literature on the intra-family allocation of consumption, leisure, wage work and household production; see, for example, the survey by Agarwal (1997). The appendix, which contains my paper, 'A model for the allocation of time within the family,' in its original version (Titlestad, 1983)¹ starts by assuming that all products from household production have perfect substitutes in commodity markets. The paper integrates the models of Gronau (1973 and 1977). The model uses a family utility function and shows that the spouses' allocations of household production and market work are not influenced by the productive characteristics of the partner, but by the individual's own wage rate and productivity in household production. Chiappori (1997, p.194) states that a crucial issue is whether the goods produced in household production can be bought and sold on the market or is household specific. Public and private provisioning of substitutes for household production have increased over time in industrialised countries. In my opinion, the assumption of perfect market substitutes for household production seems increasingly realistic in many industrialised countries.

1.9 Gender equality

At first glance, the propositions of this thesis may seem counter to the general policy of 'equal pay for jobs of equal worth'. To the extent that productivity is raised in household production, the notion of equal wages become less important. These essays illustrate that there is probably a greater correspondence between unequal pay by gender and the gendered segregation of

household skills, household tasks and occupational segregation. Jonung (1997) discusses the approaches in economic studies towards occupational segregation and wage differentials by gender. To achieve equal wage rates between men and women, equal levels of household skills and equal participation in industries producing substitute household production may be a necessary condition. One way to maintain the importance of equal wage rates, and fulfil it, can be illustrated in a science fiction scenario by transferring all household production into substitute household production. If children and adults learn no household skills and do no household production, demand for market substitutes for household production will increase. Moreover, firms will wish to recruit employees with domestic science education or firms will supply household skills as 'on-the-job' training. Firms will be eager to pay higher wages to reduce turnover. In this way, household skilled labour will no longer be in abundant supply, and domestic science education will have transformed into an occupational education!

Industrialised economies may already be heading towards this scenario by reducing in-the-home training and household production, but some new kinds of in-the-home training are emerging – like computer science, which is male-dominated. The optimistic message to parents is that a lack of household skills teaching for children (especially girls), with household services bought-in, may help towards long-term gender equality in the labour market.

These essays model one-person households. They do not model households with two adults and dependent children, nor the sharing of consumption. Consumption and production differ for an individual because of the differential treatment of paid and unpaid work by tax and social security systems. Therefore, conclusions from the formal models in this thesis do not answer the complex question of equality by gender. If women have more household skills, on average, than men, it may outweigh men's advantage in on-the-job training. Gender equality in amount of human capital seems to be greater than perceived in labour economics and feminist economics. Economic justice between women and men ultimately depends on the lifetime division of outputs like consumption and leisure.

1.10 References

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ESSAY 2

IN-THE-HOME TRAINING, HOUSEHOLD SKILLS AND LOW WAGES

by

Kristin Dale¹

Abstract

This essay presents a new, supplementary explanation of occupational choice and occupational wage differences. In-the-home training creates household skills that increase productivity in both the household and occupations with tasks similar to household production. A model shows that individuals with more household skills do not to enter higher education, choose household skilled jobs in the labour market that pay lower wages and work shorter hours than predicted by human capital theory. This stems from the effect that the future earnings of higher-educated employees must not only compensate for costs and foregone earnings during education, but also absorb the indirect costs of lower household production while studying and later in life. Empirical findings from industrialised countries are presented that highlight the gender-biased pattern of household production and of similar low wage occupations. Finally, I argue that household skilled jobs constitute the 'secondary labour market' in the 'dual labour market' theory.

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2.1 Introduction

When a mother teaches her daughter to make a bed or clean a bathroom, it is probably to create a 'helping hand' while the daughter lives at home, and train a potential wife. In-the-home training encourages skills that make a girl independent of hiring a maid in the future. However, the unintentional effect of in-the-home training may be to influence the choice of education and occupation and to lower wage rates for room-maids in the hotel industry and in other dual labour market jobs. This illustrates the new idea in labour economics presented in this paper. The idea is that in-the-home training creates household skills that also qualify for some occupations, thereby influencing labour supply and wage formation in occupations that utilise household skills. Individuals with more household skills have smaller incentives to enter education for other occupations, since the future earnings of higher-educated employees must not only compensate for costs and foregone earnings during education, but in addition absorb the indirect costs of lower household production while studying and later in life.

The field of labour economics explains the low wage rate of, for instance, room-maids as a result of unskilled labour and female crowding. Is there a demand dimension of female crowding in occupations? According to Rathbone (1917) and Edgeworth (1922) female wage rates were kept low by monopsonistic discrimination because women were excluded from 'male' professions by unions and employers. Thereby women were crowded into very few occupations. Bergmann (1974) argues that monopsony power still is important to women in local labour markets. Despite modern equal opportunity legislation, Rosén (1997) models how fewer job-offers to women yields discrimination. Is there a supply dimension to gendered crowding? Treiman and Hartman (1981) address individual choice of occupation under social and economic constraints and point to how socialisation creates gendered crowding in occupations.

Here I will study such a process by the concepts of 'in-the-home training' and 'household skills'. The child's gender, the family and the community influence a child's activities during up bringing. Therefore, in-the-home training and household skills vary according to gender and other factors. Individuals with gendered in-the-home training and household skills create supply side gendered crowding towards certain occupations. For example, many women apply

for jobs caring for children and few apply for jobs in car repair. The opposite is true for men. This reflects gendered tastes and in-the-home training during upbringing and adolescence. Not only will there be female crowding in jobs that utilise female-dominated kinds of household skills. There will also be male crowding in jobs that utilise the kinds of household skills where men are over-represented and, according to my model, these jobs will also have low wage rates compared to other male jobs. This essay addresses the paradox that household skills may result in low wages due to supply and demand circumstances.

Introducing in-the-home training creates a bridge between two parallel traditions in economic literature of explaining variation in individual earnings. Mincer (1958) started the earnings function tradition when he related individual wage rate to individual employee characteristics. The alternative approach stems from the study of income immobility across generations. Solon (1992), for example, reported a high positive correlation between the incomes of sons and fathers. However, there is a missing link between the independent variables in the two alternative explanations: the characteristics of the parenting family and of the individual. Biologists call the missing link genes. Sociologists call them socialisation. In economics, ability and learning-by-doing capture some of these aspects. The term in-the-home training captures a skill formation process influenced by the parenting family and thereby links children's skill formation to parents' skills.

This essay contains seven sections. Section 2.2 introduces the concepts in-the-home training and household skills and relate them to the human capital literature. Section 2.3 presents a formal model that shows that youth with more in-the-home training and higher levels of household skills are less inclined to attend higher education because of loss of household production. They are willing to accept lower wage rates in household skilled jobs than predicted by standard human capital theory. The analysis shows how wages and labour services are determined in a general equilibrium model. Since household production varies among individuals, Section 2.4 addresses the variation in in-the-home training and household skills among women and men, and among girls and boys. Section 2.5 presents empirical support for the link from household skills to low wage occupations. Section 2.6 discusses some dynamic effects of changing household skills. Section 2.7 contains concluding remarks.

2.2 In-the-home training and household skills

2.2.1 Definitions

In-the-home training refers to the learning of different kinds of household skills that increase productivity in various household tasks. In-the-home training is achieved through observation, teaching or doing household production. A parent's teaching or a child's trial-and-error learning both raise the productivity and quality of home made products and services. The kinds of skills that are acquired through in-the-home training depend on the kind of economy (century, country, and so on). This paper focuses on modern, industrialised economies and such types of household production as caring for babies and dependants, cleaning, cooking, driving, gardening, laundry, car maintenance, house maintenance, shopping, production and repair of clothes. In economics the home is the primary site of consumption and leisure but not production. Instead, I follow the distinction made by Reid (1934, p.6-7): household production is what you would like somebody else to do for you (i.e. cleaning) as opposed to consumption and leisure activities that you prefer to do yourself (i.e. reading the newspaper).

Table 2.1 Productive activities of households in the US in the 1930s

A. Management:

1. Choice-making.
2. Income apportionment, or budgeting.
3. Task, time, and energy apportionment.
4. Planning ways and means of carrying on tasks.
5. Actual direction of the tasks including supervision.

B. Performance:

1. Clerical work in connection with management, e.g., the checking and paying of bills, preparing instructions for workers, the keeping of accounts, and making of other records.
2. Purchasing of food, clothing, equipment, furnishings, and other goods required by the household or by the individual members of the household group.
3. 'Housework':
 - a. Preparation, serving, care and preservation of food, and clearing away of meals.
 - b. Construction and repair of clothing and furnishings, including such tasks as sewing, mending, darning, and 'fancy work'.
- c. Cleaning and care of the house, furnishings, clothing, and equipment, including laundering, daily, weekly, and special cleaning, care of the fires, disposal of waste, repair work of various kinds, care of pets.
4. Work outside the house, e.g., care of the house surroundings, gardening, dairy and poultry work, operation and care of car.
5. Care of the members of the family not included above:
 - a. Physical care of children and the sick.
 - b. Child training and education, including supervision of play.
6. Going and coming on household business, answering the telephone, the door, receiving packages, being on call or present in case of need, e.g., remaining in the house because of a sleeping child.

Source: Reid (1934), pp. 75-76.

Within one country household skills vary over time, for instance from the beginning to the end of the twentieth century. Reid (1934) is an elaborate book on the economics of household production using the USA of the early 1930s as an example. In Table 2.1, Reid lists child training and education under point B5b among household tasks. According to Reid (1934, p.149), there has to be more-or-less direct contact between producer and consumer, e.g., a mother bathing or teaching a child. The personal care and training of children and care of the sick and aged are the principal types of service production carried out by family members. Reid (1934, p.128) also speaks of tasks added for training purposes: *'Tasks may also be included in household production because of the opportunity afforded for child training and education. Gardening, poultry raising, cleaning, and other tasks are frequently assigned to the members not primarily because of the money they saved, but because of the educational opportunities afforded.'* Child training aims at household and farming skills. Reid does not emphasise the usefulness of these skills for paid employment.

Education and in-the-home training are different sources for skills. Musicians exemplify the combination of education and in-the-home training. Children who rush their homework to baby-sit or repair a bike show that household skills may be acquired at the expense of school achievements. How different sources of skills interplay is an empirical question. Becker (1991, p.27) discusses the incentive to choose classes during compulsory education: *'the incentive to invest in [human] capital that mainly raises household productivity is greater when more time is spent in the household sector, and the incentive to invest in [human] capital that mainly raises market productivity is greater when more time is spent at work. Some investments, such as on-the-job-training, mainly raises the productivity of market time; others, such as classes in child care, cooking, or art history, mainly raise the productivity of household time.'* However, classes in cooking increase household skills and thereby productivity in jobs as a kitchen help, whereas classes in child-care also increase productivity in jobs as a nursery assistant.

2.2.2 Theoretical precursors: human capital and household production

Smith (1776, chapter 10) suggests that the expense and difficulty of training and education influence wages for various occupations. Human capital theory also recognises foregone earnings as part of the human capital investment. According to Mincer (1958) and Schultz (1961), education is acquisition of human capital that raises productivity and returns in the labour market. It remains unresolved the extent to which higher wage rates of more educated individuals are due to increased labour market productivity consistent with human capital theory (Schultz, 1961) or to the signalling effects of education (Spence, 1973). Both theories argue that it is rational for the student to acquire schooling to the point where the present value of additional education equals its cost. Education and training often include some evaluation of the skills acquired. The evaluation is undertaken by teachers and exams, and by supervisors in the workplace for on-the-job training. If workers are screened according to their actual skills, the signalling effect of education is less important. Work experience (Mincer, 1974; Mincer and Polachek, 1974) and on-the-job training also tend to increase wages. Becker (1975) refined the understanding of on-the-job training by dividing it into firm specific and general on-the-job training. Lynch (1991) used the term off-the-job training for work-related courses that employees attend outside work to enhance skills. Education, on- and off-the-job training represent formalised human capital acquisition. On-the-job training is a central concept in labour economics despite serious measurement problems, see Baron et al. (1997). Experience represents informal learning. Marsick and Watkins (1990) introduce informal and incidental learning in the workplace and employees' dysfunctional learning from growing up with parents abusing alcohol. Reid (1934, p.124) suggests that the same skills are useful both in market work and household production: *'The man who is skilled in 'manual training' is more likely to do the general repairing of the house and furnishings, and the woman who can construct a garment with ease to do the home sewing, than they would if their ability in such productive processes were undeveloped.'*

Schultz (1961) discusses the concepts of human capital and investment in human capital. Because it is problematic to distinguish expenditure for consumption and investment, he estimates investment in human capital by its yield, not like real capital by investment expenditure. Bowman (1966, p.114) criticises human capital theory for limiting the returns to labour earnings by excluding the increased income in kind from household production such as

home carpentry, completing the income-tax form and subsistence farming. Inspired by Becker (1965) and referred to by Becker (1975, p.67), Michael (1970) develops a model where education influences consumption and acts as an environmental factor that shifts the production function of consumption. Gronau (1973, 1976 and 1977) pioneered studies of household production to understand female labour supply. Later Gronau (1986 and 1997) surveyed the economic literature on household production. It focuses upon household skills for adults within the household sector. According to Chiswick (1982), the productivity of individuals engaged in home-production activities varies. High productivity may lead to complete specialisation as a housewife. Lommerud (1989) shows that learning by doing in household production and market work increases work specialisation between spouses over time. As indicated by Vagstad (2001) the spouse who does not specialise in household production has strong disincentives for household skill acquisition. Neither mentions that learning by doing in household production qualifies for some paid jobs. However, the social science literature on entrepreneurs mentions various kinds of household skills as resources for women starting a business. Kaur and Hayden (1993, p.102) affirm: *'Women are therefore attracted to businesses which utilize their skills (many of which have been learnt in the context of domestic and voluntary work; for example, sewing, cleaning, cooking), and which draw on their existing social contacts and moreover can take place from a home base.'* According to Johnson and Storey (1993), female entrepreneurs perform as well as men, despite women having less on-the-job training and experience. Female entrepreneurs are over-represented in retailing, lodging, catering, repair and other services, i.e. in businesses selling substitutes for household production where household skills are relevant job skills.

If human capital had been identified through investment costs in the first place, time-use by family members might also have been studied. Leibowitz (1974 and 1977) shows that investment by mothers in reading and pre-school activities improves a child's ability to learn in school. However, I have found no studies of how other skills children learn at home influence their schooling or work career. Does in-the-home training influence occupational and educational choice? My model deals with this question.

2.3 A model of occupational choice

I begin by modelling how the level of household skills achieved during childhood prior to entering an occupation may influence a person's decisions concerning occupation and education, *ceteris paribus*. I assume that home-made products and market products (which price is normalised to one) are perfect substitutes for one another. I want to study the conditions under which the person is indifferent between two occupations, one for which household skills matters and another for which they do not. For the purpose of illustration, these occupations will be referred to as 'chambermaids' and 'economists'. This indifference condition for occupational choice departs from the standard result of human capital theory by taking account of differences in household production. Secondly, to model the equilibrium wage rate, the labour supply is characterised by variation in household skills - captured by introducing a distribution of household skills into Roy's (1951) model for occupational choice. Labour demand is modelled using an aggregate production function. Supply and demand determine the wage rates of economists and chambermaids and the allocation of individuals to the two occupations.

In the model investigated here, a person decides upon further education and occupation at the age of eighteen. Apart from all the other occupations in the real world, in this simplified model an individual can choose between two alternatives. Either she can use her household skills to obtain a job as a chambermaid, or she can attend a five-year programme and become an economist. Assume that the chambermaid will work from age 18 to 60 and the economist from age 23 to age 60. To evaluate the economic situation in a lifetime perspective in these two cases, I assume access to perfect capital markets so that the alternatives can be compared by discounting. To simplify the modelling, I make the following assumptions:

- For schooling, costs for fees and books are zero.
- Students live in dormitories and do no household tasks and have no jobs while studying.
- In real terms, the pay rates are constant over time for each profession.
- Household productivity does not increase from learning-by-doing as an adult.
- The number of working days per year is constant.
- The interest rate is constant.

These simplifying assumptions enable us to transfer the analysis from a lifetime perspective to a representative period.

2.3.1 The chambermaid case

Firstly, assume that the person chooses to capitalise on her in-the-home training and become a chambermaid. I have analysed the maximisation of utility and the allocation of time to paid work, household production and leisure in Essay 3. Here I simplify the problem with the assumption that the total working hours available for paid and unpaid work are fixed at a certain number of hours independent of occupation (for example, 12 hours per workday). The chambermaid's choice is then the allocation of time between paid work in a hotel and household production to maximise lifetime consumption. Further, assume that household production, $a_i f(H)$, consists of two elements, an individual productivity coefficient (a_i) and a general household production function, equal for everybody. The household production function $f(H)$ increases with the number of hours (H) spent at household tasks, but at a decreasing rate because everyone starts with the tasks where the productivity is the highest. However, individuals have different in-the-home training, which implies different individual levels of household skills (a_i). For simplicity, the modelling assumes an interior solution where the number of hours in household production and in wage work both are positive. Assume further that chambermaids sell room-cleaning services in a competitive labour market at the piece rate (v). Then the wage rate as a chambermaid is determined according to actual household productivity in a piece-rate system. Generally, correct assessment of household skills is unrealistic, but this assumption keeps the analysis on the human capital track, by abstracting from screening aspects.

In this one-person model, an individual with only in-the-home training seeks to maximise lifetime consumption. According to the above assumptions this implies maximising total output from household production and wage work per working day:

$$\text{Max}_H [a_i f(H) + (12 - H)a_i v], \text{ where}$$

a_i = household productivity of person i , through her household skills and in-the-home training

$f(H)$ = the household production function, $f(0) = 0$, $f' > 0$ and $f'' < 0$

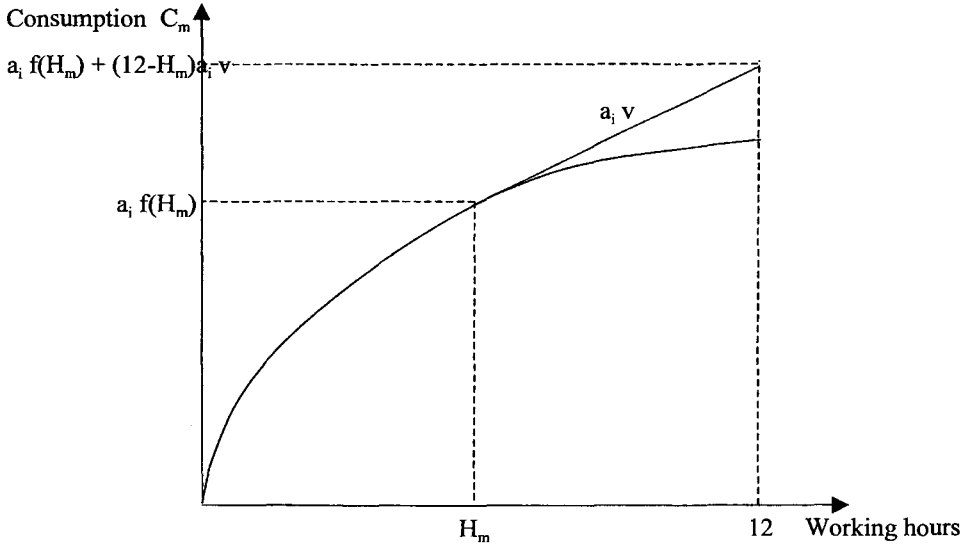
H = the number of hours in unpaid household production

$(12-H)$ = the number hours spent in paid work

v = the piece rate per cleaned room in the labour market for chambermaids

k = the number of working days per year (constant)

r = the interest rate (constant)

Figure 2.1 The chambermaid: allocation of time to household production and paid work

To maximise total output that the chambermaid can consume, she works unpaid at home for H_m hours to generate household production, $a_i f(H_m)$. She works $(12 - H_m)$ hours in the labour market as chambermaid. For these hours, the real wage rate, $a_i v$, is higher than the marginal productivity in additional household production. Total output is maximised by combining household production and paid work because the decreasing marginal productivity of household production makes the first unpaid tasks more productive than the later ones. Note that the optimal number of hours spent in household production (H_m) is independent of the level of household skills when the employer pays a piece rate per cleaned room.

Formally, the results can be established as follows. Given the assumptions, the chambermaid maximises lifetime consumption:

(1)

$$\begin{aligned} \text{Max}_H C_m &= \text{Max}_H \sum_{t=18}^{60} \left\{ \frac{[a_i f(H) + (12 - H)a_i v]k}{(1+r)^{t-18}} \right\} = \text{Max}_H [f(H) + (12 - H)v]a_i k \sum_{t=18}^{60} \frac{1}{(1+r)^{t-18}} \\ &= \text{Max}_H [f(H) + (12 - H)v]a_i k A_1 \end{aligned}$$

Here A_1 denotes the present value at the age of eighteen of \$1 every year (from age 18 to 60).

For a chambermaid the first order condition for maximum consumption is:

$$(2) \quad \frac{dC_m}{dH} = [f'(H) - v]a_i k A_1 = 0$$

This means that H_m satisfies

$$(3) f'(H_m) = v$$

or $H_m = H(v)$ where H is the inverse function of f' , implying that $H' < 0$. The optimal number of hours in household production and in wage work for chambermaids depends only on the piece rate per cleaned room, and is notably independent of individual household productivity.

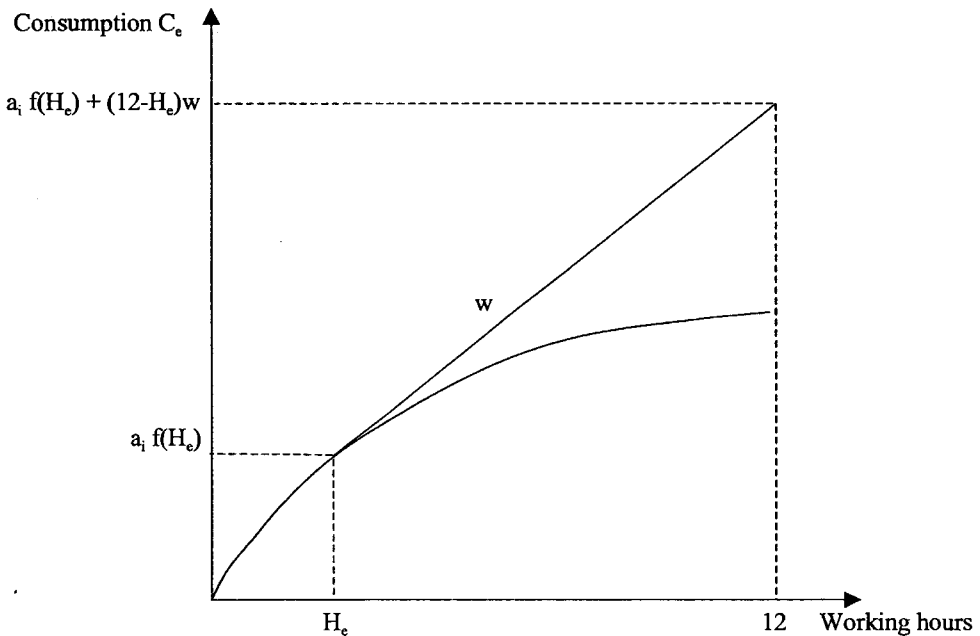
2.3.2 The economist case

As an economist, the person has had some in-the-home training and five years of higher education in economics. We assume that all people that enter higher education graduates according to schedule. Having graduated she wants to maximise consumption and total output from household production and labour income in this one-person model:

$$\text{Max}_H [a_i f(H) + (12 - H)w]$$

where w equals the wage rate of economists in the labour market.

Figure 2.2 The economist: allocation of time to household production and paid work



As economist, the optimal allocation of hours to household production and wage work depends on the wage rate of economists and on the individual household productivity (a_i).

Given the assumptions, the formal results can be established as follows. The economist maximises lifetime consumption:

$$(4) \text{Max}_H C_e = \text{Max}_H \sum_{t=23}^{60} \left\{ \frac{[a_i f(H) + (12-H)w]k}{(1+r)^{t-18}} \right\} = \text{Max}_H [a_i f(H) + (12-H)w]k \sum_{t=23}^{60} \frac{1}{(1+r)^{t-18}}$$

$$= \text{Max}_H [a_i f(H) + (12-H)w]k A_2$$

Here A_2 denotes the present value at the age of eighteen years of \$1 every year (from age 23 to 60) for an economist. The first order condition for maximum consumption is:

$$(5) \frac{dC_e}{dH} = [a_i f'(H) - w]k A_2 = 0$$

This implies that

$$(6) f'(H_e) = \frac{w}{a_i}$$

or $H_e = H(w/a_i)$. At the optimal hours of household work for the economist, the slope of the household production function equals the market wage rate divided by the person's household productivity. For economists the optimal number of hours spent in household production decreases with the increasing wage rate and increases with increasing household productivity of economists.

2.3.3 Chambermaid or economist?

At the age of 18, the individual must decide whether to start in a job as a chambermaid or to attend an economics programme. Comparing the future outcomes for the chambermaid and the economist, the economist faces delayed earnings and fewer income years. Due to the simplifying assumptions, we can transfer the analysis from a lifetime perspective to a representative period model by using the factor δ where $\delta = A_2/A_1$.

$$(7) \delta = \frac{A_2}{A_1} = \frac{\sum_{t=23}^{60} \frac{1}{(1+r)^{t-18}}}{\sum_{t=18}^{60} \frac{1}{(1+r)^{t-18}}} < 1$$

The ratio δ captures the different number of years and the delays of household production and earnings, due to education and the influence of the discount rate, r . Because the economist has fewer years of production, these years start later, and the discount rate is positive, δ is less than 1. Therefore, the economist must have higher yearly total production and earnings for a person to be indifferent between becoming a chambermaid and an economist. The factor δ

captures this. Therefore, we multiply the output of a workday for the economist by δ to compare to the output of a workday for the chambermaid. Let a^* denote the household productivity of a person that is indifferent between the two occupations for a given v and w . To be indifferent between becoming a chambermaid and an economist, the following must hold:

$$(8) \text{Max}_H [a^* f(H) + (12 - H)a^* v] = \text{Max}_H \{[a^* f(H) + (12 - H)w]\delta\}$$

Figure 2.3 Indifference between two occupations: chambermaid and economist

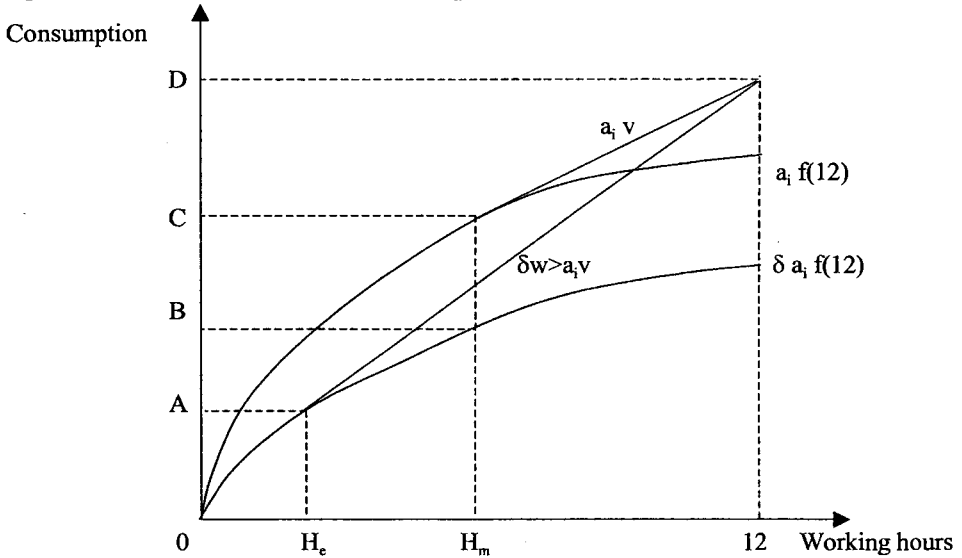


Figure 2.3 illustrates the comparison of the optimal workday of the indifferent person as a chambermaid and as an economist. To be indifferent between the two occupations, the adjusted workday output representing consumption must be equal for both occupations (D). Both spend some hours in household production and some in the labour market.

Consider the ratio of discounted value of household production in the chambermaid and the economist alternatives:

$$(9) \frac{OC}{OA} = \frac{OA + AB + BC}{OA} > 1$$

In this equation, OC represents the optimal household production by the chambermaid. OA represents the optimal adjusted household production by the economist. AB is the

chambermaid's additional household production, due to higher productivity and longer hours, and BC represents more years in household production by the chambermaid. Hence, for an individual that is indifferent between becoming a chambermaid or an economist it follows that the discounted lifetime value of household production is higher if she chooses to become a chambermaid. It is higher because of the longer daily hours in household production and because of the value of the household production during years when she did not study.

Consider the ratio of discounted lifetime earnings between the two occupations in the case of an indifferent individual. From Figure 2.3, we see that the ratio of discounted lifetime earnings between the chambermaid and the economist is less than one:

$$(10) \frac{CD}{AD} = \frac{a * v(12 - H_m)}{\delta w(12 - H_e)} < 1$$

since 1) $a * v < \delta w$, and 2) $H_m > H_e$.

The individual is indifferent between the lower lifetime earnings as a chambermaid and the higher lifetime earnings as an economist because an opposite difference in lifetime household production compensates for the earnings difference. This violates the standard human capital result that an individual is indifferent towards jobs with equal discounted lifetime earnings.

These results are formally established from the given assumptions by studying an individual that is indifferent towards the two occupations. By combining (8) with (3) and (6) it follows that this individual must satisfy $a_i = a^*$ where a^* is determined by:

$$(11) a * f(H_m) + (12 - H_m) a * f'(H_m) = [a * f(H_e) + (12 - H_e) a * f'(H_e)] \delta$$

Now divide by a^*

$$(12) f(H_m) + (12 - H_m) f'(H_m) = [f(H_e) + (12 - H_e) f'(H_e)] \delta$$

and take into account that $\delta < 1$,

$$(13) f(H_m) + (12 - H_m) f'(H_m) < f(H_e) + (12 - H_e) f'(H_e)$$

From the property that

$$(14) \frac{d}{dH} [f(H) + (12 - H) f'(H)] = f'(H) - f'(H) + (12 - H) f''(H) = (12 - H) f''(H) < 0$$

it now follows that $0 < H_e < H_m < 12$. Hence, the indifferent individual works longer hours at home if she takes on a chambermaid job than if she becomes an economist, and vice versa in the labour market. The new result about wage rates from this model is that:

$$(15) a^*f'(H_m) = a^*v < \delta w = \delta a^*f'(H_e)$$

To show (15), firstly use (12) to obtain:

$$(16) 12[\delta f'(H_e) - f'(H_m)] = [f(H_m) - H_m f'(H_m)] - \delta [f(H_e) - H_e f'(H_e)]$$

Since $H_m > H_e$, and $\delta < 1$, and also

$$(17) \frac{d}{dH} [f(H) - Hf'(H)] = -Hf''(H) > 0$$

it follows that the right-hand-side of (16) is positive. Hence, the left-hand-side of (16) is also positive, consequently, $\delta f'(H_e) > f'(H_m)$.

In accordance with human capital theory, the wage rate as an economist is higher than the lifetime adjusted wage rate as an economist. However, it is not in accordance with human capital theory that the individual is indifferent between the two occupations when the hourly pay as chambermaid is lower than this lifetime adjusted wage rate of economists. This result shows that individuals who utilise their household skills as job skills may be willing to work for a lower hourly wage rate than previously modelled. To achieve a balance between occupations the individual works fewer hours as a chambermaid than as an economist and uses her household skills to a larger degree in household production as chambermaid.

Figure 2.4 How the level of household skills influences entry into higher education

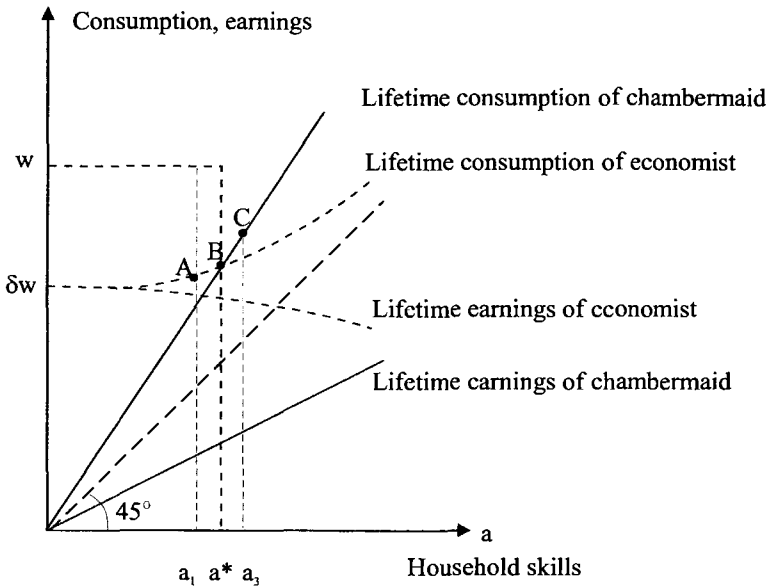


Figure 2.4 illustrates how different levels of ex-ante household skills (a_i) may influence the decision to choose further education. At the level of household skills a^* the individual will be indifferent towards becoming a chambermaid or an economist because the discounted lifetime consumption is equal for both occupations. If she has a lower level of household skills, like a_1 , she will choose the economics education to obtain A, the maximum lifetime consumption. If she has a higher level of household skills, like a_3 , she will choose to become a chambermaid to obtain C. The new idea is that people choose to enter education because they have poor household skills and therefore few opportunities in the labour market without acquiring further education. Note that a person with higher household skills (a_3) not only has lower discounted lifetime earnings than a person with lower household skills (a_1), but also earns a much lower wage rate: $a_3 v < \delta w < w$.

2.3.4 The aggregate production function and demand for inputs

To address demand for economist and chambermaid services, I use an aggregate production function where the following notation is used:

$$(18) Y = G(M, N)$$

Y = output

M = the total number of rooms cleaned per day

N = the total number of economist hours per day

G is homogenous of degree one; i.e. constant returns to scale, and the usual neo-classical properties are assumed. Now, assume perfect competition and that Y is a numeraire, i.e. all prices are measured in terms of Y , and the price of Y is equal to 1. Under these assumptions profit maximisation yields zero profits and implies that costs are minimised given output and factor prices v and w . Furthermore, for each input, the input price (measured in Y) equals the input's marginal productivity.

By definition of M , $M+N$ is neither measured in time nor is a constant. Therefore, to address how factor demand influences wage formation in equilibrium, I analyse how the ratio of inputs, economist hours per cleaned room, depends on the ratio of input prices, the economist wage rate to the piece rate of room cleaning. For this purpose, write

$$(19) \quad y = \frac{Y}{M} = \frac{G(M, N)}{M} = G\left(1, \frac{N}{M}\right) = g(n)$$

where usual neo-classical properties imply $g(0) = 0$, $g'(n) > 0$ and $g''(n) < 0$, with $n = N/M$.

Now, use this notation to establish that

$$(20) \quad v = G'_M(1, n) = g'(n) - g'(n)n > 0$$

$$(21) \quad w = G'_N(1, n) = g'(n) > 0$$

Note that (20) and (21) imply that the whole production value is paid out in wages, and profits equal zero. Take the total differential of (20) to see how a small deviation in the ratio of input factors changes the piece rate per room:

$$(22) \quad dv = [g'(n) - g'(n) - g''(n)n]dn = -g''(n)ndn$$

Hence, $dv > 0$ when $dn > 0$, since $g''(n) < 0$. This entails that v and $n = N/M$ move in the same direction. Likewise, take the total differential of (21) to see how a small deviation in the ratio of inputs changes the wage rate of economists:

$$(23) \quad dw = g''(n)dn$$

Hence, $dw < 0$ when $dn > 0$, since $g''(n) < 0$. This entails that w and n move in different directions. Therefore, when the ratio of factor prices w/v decreases, the ratio of input factors, $n = N/M$, increases, and vice versa. This implies that the demand for n as a function of w/v is a falling function, also depicted as a falling demand curve in Figure 7. From (22) and (23) it follows that when the input ratio, n , changes, the factor prices move in opposite directions; i.e. when $n = N/M$ increases, w decreases and v increases. This combination of input prices is

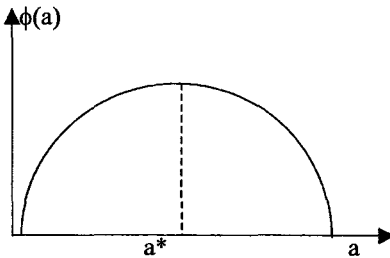
consistent with the assumptions of perfect competition, constant returns to scale and the use of Y as a numeraire.

2.3.5 Roy's model and the supply of labour services

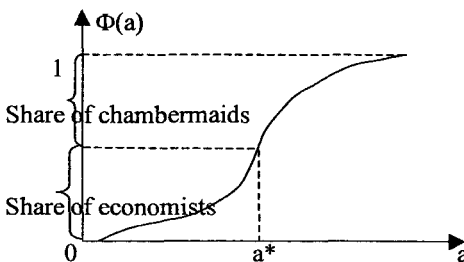
How do varying levels of household skills and amounts of in-the-home training during childhood and youth influence the choice of occupation and education of people at the age of eighteen years, *ceteris paribus*? Inspired by Roy (1951), who addressed the choice between two occupations where one occupation has a broader productivity spread, I now introduce a distribution of household skills. Individuals have varying household productivity a_i according to the in-the-home training they had during childhood and youth, and the level of household skills they acquired. This is used to model labour supply.

Figure 2.5 a & b. The distribution function and the density function of household skills

2.5a) The density function of household skills



2.5b) The distribution function of household skills



The Figure 2.5b) illustrates how the household skills and the resulting household productivity a_i are distributed in the labour force. Figure 2.5a illustrates the density function $\phi(a_i)$, which is the derivative of the distribution function of household productivity in the labour force.

Individuals with household productivity a^* are indifferent towards the two occupations, as is the case in Figure 2.3. Chambermaids are recruited among the available individuals with the

higher household productivity. There are 42 cohorts of chambermaids and 37 of economists in a steady state. Due to the varying individual productivity and the piece rate system of payment for cleaned rooms, the counting of inputs is not the number of chambermaid hours, but rather the number of cleaned rooms. Hence, given that individuals with $a_i > a^*$ become chambermaids, the amount of room cleaning supplied by chambermaids is:

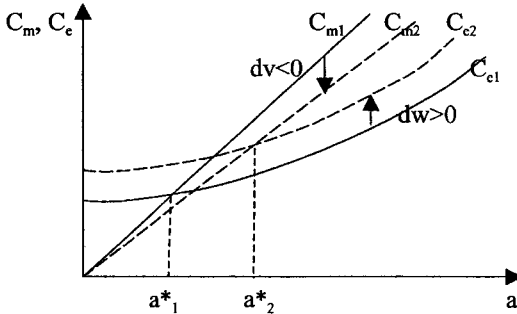
$$(24) \quad M = 42 \int_{a^*}^{\infty} [12 - H(v)] a \phi(a) da$$

The supply of economist hours is given by:

$$(25) \quad N = 37 \int_{-\infty}^{a^*} [12 - H\left(\frac{w}{a}\right)] \phi(a) da$$

Figure 2.6 depicts what happens to the household productivity, a^* , that make a person indifferent towards the two occupations, when the compensation ratio, w/v , increases.

Figure 2.6 What happens to a^* when the compensation ratio w/v increases?



Consider the case where the compensation ratio w/v increases, i.e. when w increases and v decreases. Higher w implies that the lifetime consumption of economists increase, depicted in Figure 2.6 by a positive shift from C_{e1} to C_{e2} . Lower v implies that the lifetime consumption of chambermaids decrease, shown in Figure 2.6 by the clockwise turn from C_{m1} to C_{m2} .

To analyse in a formal way how a^* changes when the compensation ratio w/v changes, take the total differential of (11) and use (3) and (6) to obtain:

(26)

$$da^* \left\{ f[H(v)] + v[12 - H(v)] - \delta \left[H\left(\frac{w}{a^*}\right) \right] \right\} + dv \{ a^* [12 - H(v)] \} - dw \delta \left[12 - H\left(\frac{w}{a^*}\right) \right] = 0$$

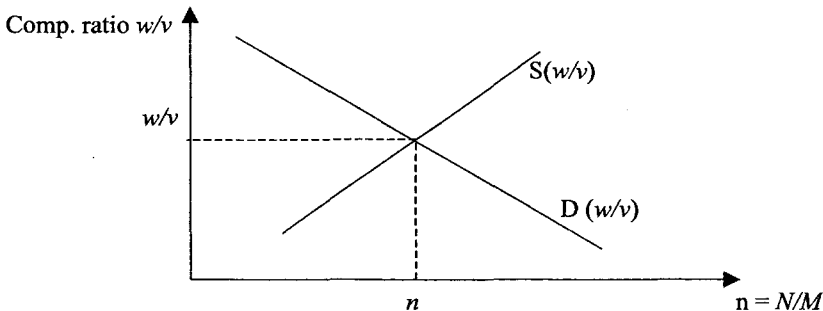
Since $f(H_m) + v(12-H_m) > \delta f(H_e)$ by (12), it follows that $dw > 0$ and $dv < 0$ imply $da^* > 0$.

When the compensation ratio of economists relative to chambermaids increases, the household productivity increases that is necessary to make an individual indifferent towards the two occupations when the distribution of household skills in the population is given. This means that more individuals become economists and fewer become chambermaids. Also, when w increases, all economists tend to reduce household production and increase hours spent in paid employment. These two effects imply that the supply curve of economist hours is an increasing function of the compensation ratio w/v . For labour supply by chambermaids, an increased compensation ratio that favours economists implies that some of the individuals will change their plans for the future occupation and educate to become economist, thereby reducing the number of future chambermaids. These individuals are those with the lower household productivity among the potential chambermaids. In addition, a reduction in the compensation for room cleaning v will reduce the number of hours that all chambermaids supply to the labour market because they increase the amount of time spent in household production. These results are depicted in Figure 2.7.

2.3.6 Market equilibrium and wage determination

Figure 7 compares the demand for economist hours to chambermaids room cleaning as a decreasing function of the compensation ratio w/v . It also shows the supply of economist hours relative to chambermaid hours as an increasing function of the compensation ratio w/v . These two functions determine simultaneously the equilibrium factor ratio $n = N/M$ and the equilibrium compensation ratio w/v . Finally, (20) and (21) determine v and w . These in turn determine a^* , thereby also M and N .

Figure 2.7 Demand and supply in equilibrium



Note that the product market is in equilibrium since the quantity produced equals total wages.

2.4 The pattern of household production and in-the-home training

Household production is a major activity in modern economies. What kind of tasks are performed and by whom? Is the pattern of household production and in-the-home training gendered? What do time-budget studies report? Do countries differ? Reskin and Padavic (1994) present the division of household tasks by full-time workers for the USA in 1987. The heavily female-dominated tasks are washing and ironing, house cleaning and preparing meals. Women dominated washing dishes and shopping less. Paying bills and driving are the most gender neutral tasks. Car maintenance and outdoor tasks are heavily male dominated. Haraldsen and Kitterød (1992) analyse time-budget data from Norway between 1990 and 92. Household production covers housework plus repair, caring services, purchase and travels. The tasks are similar to those of Reid in Table 2.1, though fishing is included in Norway and homework help is the only adult activity indicating the training or education of children. Women do more hours of unpaid household production than men: the average is 4.22 hours for women compared to 2.36 for men. Many activities have an unbalanced gender pattern. For instance, men dominate maintenance and 'other household work', while women dominate housework. Jenkins and O'Leary (1997) analysed UK trends for a gender differential in total work time, market work and domestic work. Total work time barely changed from 1975 to 1987. For women, increases in market work are offset by decreases in domestic work, and the other way round for men. A decreasing number of children reduces average domestic work by women, while the decline is partly offset by increased domestic work per child. Jacobs (1989) and Jacobs et.al (1995) show that the pattern of occupational segregation by gender is, to a large extent, stable over time and across countries. Quite possibly, gendered in-the-home training is the key to the survival of segregation by gender in jobs that require compulsory schooling only. Are children's tasks in household production also segregated by gender?

2.4.1 Results from a time-budget study of children

What kinds of in-the-home training do children have? It probably depends on the parenting household and the gender of the child. However, time-budget studies that cover household production and paid work by children are scarce. Solberg and Vestby (1987) describe time-use for a stratified sample of 800 10-12 year old Norwegian children in the 1983-84 (see Table 2.2). They report the amount of housework, care work and outdoor activities. For each activity the number indicates boys' average use of time as a percentage of girls'. 100 per cent

indicates a gender neutral activity. When boys do half of that of girls, 50 (per cent) is assigned. The number 200 tells us that boys do twice as much as girls on average.

Table 2.2 Housework and other activities, boys' average use of time as a percentage of girls'.

Housework	Activity	%	
		68	
	Cleaning own room	68	
	Tidying		74
	Vacuum cleaning		90
	Cleaning		50
	Cleaning other rooms	57	
	Tidying		54
	Vacuum cleaning		81
	Cleaning		42
	Washing windows		57
	Washing-up	64	
	Clearing dishwasher		67
	Washing-up (in the sink)		60
	Preparing food	84	
	Setting/clearing the table		90
	Preparing sandwich		82
	Making dinner		81
	Baking cake/pizza		80
	Keeping clothes	25	
	Washing/hanging up clothes		35
	Repairing clothes		33
Other work			
	Do errands	94	
	Carry in wood and water		107
	Take out the rubbish		115
	Collect the post		91
	Shop everyday commodities		102
	Caring	44	
	Look after siblings		44
	Nurse siblings		20
	Attend to playing		50
	Care for the elderly		54
	Repairs	300	
	Redecorating		212
	Cleaning bikes		1500
	Work with cars		187
	Outdoor work	160	
	Gardening		84
	Clear away the snow etc.		196
	Chop wood		267
	Animal care	95	
	Walk the dog		91
	Attend to pets		78
	Attend to farm animals		129

Sources: Housework: Solberg (1994, p.87) Table 3.13. 'Other work': Solberg and Vestby (1987, p.57) Table 3.26.

Solberg and Vestby report that overall girls do more household production (housework and other work) than boys at the age of twelve. Table 2.2 indicates that 11-12 year old girls and boys already have acquired household skills, and that in-the-home training is gendered. Girls mostly do female dominated tasks and boys do male dominated tasks. Solberg and Vestby also observe that children help with their parent's jobs. They spend most hours helping when fathers are farmers, fishermen or run retail businesses and when mothers are farmers, cleaners or day-mothers. Children work more hours in farming and fishing communities than in urban areas.

2.5. Do jobs that use household skills earn low wages?

The model in this essay suggests that occupations utilising household skills as job skills may recruit individuals even when wage rates are lower than the wage rate of unskilled individuals. This is due to higher household productivity and household production. In this section I present some empirical support for the model. The assumptions are presented in Section 2.3. Bergmann (1986, p.202) voices frustration about the low wage rate and earnings of servants in household tasks: *'Many of the housewife's duties are those of the servant, and the servant job is the one closest to the housewife's in the money economy.'* What do econometric studies tell us about the influence of household production on wages in general? Hersch (1991, p.160) indicates that combining lots of unpaid household production with wage work is a 'double burden': *'time allocated to household responsibilities has an independent negative effect on women's wages, controlling for differences in working conditions and human capital.'*

Do studies report lower lifetime earning for individuals in household skilled occupations as predicted by this essay's model? I know of no study of lifetime earnings by occupation, whereas educational length is a focus in studies of both wage rates and lifetime earnings. However, Björklund's (1993) Swedish report indicates that the dispersion of lifetime income is between 35 and 40 per cent lower than typical cross-sections of annual income. According to the model outlined here, variation in household production may compensate for differences in lifetime earnings. Jenkins and O'Leary (1996) for the U.K., and Aslaksen and Koren (1996) for Norway, report that extended income (comprising earnings and the value of household production) is more evenly distributed than money income. However, the distribution of extended income is typically reported by income group or family type, and not by occupation.

An occupation that is protected by a minimum wage indicates a low wage occupation. Although the stereotypical low-wage worker is a male teenager, over 60 per cent of low-wage workers in the USA are women, according to Kniesner (1981). Food service, unskilled clerical workers, private household workers and retail sales workers are the occupations where low-wage workers are most frequently over-represented (measured by reported wages), while private household workers and paid farm workers top the low-wage occupations when the imputed wage is considered. Kniesner calls for more attention to prime-aged married women when analysing the winners and losers created by a minimum wage.

Which occupations have the lowest wage rates according to empirical studies? Do they utilise household skills as job skills? Arai, Asplund and Barth (1998 Table 8.3 p.144) present an analysis of occupational wage differences by gender, education and age in 1991 for three Nordic countries (Finland, Norway and Sweden) entitled: '*Low Pay, A Matter of Occupation*'. Seven out of twenty four occupational groups were below median wage in all three countries. These seven low wage groups were: cleaners, hotel and restaurant workers, private service workers, food manufacturing workers, operative workers, shop assistants, secretarial and clerical workers, and unskilled health and day-care workers. Employees in many of these occupations typically benefit from in-the-home training and use household skills as job skills, such as cleaners, hotel and restaurants workers, private service workers, food manufacturing workers, and unskilled health and day-care workers. Cleaning work had the lowest wage in Sweden, the second lowest in Norway and the third lowest in Finland. According to the model in this essay, it does not pay to continue your education if you have acquired an abundance of household skills. Measures of household skills are not available, but the years of formal education of cleaners can be analysed. Among all occupations, cleaners had the fewest average years of schooling in both Sweden and Norway, whereas in Finland only chemical processing workers had shorter education than cleaners. According to Section 2.4, in-the-home training and household skills are gendered: girls and women acquire more household cleaning skills than boys and men. Is there any evidence that cleaning work is female-dominated? In Sweden, 76 percent of cleaners were women, and in Norway and Finland, 95 percent were women. Arai et al. (1998) conclude that low-pay workers are concentrated in the same occupational categories in all three countries, and young and female workers are over-represented. These findings concur with the pattern that in-the-home training also takes place during childhood and youth, and that in-the-home training in cleaning is more frequent for girls than for boys in Scandinavia.

Arai et al. (1998) also found that age-wage profiles are flatter in low-pay occupations like cleaners compared to higher-wage occupations. This complements the discussions of Polachek (1975), England (1982), and Robst and VanGilder (2000) that concern the rate of skill depreciation during periods of non-employment - the so-called atrophy rate. According to the this essay, in-the-home training is an early substitute for on-the-job training in some occupations where job tasks and tasks in household production are similar. This explains the

flattening of age-wage profiles two ways. First, in-the-home training takes place from childhood, before individuals enter the labour market. Second, individuals that withdraw for a period from the labour market back into household production typically use the same household skills in household production; thus, the real atrophy rate is low in occupations in substitute household production. Concepts like in-the-home training and household skilled occupations elicit new explanations for lower atrophy rates in some occupations than others.

2.5.1 The dual labour market: Do household skilled jobs form the secondary labour market?

Doeringer and Piore (1971) discuss the dual labour market, which consists of the primary and the secondary labour market. The secondary labour market is described as a segment with low wage rates, frequent part-time employment, flat age-wage profiles and little or no on-the-job training. The concepts and model presented in this essay open up a new interpretation of the secondary labour market as the labour market segment that uses household skills as job skills. By supplementing a neo-classical model with household production and varying household skills and household productivity, one reaches the conclusion that occupations using household skills as job skills may earn lower wages and work shorter hours than predicted by human capital theory. As mentioned above, these occupations may offer little or no on-the-job training and produce flat age-wage profiles because in-the-home training substitutes for on-the-job training. Since Taubman and Wachter (1986) suggest that the dual labour market is seldom associated with particular occupations but with the so-called secondary sector, I think that future studies of the secondary labour market should investigate the extent to which occupations in the secondary labour market utilise household skills as job skills. In the dual labour market literature, the low wages in secondary market jobs and the prevalence of part time employment have been considered problematic and a policy concern. Note that, according to my model, the shorter hours in paid work is compensated by longer hours in household production, which brings individuals to higher consumption levels. Therefore, future research should address how individuals in the dual labour market allocate time to household production, leisure, education and so on, and whether shorter working hours in paid work are preferred or enforced by restrictions.

2.5.2 Are the assumptions of the model realistic?

To what extent are the model assumptions of Section 2.3 realistic? The results in Section 2.4 of Solberg and Vestby (1987) show that in-the-home training and household skills can realistically be assumed to vary among children and to be determined prior to the youngster's choice of education. This gendered pattern of household tasks among children supports the idea that household skills influence the gendered division of household production by adults and occupational segregation by gender. Rosen and Willis (1979) model the demand for college attendance. Compared to men entering college, other male high school graduates tend to score lower in maths and tests of reading comprehension, approximately the same in manual dexterity and somewhat better in mechanical ability. Eckstein and Wolpin (1999, p.1326) find that among US white male youths in 1979, high school dropouts in full-time jobs received the highest wage offers. For high school students, part-time wage offers exceeded full-time wage offers. Youths who drop out of high school had a comparative advantage at jobs that are carried out by non-graduates. The two most frequent reasons for dropping out were 'didn't like school' and 'offered a good job, chose to work'. Eckstein and Wolpin related job skills to actual labour market experience but also mentioned endowments, which probably include household skills and in-the-home training.

The model views oversimplistically the situation where students experience no household production during higher education, while working youths enjoy regular household production. The important issue is whether students produce less household production than young employees. Facts concerning household production for 18-23 year olds are hard to find. The age of giving birth may be an indicator because the amount of household production is typically higher in families with young children. Is there any evidence that students delay childbirth relative to youths who choose shorter education? Gustafsson (2001) and Gustafsson and Wetzels (2000) study women's age at first birth for West Germany, Great Britain, the Netherlands and Sweden and conclude: *'There are some common characteristics for all four countries. First, in all four countries more highly educated women tend to have their first child at a later age than less educated women, except Swedish women among whom the medium educated group have their birth at an earlier age than low educated women do.'* In this study, the less educated group comprises women with less than high school education. The medium educated group contains individuals who have completed high school or some

additional education, and the highly educated group comprises individuals who have completed higher vocational training or university education.

2.5.3 Household skills most important in developing countries

This essay has limited itself to modern economies. However, the relative importance of in-the-home training and household skills as a share of human capital is greater in many developing countries where (a) regular schooling does not include all children and (b) the market economy is small in comparison to the household-related informal economy. The extensive use of child labour both in household production and in the market economy in developing countries indicates that in-the-home training from childhood may be important for skill acquisition. In order to address in-the-home training and household skills in developing economies, a range of additional issues need to be discussed. It is beyond the scope of this essay to do so here.

2.6. Changing household skills over time

2.6.1 Have reduced in-the-home training raised enrolment in education?

Reid (1934, p.124) suggests that in-the-home training and vocational education may be substitutes. According to my model, young individuals choose vocational and higher education when they have few of the household skills required for a household skilled job. Presumably household skills are less widespread in modern economies. Traditional economies, on the other hand, have a large primary sector (e.g. agriculture, fishery and forestry), which leads to more household production and income-generating activities centred around the home. Therefore, modernisation will reduce household skills. It is usually suggested that the large increase in education has been linked to an increase in its availability. An alternative view is that less in-the-home training and household skills may raise demand for higher education. In the market equilibrium of the labour market depicted in Figure 7, a reduction of household skills, *ceteris paribus*, leads to an outward shift of the supply curve, leading to a lower compensation ratio, w/v , and higher N/M in equilibrium. Hence, the model predicts that a reduction in household skills leads to increased enrolment in higher education.

2.6.2 Taxation and labour demand

In industrialised countries, household production decreases over time while market work increases. According to Boskin (1975), tax wedges between unpaid household production and labour market work influence the division of hours, and, according to Kolm (2000), also challenges taxation of services. Apps and Rees (1999) discuss how individual versus joint taxation of couples can affect labour supply and household production. When the housewife becomes an employee, the utility of household production by children may increase, whereas absent parents reduce the opportunities for in-the-home training. Reduced levels of household skills may be an important factor in the transfer of production from the household to the market, stimulating the introduction of labour-saving equipment in both households and businesses that produce substitutes for home-made goods and services. Reduced levels of household skills, especially among boys, may be one of the reasons why young men have higher unemployment rates than young women. According to the model in this essay, low levels of household skills induce individuals to opt for further education, but if individuals drop out, job opportunities may be scarce.

We can divide household production into goods and services. When substitute household production of goods can be moved to countries with lower wages and similar household skills, industry composition and labour demand in industrialised countries is affected. Because women have traditionally undertaken a larger share of household services, they are probably less affected by globalisation in both household production and as employees in substitute household production. However, the moving of textile and apparel production to developing countries, where work is also undertaken by household skilled female homeworkers, as illustrated by Hahn (1995), may well have affected female labour demand.

2.6.3 The recent wave of male dominated in-the-home training in computer science

Lately, home-based PCs have contributed towards information-gathering and recreational activities. To the extent that children learn to use PC software and hardware, they acquire a new kind of household skill in computer science. Hopefully, children operating PCs at the expense of homework or housework will acquire computer science household skills. To the extent that boys dominate computer in-the-home training, we can expect men to possess more computer household skills than women. Based on the predictions of this model, household skilled low wage male dominated occupations in computer science will appear. Such workers will be self-employed if larger firms demand formal education to certify skills and if no screening of computer skills is available.

2.7 Concluding remarks

The literature of social science contains a variety of theories that address the phenomenon of individual variation in wage earning. Human capital, discrimination and institutions are keywords. This essay presents an additional and novel explanation that introduces the concept of in-the-home training and explicitly addresses household skills as part of human capital. Household skills are human capital that increases household productivity. I introduce the term 'in-the-home training' to characterise the learning of different kinds of household skills through observation, teaching or participation in household production. This essay focuses on modern, industrial economies and such kinds of household production as childcare, cleaning, cooking, driving, gardening, laundry, car maintenance, house maintenance, production and repair of clothes, and shopping. The model in this essay indicates that occupations that use household skills, such as cleaning, may pay lower wage rates than traditional human capital theory has predicted. This stems from the observation that future earnings of higher educated employees not only have to compensate for educational costs and foregone wage earnings during education but also for lower household production while studying and in later life. Therefore, the model in this essay predicts that the wage differentials are greater than those predicted by traditional human capital theory between occupations based on household skills, like chamber-maids and cleaners on the one hand, and individuals with higher education like economists on the other. The model also predicts that young individuals who acquire a good deal of in-the-home training and household skills during childhood and youth may often enter occupations where household skills raise productivity in occupational tasks. However, young individuals with little in-the-home training and household skills are predicted to choose occupations that require vocational or higher education, all other things being equal. The modelling also shows how the demand for different kinds of products influences occupational choice. Do these jobs that use household skills as job skills constitute the so-called secondary labour market in the dual labour market theory? Despite the fact that women have had, on average, more in-the-home training than men, and many of the occupations that use household skills as a job skill are female-dominated, this is not a gender issue as such. The corroboration of the household skill explanation lies in studies of wage formation in male-dominated occupations relying on household skills. According to this model, people in maintenance, drivers and gardeners - being male-dominated occupations that use household skills as job skills - should also earn low wages compared to other occupations.

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ESSAY 3
LOWER WAGES WHEN OCCUPATIONAL EDUCATION INCREASES
HOUSEHOLD PRODUCTIVITY

by
Kristin Dale¹

Abstract

This essay discusses variation in wage rates among occupations that require an equally long education. The novel idea is that occupational education also raises household productivity when tasks in jobs and unpaid household production are similar. A formal model demonstrates how variation in household productivity influences labour supply and wage formation by occupation. The main finding is that the more the occupational education increases household productivity, the lower is the occupational equilibrium wage rate. This is a new explanation of lower wage rates for female dominated occupations like nurses and pre-school teachers. These results have policy implications for the dimensioning of educational programmes.

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3.1 Introduction

Jobs in the labour market and unpaid household production share common tasks. For example, cooking occurs at home and in the catering industry, and children are cared for at home and in kindergartens. When specific tasks are carried out both in an occupation and at home, presumably the occupational education designed to increase occupational productivity in addition raises household productivity. Examples are culinary education and pre-school teacher training. Different kinds of education can raise household productivity to varying degrees, presumably from none to a very high degree. The vocational education required for iron- and steelworkers contains no element of domestic science and does not increase household productivity. By contrast, domestic science programmes raise household productivity considerably. Does higher household productivity make pre-school teachers supply fewer hours and earn lower wages than other occupations with equally long education?

This essay discusses variation in labour supply and wage rates among occupations. I propose that such variation can be partially explained by the notion that educational programmes raise household skills and household productivity to varying degrees. A formal model is used to show that household productivity influences occupational labour supply and occupational wage formation. The main findings are that the more the education increases household productivity, the lower are the equilibrium wage rate and the labour supply in these occupations. This new explanation helps understand why occupations dominated by females (nurses, nursery school teachers and teachers) earn lower wages and supply fewer hours than other occupations with an equally long education.

This essay is organised as follows: Section 3.2 surveys related work on human capital theories and home economics. Section 3.3 presents the formal model where different types of education to varying degrees increase productivity in household production, thereby influencing schooling decisions and how occupational labour markets function with respect to participation and wage formation. Section 3.4 re-interprets empirical results from studies of labour force participation and wage rates by occupation. Norwegian findings show that, among five occupations with equally long college education, pre-school teachers have the lowest wages and business economists have the highest. Section 3.5 presents alternative explanations. Finally, the conclusion discusses some policy implications of this model for educational programmes.

3.2 Theoretical precursors: human capital and others

How are benefits from education assessed? Smith (1776, chapter 10) lists five principal circumstances that influence wages, one of them being expenses and difficulties of training and education. Modern human capital theory explicitly recognises foregone earnings as part of the student's investment. Mincer (1958) and Schultz (1963) argue that education is the acquisition of human capital that yields returns in the labour market through higher wages that compensate foregone earnings. The extent to which higher wage rates are due to increased labour market productivity as implied by human capital theory (Schultz, 1963), or to the signalling effects of education (Spence, 1973), is still disputed. Both theories argue that it is rational for the student to acquire schooling to the point where the present value of additional education equals its cost. Several authors have been concerned with the consumer benefits of education. Schultz (1961, 1963) addresses the consumer benefits of being a student and the benefits of being a better-informed consumer. Lazear (1977) quantifies the benefits of being a student and finds that education is a "bad" because individuals stop short of acquiring the wealth-maximising level of education. Schultz (1961) discusses the concept of human capital along with various investments in human capital. He does not suggest estimating the magnitude of human capital formation from measuring investment expenditures (as with investments in real capital) because of the difficulty in distinguishing between expenditures for consumption and investment. Schultz suggests that human investment should be estimated from its yield. Numerous studies report the economic returns to education. Card (1999) surveys the literature on the extent to which length of education affects earnings.

How have researchers accounted for the effects of education on household production?

Bowman (1966, p.114) criticises human capital theory for limiting the returns to labour market earnings without incorporating the value of increased household production. *'What it says about education as either a private or a societal investment in the acquisition of a future income stream depends upon how we define 'income' and, in applied economics, on what elements of income get measured - directly or indirectly. In practice what is most easily measured is money income, but there is also the 'real income' potential of the capacity to 'do it yourself', whether this is home carpentry or filling out your own income-tax form.'* Cohn and Geske (1990, p.39) show that filing income tax returns was an early example of non-market benefits from education in economic literature. Becker (1991, p.27) remarks that time spent in different sectors influences the incentives to invest in different kinds of human capital: *"..., the incentive to invest in [human] capital that mainly raises household*

productivity is greater when more time is spent in the household sector, and the incentive to invest in [human] capital that mainly raises market productivity is greater when more time is spent at work. Some investments, such as on-the-job training, mainly raise the productivity of market time; others, such as classes in child care, cooking, or art history, mainly raise the productivity of household time. ' This essay develops these incentives for different kinds of occupational education and brings the idea one step further to wage formation by occupation. Blaug (1992, p.217) criticises human capital theory on the grounds that '*., its rate-of-return calculations repeatedly turn up significant differences in yields of investment in different types of human capital but its explanation of the distribution of earnings nevertheless goes on blithely assuming that all rates of return to human capital formation are equalised at the margin.*' The model in Section 3.3 addresses this criticism by introducing variation in household productivity as an explanation of wage differentials and equalised returns to different types of education. Inspired by Becker (1965), Michael (1970) develops a model where consumption is influenced by education as education acts as an environmental factor that shifts the production functions of consumption. Michael (1970, p.38) argues that education would, ideally, be a vector of the quality-adjusted formal educational attainment of each family member, but empirically he uses the number of years' schooling completed by the household head (Michael, 1970, p.46). On the subject of these empirical results, Gronau (1986, p.291) writes: '*Michael attempts to estimate the elasticity of real full income with respect to schooling (holding money income constant), and his estimates range between 0.1 and 0.75. These estimates are lower than the elasticity of money income with respect to schooling. Unfortunately, these estimates are flawed because Michael erroneously uses the money income elasticities, whereas his theory deals with full income elasticities. The direction of the bias introduced by this error cannot be ascertained a priori.*' Becker (1975, p.67) refers to Michael (1970) and assumes that investment in additional years of education shifts the production function of consumption by reducing both the amount of time and goods inputs. Whereas Michael studies how the length of education for married men influences household consumption, the present model analyzes how different kinds of equally long education influence household production and wage formation, particularly relevant for women. Neither traditional consumer theory nor the approaches of Becker and Michael distinguish time allocated to leisure and household production. By contrast, this distinction is the main argument of Gronau (1977) who demonstrates the importance of household production for labour supply decisions, and highlights the substitution between wage work and household production. The model developed in the subsequent section is in line with Gronau's approach.

3.3 A model of occupational wage formation when occupational education increases household productivity

In Essay One I model the manner in which the demand for labour with different kinds of skills influences wage formation. Here I simplify the problem by only modelling how supply factors determine the relative wage rates of occupations when effects on household production are accounted for. This model incorporates the idea that different kinds of occupational education also increase household productivity to varying degrees. With the exception of this new element, I apply the standard human capital approach to investment in education and the household production function that specifies three kinds of time uses (following Gronau, 1977). The choice of education depends on the benefits that are derived from education. In this model, I abstract from the pure consumption aspect of an education. According to human capital and screening theories, the longer the education, the higher the costs and returns. To disregard how variation in length influences the educational choice, the model considers an individual who chooses among different types of education of equal length. For instance, occupations like nursing or engineering may require equally long, but different, kinds of education in the college sector. With the assumption of equal length of education, I assume equal money costs and equal time costs of education, and abstract from different economic lifetimes of various kinds of education. Thus, no dynamic model is needed to capture the essence. The model is concerned with two kinds of education of equal length. Candidates from Education 1 enter into Occupation 1, which implies that candidates from the engineering programme become engineers. I assume that Education 2 improves household productivity more than Education 1. This implies that Education 2 contains more elements that might be part of an educational programme in domestic science. The individual maximises its utility from consumption and leisure, subject to the time and the budget constraints.

I assume that the individual consumes a commodity that can be home made or bought (at the price of 1), and that products from household production and market products are perfect substitutes. Output from household production is an increasing and concave function of hours spent in household production. This is realistic if individuals get tired of housework or if tasks are sorted according to falling productivity. The formulation of the household production function avoids 'corner solutions' in the division between work in the labour market and in the household. Note that the household production function includes only time-use and no specified goods input. The productivity coefficient captures the level of household skills and is influenced by the person's occupational education. The productivity coefficient enters

multiplicatively. This formulation differs from Michael (1970) where the increase in productivity from longer education is resource saving and reduces time-use and commodity inputs to the same degree according to a (Hicks) neutrality assumption. Gronau (1986, p.285, Note 13) clarifies that a household production function where the productivity coefficient enters multiplicatively, as in my model, implies that hours spent in household production increase with increasing household productivity.

The following notation is used for the person: Education i , $i \in \{1, 2\}$, leads to occupation i .

C_i = the consumption in occupation i .

L_i = the hours of leisure in occupation i .

w_i = the hourly wage rate in occupation i .

a_i = the household productivity from education i ; assume $a_2 > a_1 \geq 0$.

H_i = the hours of household production in occupation i .

N_i = the hours of wage work in occupation i .

The individual maximises utility $U(C_i, L_i)$ from consumption and leisure, subject to the time and the budget constraints. The utility function U is strictly increasing, strictly quasi-concave for $C_i > 0$ and $L_i > 0$, and satisfies that $U_L/U_C \rightarrow \infty$ as $L_i \rightarrow 0$ for $C_i > 0$. The time constraint states that all hours of the day, t , are allocated to household production, wage work and leisure: $t = H_i + N_i + L_i$. The amount of household production, $X_i = a_i f(H_i)$, depends on individual household productivity, a_i , and on the number of hours in household production, H_i , and $f(H_i)$ satisfies that $f > 0$, $f' > 0$, $f' \rightarrow \infty$ as $H_i \rightarrow 0$, $f'' < 0$. The budget constraint states that consumption equals the extended income that consists of household production and real wage earnings: $C_i = a_i f(H_i) + w_i N_i$.

Some conditions have to be met for an interior solution where all three activities take place.

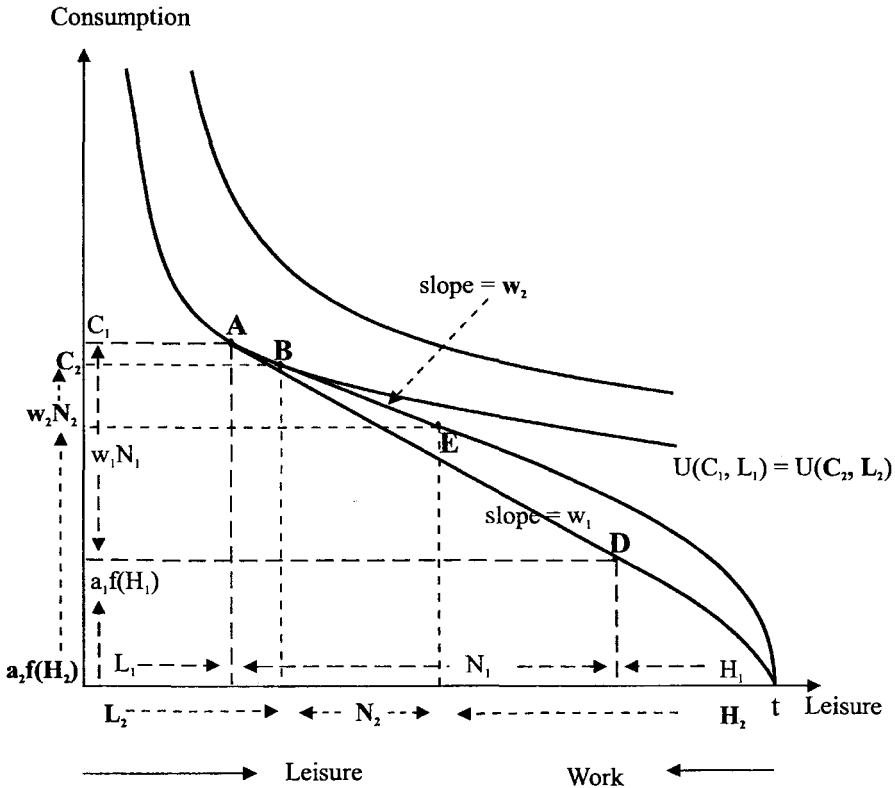
From the assumption that $U_L/U_C \rightarrow \infty$ as $L_i \rightarrow 0$ for $C_i > 0$, it follows that leisure is positive.

From the assumption that $f' \rightarrow \infty$ as $H_i \rightarrow 0$, it follows that household production is positive.

An additional assumption is needed to ensure that wage work is positive¹. See Figure 3.1 for the intuition of the formal model.

¹ Assume that $N_i = 0$, and solve $\max U(C_i, L_i)$ subject to $C_i = a_i f(H_i)$ and $t = H_i + L_i$. By inserting the constraints this is equivalent to maximising $U[a_i f(H_i), t - H_i]$ over values of H_i . The first order condition is: $U_C a_i f'(H_i) - U_L = 0$. This means that the marginal rate of substitution between leisure and consumption equals the marginal value of household production, $U_L/U_C = a_i f'(H_i)$. For values of H_i that make this lower than the wage rate, then it is optimal to wage work.

Figure 3.1 The equilibrium wage rates and the allocation of time for two occupations



The horizontal axis represents the hours of a day (t) and the vertical axis consumption in real terms (C). If the person graduates from Education 1 into Occupation 1 with wage rate w_1 , point A in Figure 3.1 maximises his utility. He spends L_1 hours of leisure and consumes C_1 , partly bought by wage earnings (w_1N_1) and partly produced by H_1 hours in household production ($a_1f(H_1)$). For the person to be equally well off if he chooses Education/Occupation 2, he must have the same utility level and chooses point B which represents more leisure (L_2) and less consumption (C_2). Consumption is partly produced at home, working H_2 hours in household production ($a_2f(H_2)$) with the higher productivity coefficient a_2 , and using less wage earnings (w_2N_2) to acquire goods and services. The wage rate of Occupation 2 is determined by tangents in E and B. The equilibrium wage rate is relatively lower for the kind of education that improves household productivity the most, $w_2 < w_1$. People, who choose an education that increases household productivity more, spend more hours in household production to reap the returns to higher productivity as a homemaker. The lower wage rate makes them work fewer hours in the labour market and spend more hours at leisure, according to Figure 3.1

Formally, these results can be established as follows. The modelling assumes an interior solution where H_i , N_i and L_i are all positive:

Max $U(C_i, L_i)$ subject to $C_i = a_i f(H_i) + w_i N_i$ and $t = H_i + N_i + L_i$

$$\mathcal{L} = U(C_i, L_i) + \lambda (a_i f(H_i) + w_i N_i - C_i) + \mu (t - H_i - N_i - L_i)$$

Differentiate the Lagrange function, \mathcal{L} , by each variable C_i , L_i , H_i , N_i :

$$\partial \mathcal{L} / \partial C_i: \quad U_c - \lambda = 0$$

$$\partial \mathcal{L} / \partial L_i: \quad U_l - \mu = 0$$

$$\partial \mathcal{L} / \partial H_i: \quad \lambda a_i f' - \mu = 0$$

$$\partial \mathcal{L} / \partial N_i: \quad \lambda w_i - \mu = 0$$

These equations imply $\frac{U_l}{U_c} = \frac{\mu}{\lambda}$, $a_i f' = \frac{\mu}{\lambda}$ and $w_i = \frac{\mu}{\lambda}$ from which it follows that

$$\frac{U_l}{U_c} = w_i \text{ and } a_i f'(H_i) = w_i.$$

For a person in a specific occupation, the optimal allocation of hours implies that the marginal value of leisure, household production and wage work are equal.

In order for all occupations to recruit newcomers, people must consider various kinds of education as attractive independent of their relation to household production. If we assume that all individuals are equal, for a labour market equilibrium to be achieved when two kinds of occupation are alternatives, the representative person must be indifferent towards the two kinds of education (and occupation), so that $U(C_1, L_1) = U(C_2, L_2)$.

The model has 7 equations and 8 unknowns ($w_1, w_2, H_1, H_2, N_1, N_2, L_1, L_2$), provided that a_1 and a_2 are exogenously given.

$$(1) \frac{U_l(a_1 f(H_1) + w_1 N_1, L_1)}{U_c(a_1 f(H_1) + w_1 N_1, L_1)} = w_1$$

$$(2) \frac{U_l(a_2 f(H_2) + w_2 N_2, L_2)}{U_c(a_2 f(H_2) + w_2 N_2, L_2)} = w_2$$

$$(3) a_1 f'(H_1) = w_1$$

$$(4) a_2 f'(H_2) = w_2$$

$$(5) H_1 + N_1 + L_1 = t$$

$$(6) H_2 + N_2 + L_2 = t$$

$$(7) U(a_1 f(H_1) + w_1 N_1, L_1) = U(a_2 f(H_2) + w_2 N_2, L_2)$$

To facilitate the analysis, I assume that the model is closed by labour demand conditions determining w . Then H , is determined by (3), and L , and N , are determined from (1) and (5), implying that the utility level for Education 1 is given.

Since the utility level is equal for the two kinds of occupation (and education), we can ask what happens to the wage rate in Occupation 2 when the household productivity from attending Education 2 increases slightly, under the assumption that this does not change w .

Take the total differential for Education 2 (from (7)):

$$U_c [da_2 f(H_2) + a_2 f'(H_2) dH_2 + dw_2 N_2 + w_2 dN_2] + U_l dL_2 = 0$$

and divide by U_c to obtain

$$da_2 f(H_2) + a_2 f'(H_2) dH_2 + dw_2 N_2 + w_2 dN_2 + U_l/U_c dL_2 = 0$$

Use (4) and (2),

$$da_2 f(H_2) + w_2 dH_2 + dw_2 N_2 + w_2 dN_2 + w_2 dL_2 = 0$$

$$da_2 f(H_2) + dw_2 N_2 + w_2 [dH_2 + dN_2 + dL_2] = 0$$

Since $dH_2 + dN_2 + dL_2 = 0$ by (6), we have that $da_2 f(H_2) + dw_2 N_2 = 0$, and

$$\frac{dw_2}{da_2} = -\frac{f(H_2)}{N_2} < 0. \text{ When Education 2 raises household productivity more, the equilibrium}$$

wage rate in Occupation 2 decreases.

Proposition 1: The more an occupational education increases household productivity, the lower is the equilibrium wage rate of the occupation.

To see how an increase in household productivity influences hours spent in household production, take the total differential of (4):

$$da_2 f'(H_2) + a_2 f''(H_2) dH_2 = d w_2$$

and divide by da_2 to obtain

$$f'(H_2) + f''(H_2) dH_2/da_2 = dw_2/da_2 = -f(H_2)/N_2$$

$$f''(H_2) dH_2/da_2 = -[f'(H_2) + f(H_2)/N_2]$$

$$\frac{dH_2}{da_2} = -\frac{f'(H_2) + f(H_2)/N_2}{a_2 f''} > 0$$

When Education 2 raises household productivity more, the optimal number of hours spent in household production increases. What happens to leisure when household productivity increases? Since we have a situation with a given utility level (cf. equation (7)), there is no income effect. It now follows from equation (2) and the assumption that the utility function is strictly quasi-concave, that $\frac{\partial C_2}{\partial w_2} > 0$ and $\frac{\partial L_2}{\partial w_2} < 0$.

Hence, we obtain $\frac{dC_2}{da_2} = \frac{\partial C_2}{\partial w_2} \frac{dw_2}{da_2} < 0$ and $\frac{dL_2}{da_2} = \frac{\partial L_2}{\partial w_2} \frac{dw_2}{da_2} > 0$.

When Education 2 increases household productivity, hours of leisure increase, while consumption of goods and services is reduced. How is labour supply affected by an increase of household productivity from Education 2? Use (6), and obtain $\frac{dN_2}{da_2} = -\frac{dH_2}{da_2} - \frac{dL_2}{da_2} < 0$.

When Education 2 raises household productivity, labour supply in Occupation 2 decreases.

Proposition 2: The more an occupational education increases household productivity, the more hours the person will allocate to household production and leisure, and the less hours the person will supply in the occupational labour market.

This model uses ‘the representative person’ and assumes that all individuals are equal. This implies that all individuals choose Education 2 if the relative wage of Occupation 2 is slightly higher than the equilibrium relative wage, and vice versa. However, in the real world, individuals are heterogeneous due to variation in personal values, attitudes and household skills (as in Essay Two). Therefore, the economic terms of various occupations and the effects of occupational education on household productivity are not the only factors that influence occupational choice. Some individuals may feel an inclination towards nursing. Some have taken care of younger siblings and wish to become a pre-school teacher, whereas others have fixed bicycles and PCs and fancy engineering. The extent to which occupational education raises household productivity is one of several factors that may influence occupational choice, labour supply and wage formation. Propositions One and Two deal with these effects.

3.4 Comparing wages and working hours for different occupations

The derived propositions from the previous section can be evaluated using data from Norwegian graduates in 1978 from five different occupational programmes of equal length. Hoel, Mastekaasa and Arnesen (1990), and Arnesen (1992), present data concerning wages in 1989, labour force participation 1978-89 and information about the number of children. The five occupational programmes are: pre-school teacher, nurse, teacher, and engineer or business economist. According to Hoel, Mastekaasa and Arnesen (1990), wage rates vary systematically with occupation and the public or private sector nature of the job.

How may these five kinds of occupational education be ordered according to household productivity? Do pre-school teachers and primary school teachers have higher productivity in household production? Leibowitz (1974, 1977) shows that home investment by mothers in reading and other 'pre-school' activities improve the ability of young children to learn when starting school. When parents have completed the necessary education to become a pre-school teacher or a teacher, they have, presumably, increased productivity not only in raising other people's children, but also in raising their own children. The requisite education to become a registered nurse includes lectures and practice in taking care of basic needs. This raises household productivity. In becoming an engineer, an individual improves his mechanical skills, useful to keep domestic appliances and cars running. Business economists acquire skills helpful to household budgeting. Occupational education raises household productivity when there is an overlap between tasks in household production and an occupation. Following graduation, family formation will influence household production. I therefore expect pre-school teachers, in this period of the lifecycle, to hold the occupational education that have increased household productivity the most.

Table 3.1. Occupational wages in 1989 for 1978 graduates (with equal length of education)

Occupation by household productivity	Pre-school teacher	Nurse	Teacher	Engineer	Bus.econ.
Average full-time monthly wages 1989	12930	13310	14020	19210	21320
Av full-time monthly wage, private sec.	13160	14300	18170	20410	22700
Av full-time monthly wage, public sector	12880	13220	13690	15950	16700
Share of employees in public sector	79	89	91	26	21

Source: Hoel, Mastekaasa og Arnesen (1990, Table 3, p.31 and Table in Vedlegg 3, p.48).

In Table 3.1 I have ordered the various kinds of occupational education according to my perception of their relevance to household productivity: pre-school teacher, nurse, teacher, engineer and business economist. Table 3.1 shows that as occupational education increases household productivity, the lower the occupational wage rate is (and the average full-time monthly earnings equivalent). This holds within the private and the public sectors. Public sector monopsony may keep wage rates low for nurses and teachers, but pre-school teachers do not fit the pattern. The public sector dominates employment to a lesser degree for pre-school teachers, and the wage rate is even lower. These findings support Proposition 1.

Does the allocation of time to household production and paid work fit Proposition 2? Much as with Table 3.1, the various occupations in Table 3.2 have been ordered according to how much the occupational education raises household productivity. Female labour force participation is 10 percentage points lower than that of men and varies considerably with occupation. Female pre-school teachers have the lowest labour force participation. However, labour force participation varies less than hours worked because of part-time work and leave. Women reported less paid work than men during the first ten years following graduation, which is no surprise considering childbearing and maternity leaves. How do hours of paid work differ among occupations? Table 3.2 shows female occupational variation in paid work. During the ten-year period, female nurses worked, on average, only 63.7 per cent of a full-time equivalent. By contrast, female engineers and business economists worked 76.7 per cent of a full-time equivalent. Ten years after graduation, in February 1989, female nurses merely worked 60 per cent of full-time, more than pre-school teachers, whereas female teachers topped the list with 75 per cent, slightly above female business economists and engineers. The first ten years after graduation is a period of family formation when women give birth to children. This raises the demand for household production. In addition, the number of children varies by occupation. Female nurses have an average of 1.7 children, while female engineers and business economists on average only had 1.3 children due to postponed family development. Female part-time work varies among occupations. A total of 59 per cent of female nurses work part-time, 42 per cent of pre-school teachers, 38 of teachers and 31 per cent of female business economists and engineers work part-time. Among pre-school teachers, 77 per cent report child-care as the main reason for part-time work, whilst only 59 per cent among administrators and engineers do. The overall pattern of paid work by women supports Proposition 2 that the more household related the occupation, the fewer hours are spent in paid work. The allocation of hours to paid work vary according to occupation as

stated by Proposition 2, except for female nurses working fewer hours and female teachers working more hours. However, labour demand may account for this pattern since nurses frequently work shifts, and teachers spend fewer hours at work than most other occupations.

Table 3.2 Graduates 1978: Paid work and children by occupation (equal length of education)

Occupation ordered by household productivity	Pre-school teacher	Nurse	Teacher	Engineer & Bus.econ*	Source
Share of full-time work by women, 10 years, %	68,3	63,7	71,7	76,7	Tab.12,p.35
Share of full-time work by women, Feb.1989, %	68,1	60,2	74,9	74	Tab.2,p.22
Average number of children in 1989 for women	1,6	1,7	1,6	1,3	Note10,p.47
Share of part-timers among women, Feb.1989, %	41,5	58,6	38,4	30,8	Tab.5,p.26
Childcare is the main reason for part-time, %	77	75	69	59	Tab.6,p.27
Share of homemakers among non-participants,%	74	79	73	52	Tab.3,p.24
Share of non-participants wanting work, %	53	51	73	63	Tab.4,p.25
Cond: Better/cheaper child care (1=most imp.)	1	1	1	2	Tab.V11,p.61
Cond: Find relevant work (1=most important)	2	3,5	2	1	Tab.V11,p.61
Share of part-timers among men, Feb.1989, %	13,7	7	5,5	1,5	Tab.5,p.26

Source: Arnesen (1992). * The few business economists are merged with engineers by Arnesen (1992).

Is the public sector a monopsonist for pre-school teachers, nurses and teachers, as indicated by Table 3.1? Such monopsony is presumably more limited than is normally assumed because the public sector is not without competition. The public sector competes with private households where unpaid household production may be more attractive to individuals with high household productivity acquired through occupational education. How can unpaid household production be more attractive than paid work? Boskin (1975) shows how differential tax treatment of paid work and household production reduces returns from paid work in relation to untaxed household production, thereby moving hours away from the labour market towards household production. Even small increases in household productivity may become more important than bigger increases in job productivity because of this differential tax treatment. Sandmo (1990) discusses how the choice between buying a service or producing it at home complicates the optimisation of tax systems and rates. Unpaid household production may be profitable despite much lower productivity at home when the choice is affected by value-added tax, payroll tax and income tax.

Is there any support for Proposition 2, which holds that unpaid work at home is longer in occupations where the occupational education raises household productivity to a greater extent? The share of homemakers among individuals that do not participate in the labour market is higher for nurses than for the two teacher groups, whereas only half of the non-

wage-working engineers and business administrators are homemakers. In addition the share of non-participants wanting paid work is lowest for nurses and pre-school teachers, higher for engineers and business economists and highest for teachers. Business economists and engineers report access to relevant jobs as the most important condition for entering paid work, whilst the other groups mention better or cheaper childcare.

Presumably, education increases household productivity not only for women, but also for men. Following Proposition 2 we should expect to find that male pre-school teachers take on more care work for own children than other men, and that male nurses and teachers take on more household production than male administrators and engineers. This is supported by the data in Table 3.2, showing that part-time employment varies from 14 per cent for male pre-school teachers to 1.5 per cent for male administrators and engineers.

3.5 Alternative explanations

Differences in personal values have been suggested as an explanation of educational choice, and compensating wage differentials as a reason for wage differentials among education of equal length. Hoel (1995) suggests that differences in personal values influence what kind of education and occupation individuals choose. The empirical results she reports show a tendency towards this. She uses measures like the interest individuals take in helping others, in having an interesting job, in earning high wages, and so on. For instance, female nurses score highest on 'wish to help other persons', while male candidates in business economics score the highest on 'desire high earnings'. However, the variation in reported personal values does not explain the variation in wage work among groups, probably because 'having an interesting job' is the most important job-characteristic reported by every group when subdivided by education and gender. In a study using factor analyses, Edvardsen (1995) found that, in 1991, different motives influenced the choice of occupation by Norwegian 18-year-olds. Future engineers typically had a high score for 'wishing to decide and create'. Future teachers had a high score for 'wishing contact with other people' and 'wishing to help'. Pre-school teachers and nurses also had high scores for 'wishing to help', but, in addition, they had high scores for 'attachment to the domicile'. Edvardsen's study also reported the pupils' favourite subjects. Youths wishing to become an engineer most frequently favoured maths, teachers and pre-school teachers favoured the mother tongue, and nurses reported home economics and needlework as their favourite subject. These results illustrate that differences in values and tastes may play some part in the individual choice of education and occupation. The influence of various factors, and the importance of the interaction between interests and skills, have yet to be explained.

Polachek (1978) suggests that gender differences in college major go beyond ability and intended labour force commitment. The observation that male engineers earn higher wage rates than female nurses has been explained by compensating wage differentials. Assuming that male engineers struggle to learn maths, and that female nurses love caring, Polachek and Siebert (1993, p. 206-207), conclude that engineers have higher wage rates through compensating wage differentials. Whether engineers face more hardships than nurses do, is an empirical question. As indicated by Altonji and Blank (1999, p.3205) the sources of gender differences in test performance in math scores and verbal scores remain an active and controversial area of study. 'Hardships' during education or work are difficult to evaluate

because self-selection reduces attendance by individuals thinking that tasks are real hardships. Willis and Rosen (1979) report that expected gains in life earnings influence the decision to attend college and that indicators for family-background reflect financial constraints and tastes. These results accord with a more than one-factor ability consideration where boys chose to attend college in accordance with the theory of comparative advantage. Furthermore, Frank (1985) introduces higher status in the job as an element that compensates for a lower wage rate. To compensate for lower wage rates in my setting, pre-school teachers should have higher status than engineers and business economists, which seems unlikely.

Polachek (1976) argues that women with a higher priority for their own family and children and a higher expectancy of becoming a housewife choose shorter education and occupations where job skills depreciate slowly. However, according to Altonji and Blank (1999, p.3205), there is no longer any difference in average years of education between young men and women in the USA. There are modest differences in the high school curriculum taken by boys and girls. Boys take more maths and science courses than girls, and fewer courses in foreign language and commercial arts. Additionally, gender differences in the distribution of college majors have declined. An alternative explanation for educational choice and occupation may be derived from my model in Section 3.3: Women with a higher priority for their own family and children choose equally long occupational education that increases household productivity to a greater extent. When occupational skills are used in both a job and household production, withdrawal from the labour market into household production does not depreciate job skills. Due to increased household productivity such educational programmes and occupations recruit despite lower wage rates.

3.6 Concluding remarks

3.6.1 Educational policy

When educational programmes for pre-school teachers are also beneficial for raising children at home, the number of students that apply for such programmes is higher than the employment opportunities in isolation would imply. The home economics aspect of the education raises the number of applicants despite relatively low wage rates in the occupation. However, this may also be because the traditional home economics education has not been updated from a focus on production of goods at home towards the need for care-worker competence in today's households where technology has improved and ready-made products have increased in availability. Is it efficient to make homemakers attend nursing programmes and learn care-work in hospitals? Would it be cheaper for society to upgrade shorter programmes in home economics to include care-work, and recognise them as professional programmes for occupations like child-care assistance and nursing assistance? Recognising that some kinds of occupational education increase household productivity - as if they were kind of home economics programmes - would shed new light on the issue of required capacity for these educational programmes. Educational programmes that increase household productivity to the greatest extent need surplus capacity relative to the demand from the labour market to cover the demand from household production.

3.6.2 Further research

Time-use studies document hours in unpaid household production by groups, but seldom by occupation. Data that concern output from household production, household productivity and the shape of the household production function are scarce. Therefore, the assumptions concerning household production in this essay cannot be confronted with evidence. It is hard to single out the extent to which the occupational patterns can be explained by differences in wage rates, values or household productivity. Whereas a desire to help ill individuals should not make nurses homemakers, a desire to help all individuals - family members included - should make nurses more likely to choose unpaid household production. Further research is needed to disentangle the importance of personal values and household productivity for the choice of education and occupation and the allocation of time.

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ESSAY 4

**THE INFLUENCE OF HOUSEHOLD PRODUCTION
ON INTER-INDUSTRY WAGE DIFFERENTIALS**

by
Kristin Dale¹

Abstract

A new explanation of inter-industry wage differentials addresses household production and industrial organisation. Entry costs are low for firms that produce substitutes for household production, and workers in such firms only need household skills. A novel three-stage model shows that high entry costs for new firms in an industry generate few and large firms, high profits and wages. If industries with substitute household production have low entry costs, they consist of more and smaller firms than other industries, have lower profits and pay lower wages. Are industries with substitute household production the core of the 'secondary sector' in the 'dual economy'? Illustrations cover Japan, Norway and the USA. Policy issues include self-employment programmes and minimum wages.

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4.1 Introduction

Studies of wage differentials across time and space show that the type of industry itself influences the wage rate of workers. Lang et al. (1987, p.9) conclude from several studies that significant differences in earnings exist between individuals who appear identical to economists. While some of these differences may be returns to unobservable skills and ability, a large proportion is probably solely due to the place of employment. What is the pattern of inter-industry wage differentials? Table 4.1 shows the top ten and bottom ten wage industries in the USA in 1984 (according to Krueger and Summers, 1988). Contrary to their discussion, this essay focuses on the low wage industries.

Table 4.1 The US Industries with the highest and lowest wage level in 1984²

Industry (two-digit)	Estimated coefficient
10 Top wage industries:	
Petroleum	0.371
Tobacco	0.340
Public Utilities	0.259
Mining	0.241
Chemical	0.221
Transport Equipment	0.191
Machinery, Excl. Elec.	0.185
Communications	0.171
Primary Metals	0.162
Paper	0.141
10 Bottom Wage industries	
Leather	0.082-
Medical Services	0.082-
Apparel	0.127-
Entertainment	0.141-
Personal Services	0.154-
Other Retail	0.155-
Eating and Drinking	0.189-
Education Services	0.194-
Welfare Services	0.246-
Private Household	0.366-

² Source: Krueger and Summers (1988, pp.265-6) Table II.

Other explanatory variables are education and its square, 6 age dummies, 8 occupation dummies, 3 region dummies, sex dummy, race dummy, central city dummy, union member dummy, ever married dummy, veteran status, marriage x sex interaction, education squared x sex interaction, 6 age x sex interactions, and a constant. Cross-sectional log-linear regression weighted by employment shares and reported as deviations from the weighted mean of all industries.

Table 4.1 presents estimates of industry wage dummy variables for some industries, reported as deviations from the weighted mean wage of all industries, with individual characteristics controlled, but no control for establishment and firm characteristics. The estimated coefficient of an industry in Table 4.1 represents approximately the percentage wage difference from the mean wage of all industries for similar employees. In the petroleum industry the wage was approximately 37 per cent above the mean wage of all industries. In the leather industry and in medical services the wage was 8 per cent lower than the mean. Table 4.1 shows that the industry 'paid work for private household' had the lowest wage in the USA in 1984 - about 37 per cent lower than the mean of all industries.

What can explain these inter-industry wage differentials? Krueger and Summers (1988) conclude that the pattern of high wage industries can be explained by efficiency wage theories whereby employers willingly increase wage rates to obtain reduced turnover and higher productivity. However, neither Krueger and Summers (1988) nor Arai (1990) provide causal evidence to support this conclusion. Men who work full time in large establishments in concentrated, capital intensive, unionised industries dominate the top ten wage industries of Table 4.1. Women, who work full time or less in smaller establishments in competitive, labour intensive, non-unionised industries dominate the low wage industries. Another explanation may be that the share of female workers in the industry has not been controlled. Female dominated occupations may earn lower wages because a crowding of females leads to lower wages as Edgeworth (1922) argued. However, many more occupations are now open to women, though discrimination by employees or by monopsonistic employers (Bergmann, 1974) may still exist. Nevertheless, Löfström (1993) reports that female crowding is only part of the explanation for wage differentials by industry among Swedish employees in 1991.

The purpose of this paper is to introduce a new explanation of wage differences among industries. Two alternative research strategies - involving disequilibrium models or equilibrium models with wage differentials - are suggested by Lang et al. (1987, p.7), on the grounds that the pattern of high and low wage industries have hardly changed during the twentieth century in the USA. Lang et al. (p.8) recommend searching for an equilibrium model with particular wage differentials: *'Moreover, the evidence in the paper by Krueger and Summers (1987) of strong international correlations of inter-industry wage differentials, at*

least among developed capitalist economies, is more easily understood if the economy has a tendency to converge to particular differentials.' This essay enlarges the set of equilibrium models with particular wage differentials among industries.

The new explanation, which I want to focus on here, stems from an intriguing question: Why are men in the expanding business of car maintenance paid relatively lower wages than men in other sectors of iron and metal industry in Norway (after controls for qualifications, establishment size and region, [Dale 1994])? The relatively low wage rates in car maintenance cannot be explained by female crowding. However, the hidden explanation may lie in a similarity to household production. Firstly, the car repair business may be much more competitive than other sectors of the iron and metal industry due to the many actual and potential entrepreneurs attracted by the low entry costs of new firms. More people will consider starting a garage than a firm that produces primary metals. Secondly, car mechanics keep the family car running, and exchange services. Some of them probably started to repair cars as youth at home.

The ten low wage industries in Table 4.1 are: leather, medical services, apparel, entertainment, personal services, other retail, eating and drinking, education services, welfare services and paid work for private households. These industries involve production that, to a large degree, is similar to unpaid household production. In this essay, such industries are classified as industries with substitute household production. The top ten wage industries in Table 4.1 seem to have very little substitute household production.

This essay is organised as follows: Section 4.2 characterises industries with substitute household production. These characteristics are used in a model of wage formation in section 4.3. Results from the model are related to international empirical evidence in section 4.4 and implications for the 'dual economy' and labour market policies are presented in the final section.

4.2 Characteristics of industries with substitute household production

This paper focuses on two novel aspects of industries with substitute household production. The concept of substitute household production relates to the use of similar production processes and equipment in firms and homes. Some other aspects are not considered, such as the potential effects from the tax wedge (discussed by Kolm, 2000), and that of consumer demand for products. Due to space constraints, I confine this essay to industrialised economies.

Firstly, common characteristics of industries with substitute household production are that technology is widespread, well known and used in many households. Given that the specific production takes place in households, the technology and equipment are also available for new firms, and entrepreneurs may start a business at a low entry cost - self-employed or a small firm. Cooking is a part of household production, and ensures that a restaurant firm can be established at a small scale with low entry costs for capital equipment. While many people may consider opening a restaurant, which is a typical example of a firm with substitute household production, few would consider starting a petroleum company, a chemical firm or a paper mill because of the high entry costs for capital equipment and lack of know-how. The presence of substitute household production creates a highly competitive industry through low entry costs.

Secondly, many types of household production are widespread (cooking, cleaning, child-rearing, repairing, sewing etc.). People learn household skills from participation, observation or explicit teaching (the case with cooking, sewing). Everyone in industrialised countries has some of these skills. When tasks in firms and in household production are similar, household skills are relevant job skills for entrepreneurs and employees. Using the term 'no qualifications' for people who have not attended occupational training or higher education programmes, as Oulton (1996) does, is an under-estimation of household skills acquired from upbringing, household production and compulsory schooling. In the real world, firms are not like homes, and jobs in firms are not homogeneous. Thereby firms and industries differ by the degree to which they utilise household skills as job skills. Typically, paid work in private households makes extensive use of many household skills. The share of employees who need more qualifications than household skills may influence wage formation.

4.3 A model of entry costs and wage formation

The model below focuses on two characteristics and is a novel three-stage game. Manning (1994) surveyed economic literature of two-stage models that determine production and wage formation, and Michaelis (1997) also applies a two-stage models for such a purpose. Booth (1995) surveys the huge economic literature of trade unions, and sets out in a very systematic manner the assumptions and implications of various (two-stage) models from a comparative perspective. However, the model in this essay differs from other contributions in various respects. In particular, the model introduces the entry cost of new firms at an additional first stage, thus creating a three-stage model. We apply some simplifying assumptions to reduce the complexity and disentangle the three stages so that the model can be solved through backward induction.

Stage 1: Firm entry

Many potential firms may enter a particular industry. Any firm i that enters must pay an entry cost f , which stems from a capital investment that is non-reversible and lost if the firm is driven out of business. The entry cost is specific to a certain line of industry, but varies among industries. If firm i enters business, its production is a linear function of employment. Without loss of generality we set $q_i = l_i$, where q_i denotes the quantity produced by firm i and l_i denotes the employment in firm i . This implies that each worker produces one unit of the product. In other words, the level of production is proportional to the level of employment.

Stage 2: Wage formation

For simplicity, wage formation is modelled *as if* each firm established in stage 1 has a monopoly trade union that unilaterally determines the wage paid to all workers employed by the firm. Assume that the monopoly union of any firm i is ruled by the wish to raise the earnings of the workers in the firm. This implies to maximise the ‘real wage surplus’ that equals the increase in the real wage bill in the unionised firm compared to the alternative value of its workers. Formally, this corresponds to maximising the utility function

$$u_i = (w_i - w_0)l_i,$$

where w_i denotes the wage set by the monopoly union in firm i , and w_0 denotes the alternative value for the category of workers employed in firm i . The alternative value w_0 is

equal for workers of the same category and corresponds to their best alternative (the highest wage in alternative employment, or unemployment benefit or household production). The term in the parentheses measures the improved position of a worker from taking on work in firm i . The monopoly union of the firm takes into account that the employment and production in the firm will depend on the wage.

Stage 3: Production and employment determination

Assume that each firm exercises its *right-to-manage* and chooses q_i to maximise profit

$$\Pi_i = Pq_i - w_i q_i ,$$

where Π_i is profit excluding sunk entry cost, and P denotes price. The product is assumed to be homogeneous, and the inverse demand function in the market is assumed to be linear:

$$P = P(Q) = 1 - Q ,$$

where Q denotes the sum of the quantities produced by all the firms that have entered the specific industry: $Q = \sum_j q_j$.

Solution to the model

The model is solved by finding a subgame-perfect equilibrium, i.e. strategies that constitute a Nash equilibrium in any subgame. By construction, this model has a unique subgame perfect equilibrium that can be found through backward induction.

Stage 3 solution

A history (subgame) at the beginning of stage 3 is characterised by a number of firms, n , that entered the specific industry at stage 1, and the wage rates that the firm specific unions have determined in each of those firms (w_1, \dots, w_n) . Hence, finding the Nash-equilibrium in such a subgame is equivalent to finding the unique Nash equilibrium of the ordinary Cournot competition model with n firms, where firm i has the profit function $\Pi_i = P(Q)q_i - w_i q_i$. Provided that the wage rates are not too unequal (so that all entered firms will produce positive quantities), this unique Nash-equilibrium is characterised by firm i producing

$$q_i = \frac{1}{n+1} (1 - nw_i + W_{-i}) \quad \text{where } W_{-i} = \sum_{j \neq i} w_j .$$

This is demonstrated in the Appendix in section 4.8.

Stage 2 solution

A history (subgame) at the beginning of stage 2 is characterised by a number of firms, n , that entered the specific industry at stage 1. Assume now that the unions expect that the firms in stage 3 will behave according to the sub-game-perfect equilibrium strategies keeping in mind that $l_i = q_i$. A Nash equilibrium of a subgame at the beginning of stage 2 will then be a Nash equilibrium of a static game, where each union sets a wage rate $w_0 \leq w_i \leq 1$, and where its utility is given by

$$u_i = \frac{w_i - w_0}{n+1} (1 - nw_i + W_{-i}) .$$

This game has a unique Nash equilibrium, where union i sets the wage rate

$$w_i = \frac{nw_0 + 1}{n+1} .$$

This is shown in the Appendix in section 4.8.

Stage 1 solution

The wage rate for firm i found in the solution of stage 2 implies that the firm's profit, excluding the sunk entry cost (as calculated in the Appendix in section 4.8) is given by

$$\Pi_i(n) = \frac{[n(1 - w_0)]^2}{(n+1)^4} ,$$

when n firms have entered. The equilibrium number of firms to enter a specific industry is denoted by n^* , and is found by comparing $\Pi_i(n^*)$ to f . In equilibrium n^* is characterised by the fact that ex-post none regret having or not having entered this specific industry. This means that n^* is determined so that profit is non-negative when entry cost is deducted:

$$\Pi_i(n^*) - f \geq 0 .$$

However, if one more firm had entered in stage 1, this expression would have been non-positive:

$$\Pi_i(n^*+1) - f \leq 0 .$$

Results

This model shows some interesting results about how the entry costs for a new firm and the alternative value of workers in an industry influence the number of firms, the size of firms, the equilibrium wage rate and profits.

Firstly, the model shows that a higher entry cost for firms in a particular industry leads to a lower optimal number of firms, higher profits and a higher wage rate in equilibrium in the particular industry. Table 4.2 illustrates these analytical results, i.e. how the entry costs for new firms in a particular industry affect the optimal number of firms, and - for each firm - the optimal production, employment, wage rate and profits in the particular industry when the best alternative for workers is set to zero.

Table 4.2 Numerical example of consequences of different entry costs

To simplify assume that the best alternative for workers is no income, $w_0 = 0$.

Entry cost F	Number of firms N	Profit in firm i Π_i	Quantity in firm i q_i	Wage rate in firm i w_i
$\frac{1}{16} < f$	0			
$\frac{4}{81} < f \leq \frac{1}{16}$	1	$\frac{1}{16}$	$\frac{1}{4}$	$\frac{1}{2}$
$\frac{9}{256} < f \leq \frac{4}{81}$	2	$\frac{4}{81}$	$\frac{2}{9}$	$\frac{1}{3}$
$\frac{16}{625} < f \leq \frac{9}{256}$	3	$\frac{9}{256}$	$\frac{3}{16}$	$\frac{1}{4}$
$\frac{25}{1296} < f \leq \frac{16}{625}$	4	$\frac{16}{625}$	$\frac{4}{25}$	$\frac{1}{5}$

Independently of the value of w_0 , the model predicts that n goes to infinity and w approaches the competitive wage, w_0 , in the limit as f goes to 0. Thus, when the entry cost for a new firm in an industry is negligible, the model predicts that workers' wages will be fixed at no more than the competitive wage rate of their skill category.

Secondly, the model results show the importance of the alternative value of the worker for the wage level in an industry. If two specific industries have equal entry costs for firms, then the industry with the workers who have a higher opportunity value, pays higher wages. This implies that unions claim higher wages when the best alternative is a good one like another high wage job.

Table 4.3 Numerical example of consequences of various alternative values of workers

Assume that two industries have the same entry costs, $f = 1/32$.

Best alternative for workers	Wage rate in firm i	Number of firms
w_0	w_i	n
$\frac{1}{4}$	$\frac{5}{8}$	1
0	$\frac{1}{4}$	3

Notice that the wage difference between two industries with equal entry costs may more than exceed the difference in the alternative value of the workers in the two industries. This result is demonstrated in Table 4.3 ($3/8 > 1/4$). Therefore, raising the alternative value of workers may raise the wages even more.

4.3.1 Interpretation of the model for industries with substitute household production

Up to this point the formulation and solution of the model are applicable to many industries. Now I interpret the model for industries with substitute household production. Industries with substitute household production utilise the same production processes as household production, and their technology is widespread and well-known, and capital equipment is available both for household production and for a new firm at a low cost. Consequently, one characteristic of such industries is that new firms' entry costs are low. Furthermore, industries with substitute household production have at their disposal a large pool of potential workers, since most people obtain some household skills from observation or participation in household production. Household skills are the typical job skills of workers in the firms with substitute household production. When employees utilise household skills as job skills and have no additional qualifications, they do not face labour market options as good as those faced by other employees who have vocational or higher education or on-the-job training. For example, if employees with household skills have worked more hours in household production and fewer hours in paid work at a low wage rate (as is indicated in Essay One), they tend to obtain lower unemployment benefits than other employees. As a result, another characteristic of industries with substitute household production is that the opportunity cost of workers is low.

If it is true that industries with substitute household production have lower entry costs than other industries, and also true that they have employees with a lower opportunity value than other workers, then the model in this essay predicts that these industries will be less concentrated, have lower profits and pay lower wages than other industries.

4.3.2 Discussion of some assumptions in the model

The assumption that wages are set *as if* there is a monopoly union, creates a simple rent-sharing mechanism for the profit potential of the firm (excluding the sunk entry costs).

Research in industrialised countries suggests that the ability to pay leads to higher wage rates through some kind of rent-sharing in empirical studies from industrialised countries. Booth (1995, p.3) remarks that '*these [trade union] models are also relevant for a broader class of situations than those in which a trade union explicitly represents workers*', and she mentions the insider-outsider and the implicit contract literature. In my model varying entry costs create a varying *ex post* ability to pay. The property that wages are set *unilaterally* by unions is not essential to the qualitative results. Even if the assumption of unionisation is taken literally, this model does not imply that all employees should be unionised. It suffices that the wage fixed by the firm's union applies to both unionised and non-unionised workers. Unionisation is not a precondition for the results of the model if firms fear unionisation of their own workers and willingly pay the wages of unionised firms to avoid unionisation. The firm then mimics a union and pays the wage in the model. Furthermore, if the entry cost of a new firm, f , is low, the firm's *ex post* rents are low, and the wage set in the monopoly union solution almost converges with the competitive wage of the worker category. Hence, unions do not influence wage setting in industries with low f , such as industries with substitute household production. Thereby, workers have small incentives to unionise in such industries. This is consistent with the low degree of unionisation observed in industries with substitute household production.

In the model it is assumed that every industry uses but one category of workers and that their alternative value, w_0 , is equal for all individuals in the category because it is an option that is open to everybody in the particular category. A law firm example may illustrate the importance of a high alternative value of workers. Because standard office facilities with PC and fax are sufficient real capital to enter business, entry costs are rather low for a law firm.

The opportunity value of lawyers is high because they can take high-paying jobs as legal advisers or administrators. Therefore, it is consistent with this model that lawyers earn high wages.

How penalised are workers when they get fired? According to the model in this essay they may be paid a much higher wage than their opportunity value. Bluestone and Harrison (1982, p.10) assert that *'automobile workers who lose their jobs in this high productivity industry are found two years later to be in jobs that pay on average 43 percent less. Even six years after losing their jobs, these workers have recovered only five-sixths of the salaries they would have been earning had they not been laid off.'* This illustrates that workers are paid wages well above their opportunity value in industries with high entry costs (such as car manufacture) as predicted by the model in this essay.

If the market size is doubled, so that the inverse demand function in stage 3 is $P=1-Q/2$, and if f is also doubled, then the equilibrium number of firms and the wage rate would be unchanged. Hence, it is entry costs relative to market size that matters. For example, when trade liberalisation increases the size of the market, the model captures this through lower entry costs, and predicts lower wages in the affected industries, *ceteris paribus*. However, such a market integration may also affect the prices of consumer commodities; hence, the argument above does not necessarily imply that the *real* wage will decrease.

4.4 Empirical illustrations

4.4.1 Substitute household production in retrospect

Reid (1934, p.47) has described the changes in the division of production between households and firms in the USA: *'As factory production increased, tasks left the home. At first goods were made in both home and factory. The family gave up home production only as they were able to find a wider market for the products they had to sell. As time went on, one form of production after another, spinning, weaving, sewing, tailoring, baking, butchering, soap-making, candle-making, brewing, preserving, laundering, dyeing, gardening, care of poultry, and other tasks have wholly or in part been transferred to commercial production. In addition, child care, education, and care of the sick are now to a large extent carried on by paid workers. ... The change did not occur with equal rapidity in all parts of the country.'*

Reid (1934, p.43) also mentions bygone equipment for household production in farms citing Andrews (1919, p.64): *'The average New England country household was a sort of self-sustaining unit which depended little on the world beyond its own gates. Its equipment included not only usual chairs, beds, tables, and kitchen utensils and tableware, but the shoemakers' tools and shoe leather ... surgeon's tools and apothecary stuffs, salves and ointments ... occasionally a still or a cider press and outfits for carpentering and blacksmithing.'* These lists reveal which industries that had substitute household production long ago. With the exception of retail and entertainment, these industries are the lowest wage industries of Table 4.1. Previously industrial manufacturing of furniture, shoes, leather, textiles, toys and drinks had substitute household production. Today manufacturing of various kinds of food and clothing has substitute household production in industrialised countries.

The presence of similar production both in firms and households indicates that economies of scale are moderate or non-existent. I therefore expect to see a different size distribution of establishments in industries with and without substitute household production. Statistics Norway (1997, p.60-7) reports for 1995: 26 per cent of employment in the manufacture of bread, fresh pastry and cakes stems from establishments with less than 10 individuals, while 13 per cent of employment in clothing concerns such small establishments. Not one establishment in these industries employed 200 or more individuals. Only 1 per cent of employment in the manufacture of basic metals involves establishments with less than 10

persons, while 73 per cent of employment stems from large establishments with more than 200 persons. These numbers illustrate that industries with much substitute household production like baking and sewing consist of smaller establishments than industries with little or no substitute household production.

4.4.2 Econometric results from Japan and Norway

Tachibanaki (1996) presents estimations of earnings functions from manufacturing industries in Japan. In Table 4.4 these industries are ordered according to falling average capital intensity. His study does not contain an ideal measure of entry cost, but capital intensity and concentration (measured by share of workers) are reported and used here as indicators of entry costs. Table 4.4 shows that industries with higher capital intensity often are more concentrated and pay higher gross wages. Petroleum and coal - the most capital-intensive industry - paid a wage premium of 8 % (after controls for individual characteristics and firm variables including size, measured as deviance from the weighted mean). On the other hand the least capital-intensive industry, clothing, had a wage differential of 12 per cent below the average after similar controls. Wage differentials by industry tend to decline both with decreasing capital intensity and decreasing concentration. Both capital intensity and concentration correlate positively with unionisation. Unionisation is low in Japan in the low wage industries.

Clothing manufacture is an industry that has substitute household production. It had the second lowest capital intensity among the Japanese manufacturing industries in 1978, the third lowest concentration, the very lowest wage level and wage differential (after controls), and the fourth lowest unionisation (19 per cent), which supports the model in this essay.

Use the manufacturing of precision instruments as an example of an industry where capital intensity is low despite little substitute household production. For such industries, both unionisation and concentration are above the average for manufacturing industries. The high wage level in precision instrument manufacture probably stems from the large amount of human capital required. However, the pattern of human capital by industry is not available in Tachibanaki's (1996) study of wage determination in Japan.

Table 4.4 Empirical evidence from manufacturing industries in Japan 1978

Manufacturing industry	Capital:labour	Worker conc.	Wage/worker	Wage diff.	Unionization%
Line of industry	Tab.9.2	Tab. 9.1	Tab.9.2.	Tab. 5.2b	Tab. 9.1
	yen, 1978				
27 Petroleum, coal	40072	46	3421	0.077	59
31 Iron, steel	15587	64	3189	0.024	65
26 Chemical products	10113	55	3146	0.028	72
32 Non-ferrous metal	8099	47	2818	-0,005	63
24 Pulp, paper	6737	25	2225	-0,03	35
30 Ceram., stone, clay	4342	21	2066	0.001	33
36 Transport. equipment	4000	64	2792	-0,016	71
18 Food, tobacco	3395	24	1695	0.022	31
28 Rubber products	2871	44	2265	-0,02	57
34 Machinery	2862	32	2561	0.006	46
33 Fabricated metal	2813	14	2000	0.001	25
38 Other manufacturing	2694	13	1795		18
22 Lumber, Wood	2580	4	1593	-0,075	13
25 Publishing, printing	2517	20	2616	0.004	29
20 Textile mills	2113	20	1419	-0,096	39
23 Furniture	1928	5	1589	-0,044	13
35 Electrical machinery	1907	47	2209	-0,053	53
37 Precision instruments	1795	34	2138	-0,008	50
21 Clothing	766	5	1162	-0,125	19
29 Leather	752	3	1522	n.a.	12

Source: Tachibanaki (1996), referred to as (T) below.

Capital : labour: (T., p.177, footnote b) '*Capital : labour ratio is computed by dividing the total assets at the end of the year by the total no. of workers. 'Asset' refers to corporate fixed assets including (i) land, (ii) buildings, (iii) machine and equipment, (iv) transportation equipment.*'

Worker conc.: (T., p.175, footnote b) '*Worker concentration is the % of workers in firms with 1000 or more workers. Firms of under than 10 workers are excluded from the survey.*'

Wage/worker means (T., p.177) '*wage payment per worker.*'

Wage diff.: (T., p.89) '*Pure industrial advantages (or rents), after control for various qualifications in employees and firms: two-digit industrial classification.*'

Unionisation: (T., p.175, footnote d) '*Each of the unionization rates is computed by dividing the number of union members by the total number of workers in the industry, including those who work in firms with under than 10 workers. The unionization rate for retail and wholesale trade together is 0.143. The average unionization rate in the competitive sector is 0.217, while that in the non-competitive sector is 0.546.*'

4.4.3 Education and gender

Oulton (1996) reports that the share of employees with no vocational education is much higher in the UK than in Germany. The likely causes are a different system of education and apprenticeships together with genuine differences in qualifications, revealing that industrial educational requirements are relative. In 1987 the share of employees with only compulsory education in instrument engineering was 52 per cent in the UK and 26 per cent in Germany. Sectors with substitute household production tend to have a higher share of employees with only compulsory education. In the clothing and fur industry this proportion was 83 per cent in the UK and 35 per cent in Germany. Oulton (1996, p.205, p.207) labels this skill category 'no

qualification'. Since it is hard to find a precise label except 'compulsory education only', 'no qualification' indicates that qualifications attained through household production and compulsory schooling are not considered to be job qualifications in industrialised countries.

Table 4.5 shows results from Norway on inter-industry patterns including education and gender in 1990. The information includes: capital per employee, average years of education, percentage of female employees and inter-industry wage differentials (after standard controls that include size of establishment). Confirming the international pattern, petroleum refining is the manufacturing industry most characterised by the highest capital intensity, a male dominated workforce that has high average education and that receives the highest wage premium (after controls). In reverse order production of clothes and footwear have the lowest capital intensity, the lowest educational level, are female dominated, and have the lowest wages (after controls). The clothing industry is a typical example of industries with substitute household production.

The presence of short education and female domination in industries like manufacturing of clothes, footwear, fish products, textiles and leather supports the hypothesis that household skills are important in these jobs. In Japan, high wage industries like printing and publishing, and production of instruments have low capital intensity, but Norwegian data below in Table 4.5 confirms that such industries are male dominated and contain employees that are better-educated than industries with substitute household production.

Table 4.5 Empirical evidence from manufacturing industries in Norway 1990 and 1986

ISIC	Line of industry	Capital/worker	Years of education	Female %	Wage differentials	
		Tab.8.8	Tab.8.3	Tab.8.5	Tab. 5.1	Aggr.ind.
22	Crude petroleum&n.gas	n.a.	12,68	24	0,17	
353	Petroleum refining	14668	12,00	16	n.a.	0,19
354	Man. of other petro.p.	3943	10,42	13	n.a.	0,19
351	Industrial chemicals	3720	11,15	14	-0,07	
372	Non-ferrous metals	3348	10,92	17	-0,07	
341	Paper & pulp	3227	10,39	17	-0,09	
21	Coal mining	2596	10,50	35	n.a.	0,02
371	Iron and steel	2558	10,57	13	0 Ref.ind.	
23	Metal ore mining	2438	10,57	18	n.a.	0,02
29	Other mining	1822	10,02	12	n.a.	0,02
369	Other mineral products	1614	10,21	14	n.a.	-0,02
314	Manufact. of tobacco	1447	10,03	52	n.a.	-0,06
313	Manufact. of beverage	1439	10,52	20	n.a.	-0,06
355	Rubber products	1427	10,41	18	n.a.	-0,07
352	Other chemicals	1288	10,85	38	0,07	
362	Glass and glass pr.	1224	10,32	26	n.a.	-0,02
311	Other food manufact.	1194	10,44	37	n.a.	-0,06
331	Wood	1061	10,07	15	n.a.	-0,07
356	Plastic products	999	10,50	29	n.a.	-0,07
321	Textiles	862	9,86	60	n.a.	-0,15
383	Electrical apparatus	851	11,04	30	n.a.	-0,03
384X	Transport equipment x	765	10,58	12	n.a.	-0,03
361	Ceramics	681	10,74	45	n.a.	-0,02
382	Machinery	670	11,04	13	-0,02	
3114	Fish products	642	9,85	51	n.a.	-0,06
390	Other manufact. ind.	641	11,21	41	-0,04	
332	Furniture and fixtures	626	10,07	27	n.a.	-0,07
381	Metal products	588	10,38	16	-0,06	
323	Leather	489	9,70	45	n.a.	-0,15
342	Printing & publishing	487	11,17	37	0,23	
385	Instruments	459	10,86	25	n.a.	-0,03
3841	Ship building	416	10,61	10	-0,02	
324	Footwear	310	9,56	58	n.a.	-0,15
322	Clothes	306	9,82	84	n.a.	-0,15

Sources: *Capital/worker* (Dale et al., 1993, p.148) stems from data collected by Statistics Norway for Manufacturing statistics 1990, calculated from the fire insurance value divided by the number of employees. Numbers represent urban capital intensity estimated from a weighted linear regression with regional controls. *Years of education* (Dale et al., 1993, pp.120-7) Educational certificates are assigned the scheduled number of years to pass. Statistics Norway coupled information from the register of the individuals' highest completed education with population census data concerning which individuals worked in which industries in 1990. Numbers represent average years of education in urban regions estimated from a weighted linear regression with regional controls.

Female % (Dale et al., 1993, p.131-2) represents female share of the number of employees in urban areas estimated from a weighted linear regression with regional controls from the population census data 1990. *Wage differentials* (Dale, 1994, p.121-4) (not fully an ISIC classification) by industry (second last column) or more aggregated industries (last column). Coefficients estimated by a log linear weighted regression controlled for occupation, gender, region and establishment size from a data set of blue collar workers from the Norwegian Employer Federation, 1986. Reference group for industries: iron and metal. 'n.a.' means not available.

4.4.4 Relating the concept of 'entry costs' to firm characteristics in earnings functions

The entry costs of a new firm in the model of this essay is the initial capital necessary to enter business that is not recoverable if entry fails. While the entry costs of a firm may be important for wage formation, as this paper illustrates, it seems to play no part in labour economics. To my knowledge, no study of wage rates uses the entry costs of a firm as an explanatory variable. However, there are studies that discuss how related concepts like 'barriers to entry' or 'concentration' may raise wages, for instance Abenoja and Lapid (1987) and Nickell, Vainiomaki and Wadhvani (1994). These studies report that more concentrated industries earn higher profits and pay higher wage rates. This is in line with my model's result that market concentration, profits and wages correlate positively. Below I relate 'entry costs of a new firm' to characteristics that are frequently cited by labour economists as independent variables in empirical studies of earnings functions.

4.4.5 Firm characteristics in earnings functions

Ever since Mincer (1974), the estimated wage equation frequently has a log-linear structure, implying that the underlying model of wage differentials consists of the product of the independent variables. Hildreth and Oswald (1997) show that changes in profitability feed into lasting changes in wages. They criticise the empirical literature on wage formation (based on individual and household data) for not capturing the proper establishment and company effects. They argue that company or establishment wage panel data should be used. The explanatory variables differ among empirical studies and are typically restricted by the data set. For example, Denny and Machin (1991) report for the UK in 1976-86 that profits per employce, industry wages and the capital-labour ratio raise firm-level wages. Edin and Zetterberg (1992) utilise independent variables for firm size, regional unemployment, job characteristics as shift-work and industry dummies. Tachibanaki (1996) applies independent variables for capital intensity, establishment size, firm size, industry dummies and 'worker concentration' to measure product market power.

Lang et al. (1987, p.9) conclude about empirical analysis of wage differentials by industry: *'The paper by Dickens and Katz [chapter 3, 1987] investigates which factors influence inter-industry wage differentials. Their unusually careful empirical study demonstrates that most of the factors are so interrelated that it is impossible to ascertain the relation between key*

variables and inter-industry wage differentials. Instead, the results are highly sensitive to choice of sample and model specification. Nevertheless, certain variables appear to play an important role - the average level of education in the industry, the average size of the establishments, measures of profitability and the capital/labor ratio.'

These findings support the potential importance of concepts in the model of this essay. Firstly, the alternative value of workers in the model relates to the level of education. Secondly, the entry costs of new firms relate to the capital /labour ratio and the size. The product of the capital/labor ratio and the number of employees correspond to the capital of a firm as a 'going concern'. The capital/labour ratio multiplied with labour concentration represents the capital as a going concern per market share. To what degree the concept 'entry costs of a new firm' correspond to the independent variable 'the capital of the going concern', depends upon the irreversibility and the potential loss of capital when the firm leaves business. Therefore, independent variables in earnings equations such as capital intensity, size and concentration may capture some aspects of the concept of the entry costs of a new firm.

4.5. Discussion

4.5.1 Why has household production not been related to wages previously?

The most likely answer to this question is that economists and other social scientists tend to associate consumption with households and production with firms. When Hamermesh (1993) surveyed economic literature on labour demand, and Tirole (1988) presented the theory of industrial organization, household production cannot be found in the index of these books. Furthermore, to reduce data collection costs, self-employment and small establishments are omitted in industrial data sets or reported in summary statistics. In Norway, for example, when manufacturing establishments have less than five employees, only employment and sales data are collected. When other characteristics of all firms are later estimated using data from 'large' establishments, differences between small and large establishment within an industry may be underestimated. Table 4.4 used data for Japan where information was excluded for firms with less than ten employees. This may bias the results about the economies of scale in industries. Last, but not least, actual and potential intra-industry competition from both small firms and households are ignored. The international industrial classification systems order industries according to technology type combined with raw material type. Lists of industries according to ISIC- and CIC-classifications distribute industries with substitute household production throughout the list. To make the point of industries with substitute household production noticeable, regrouping is required.

There are various ways in which household production may influence markets, and thereby wage formation. Phenomena like tax-wedges influence demand for consumer products and the supply of labour services by subsidising household production. However, this essay focuses on the supply side of product markets - taking into account the degree to which production in firms could take place at home. Empirical studies have to test which mechanisms are the most important of those related to household production. Relevant data sets are not presently available. They should cover firms and household production, tax data and various kinds of human capital including household skills.

4.5.2 The mixed blessings of self-employment schemes to reduce unemployment

Many governments make self-employment schemes an integral part of labour market programmes to fight unemployment. Consider the activities of female entrepreneurs. According to Kaur and Hayden (1993, p.102) female entrepreneurs are attracted to businesses that use their domestic skills, whereas Johnson and Storey (1993) hold that female entrepreneurs are over-represented in retailing, lodging, catering, repair and other services. Most of these businesses have some kind of substitute household production. Remember that the success probability of establishing a new firm or self-employment is less than one, not least for people who have been unemployed. The results of the model of this paper challenge self-employment policies, not only because of the risk of business failure, but also for the long run effects of directing more people into firms with low entry costs that face substitute household production and receive low wage rates and profits.

4.5.3 The minimum wage

Card and Krueger (1995) present empirical studies of the economics of the minimum wage in the USA. Most empirical evidence is confined to relatively few industries: agriculture, manufacturing of clothing, textiles, furniture, toys and sporting goods, retail trade, restaurants, fast-food industry and other household related services. They conclude that enforcement of moderate minimum wages in USA is neither so harmful to employment and consumer prices, nor so good for wage earnings as the debate among economists have indicated. Except for retailing, industries where the minimum wage is an issue have a high degree of substitute household production in industrialised countries. This is in itself evidence that the presence of substitute household production reduces wages. Brozen (1962) describes how many occupations in the USA were gradually covered by minimum wage legislation while paid household workers - the core occupation in substitute household production - remained uncovered. Card and Krueger (1995) indicate that, for industrialised countries, enforcing a minimum wage is an effective means of raising wages in industries with no international competition.

4.5.4 Is substitute household production the demarcation line of the 'dual' economy?

The segmented labour market approach, which includes 'the dual economy' and 'the dual labour market', is identified with social scientists as Doeringer and Piore (1971). They argue that the neo-classical apparatus provides an inadequate description of the labour market and

leaves unexplained major labour market policy questions, according to Taubman and Wachter (1986) who emphasise the problem of demarcating between sectors. Dickens and Katz (1987, p.79) comment on empirical findings that concern the dual economy: *'Industry characteristics are fairly highly correlated with each other. Further, there is a pattern to the correlation suggesting the existence of one or a few underlying factors, which explain the distribution of industry characteristics. This has been the conclusion from the 'dual-economy' perspective. Several authors have factor analyzed industry data and have found one dominant factor corresponding to the view that there is a single dimension along which industries vary. At one end of this spectrum are industries which pay high wages, have substantial market power, tend to be made up of large firms with large establishments, have a higher union density, have high capital-to-labor ratios and employ fewer women. At the other end are those with the opposite characteristics.'* The secondary sector of the 'dual-economy' consists of industries that pay low wages, have no market power, tend to be made up of small firms with small establishments, have a low union density, have low capital-to-labour ratios and employ more women. This fits well with the description of industries with substitute household production that employ household skilled workers, especially when we take into account that women spend more hours in household production than men (see Essays One and Two) and have more household skills.

The results of the formal model alongside the empirical results presented in this paper, leads to a new hypothesis: The production of services and goods with substitute household production takes place in the so-called secondary sector of the dual economy, and employees use household skills as job skills. Substitute household production links potentially strong product market competition and strong labour market competition with certain lines of industry. Industries with substitute household production have two characteristics: low entry costs of firms and many employees who use household skills as job skills. These two characteristics result in a 'secondary sector' - a low wage industrial sector as shown by the model in this paper, that contains industries with substitute household production, and a corresponding 'secondary labour market' a segment of household skilled jobs with low wages. Degree of substitute household production seems to be an underlying cause of variation in the 'dual economy'. The secondary segment of the 'dual labour market' consists of the segment of household skilled jobs. It seems promising in empirical studies to introduce

demarcation lines between occupations with household skills and occupation with other skills and industries with substitute production and other industries. Furthermore, when classification is made problematic by a mixture of both characteristics, this merely corresponds to the view in the labour market literature (surveyed by Taubman and Wachter, 1986) that classification is a matter of degree; there need not be an absolute divider. When the concepts of household skills and industries with substitute household production are introduced into the neo-classical models of this essay and Essay Two, the results reconcile the gap between the neo-classical and the dual labour market theories. This is not to say that industries with substitute household production are the only industries in the secondary sector, nor are household skilled jobs the only jobs in the secondary labour market.

4.6 Concluding remarks

This essay presents a new explanation of inter-industry wage differentials that combines household production and industrial organisation to address industries with production similar to households, i.e. industries with substitute household production. Entry costs are low for firms producing substitutes for household production, and workers in such firms need only household skills. A novel three-stage model in this essay shows that: High entry costs for new firms in an industry generate few and large firms, high profits and wages. If industries with substitute household production have low entry costs, they consist of more and smaller firms than other industries, and pay low wages to household skilled employees. Illustrations present empirical results from Japan, Norway and the USA. These results are discussed in relation to policy issues that include self-employment programmes and minimum wages. Last, but not least, the discussion suggests that industries with substitute household production are the core of the 'secondary sector' in the 'dual economy'. Thereby, the degree of substitute household production acts as a line of demarcation between industries in the dual economy, and that degree of household skills may be a divider in the 'dual labour market'. In this case, the introduction of these concepts reconciles neo-classical models and theories of segmented labour markets.

4.7 References

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4.8 Appendix: Derivation of the subgame-perfect equilibrium

The solution of stage 3:

$$\Pi_i = P(Q)q_i - w_i q_i = (1 - Q)q_i - w_i q_i$$

$$\frac{d\Pi_i}{dq_i} = (1 - Q_{-i} - q_i) - q_i - w_i = 0 \quad \text{or}$$

$$1 - Q_{-i} - (2q_i + w_i) = 0$$

Multiplying this first-order condition with $(-n)$ yields

$$-n + nQ_{-i} + n(2q_i + w_i) = 0$$

By adding

$$1 - Q_{-j} - (2q_j + w_j) = 0$$

for all $j \neq i$ to the left-hand side of this equation, we obtain

$$-n + (n - 1) + (n + 1)q_i + nw_i - W_{-i} = 0 \quad q_i = \frac{1 - nw_i + W_{-i}}{n + 1}$$

The solution of stage 2:

$$u_i = (w_i - w_0)l_i = \frac{w_i - w_0}{n + 1} (1 - nw_i + W_{-i}) \quad \text{since } l_i = q_i$$

$$\frac{du_i}{dw_i} = \frac{1}{n + 1} [(1 - nw_i + W_{-i}) - nw_i + nw_0] = 0 \quad \text{or } 1 - 2nw_i + W_{-i} + nw_0 = 0$$

Multiplying this first-order condition with $n+2$ yields

$$(n + 2) - (n + 2)2nw_i + (n + 2)W_{-i} + (n + 2)nw_0 = 0$$

By adding

$$1 - 2nw_j + W_{-j} + nw_0 = 0$$

for all $j \neq i$ to the left-hand side of this equation, we obtain

$$(2n + 1) - (2n + 1)(n + 1)w_i + (2n + 1)nw_0 = 0$$

$$(2n + 1)(nw_0 + 1) = (2n + 1)(n + 1)w_i \quad w_i = \frac{nw_0 + 1}{n + 1}$$

Calculation of profit excluding the sunk entry costs:

Since the stage 2 solution is symmetric, $w_j = w_i$ for all $j \neq i$,

$$q_i = \frac{1 - nw_i + (n-1)w_i}{n+1} = \frac{1 - w_i}{n+1} = \frac{1 - \frac{nw_0 + 1}{n+1}}{n+1} = \frac{n+1 - nw_0 - 1}{(n+1)^2} = \frac{n(1-w_0)}{(n+1)^2}$$

Hence, the stage 3 solution is also symmetric ($q_j = q_i$ for all $j \neq i$) and

$$P(Q) - w_i = \frac{(n+1)^2 - n^2(1-w_0) - (n+1)(nw_0 + 1)}{(n+1)^2} = \frac{n(1-w_0)}{(n+1)^2}$$

Therefore, the profit excluding the sunk entry costs is given by:

$$\Pi_i(n) = [P(Q) - w_i]q_i = \frac{n^2(1-w_0)^2}{(n+1)^4}$$

ESSAY 5

**WAGE EMPLOYMENT VERSUS FAMILY-BASED
SELF-EMPLOYMENT IN A REGIONAL PERSPECTIVE**

by

Kristin Dale¹

Abstract

Industry patterns differ between rural and urban areas. Shops, restaurants, inns, farms, and so on, are often family-based businesses. This paper analyses the pattern of wage employment and family-based self-employment in rural and urban areas. The model has two sectors (wage employment and family-based employment) and two regions (urban areas and rural areas, with a cost disadvantage). The model predicts an increased prevalence of family-based employment in rural areas when wages are regulated nation-wide and rural capital intensity is maintained through capital subsidies. Empirical results from Norway support these results to some extent.

¹ I would like to thank Otto Andersen, Geir B. Asheim, Rolf J. Brunstad, Erik Hernæs, Steinar Holden, Karl Robertsen, Agnar Sandmo, Inge Thorsen, Stein Østbye and participants of the EALE Conference in Regensburg, September 1999, for helpful comments.

5.1 Introduction

Industry patterns differ between rural and urban areas. Agriculture and other primary industries tend to locate in rural areas, as do small trade and tourism firms seem numerous in rural areas. Shops, restaurants, inns, farms, and so on, are often families-based businesses using household resources. Do rural areas 'lack' wage employment? Is family-based income more important, in rural areas? These questions are the focus of this essay, which discusses the importance of family-based employment in rural areas in the context of a model with two geographical regions and two industry sectors. The two regions are urban and rural (the latter is assumed to have a cost disadvantage). The first sector has ordinary wage employment where the wage is regulated through economy-wide agreements, while the second sector comprises family-based businesses. I assume that rural amenities and capital subsidies prevent factor mobility between the two regions. Under the assumption that the wage in the first sector (and in both regions) equals the urban equilibrium wage, I demonstrate the result that the industry pattern in the rural region shifts towards the sector with family-based businesses.

Studies of regional economics approach production from various perspectives. The Export Base theory (Paelinck and Nijkamp, 1975) provides regional income models. In this essay, I use a different model to emphasise a particular aspect of ownership structure: family-based employment. In wage employment, employees and owners are not the same individuals. In family-based businesses, the family establishes a firm or other income-generating activity, and supplies both capital and labour inputs. In Essay Four, I showed that household production influences wages and profits in industries with substitute household production. Some of these industries have a higher proportion of family-based firms. National regulation of wages in some sectors, in addition to tax policies that treat family members and other employees differently, may advance rural self-employment. Rural development measures that encourage entrepreneurs will also promote self-employment. Do studies show that self-employment is more important in rural areas? Is this due to self-employment in agriculture? If private company employment is less frequent in rural areas, what roles do public employment and self-employment play?

Section 5.2 surveys some selected economic studies related to family-based firms. The industry pattern in rural areas is analysed graphically in Section 5.3 by the economic model of industry structure with two sectors and two regions. Section 5.4 presents some empirical results from Norway - a country with significant regional policy measures. The relative distribution of earnings from self-employment and wage work in Norway in 1996 partially supports the results of the formal model. Finally, Section 5.5 contains concluding remarks. Appendix A in section 5.7 is a mathematical analysis of the model, and Appendix B in section 5.8 presents some empirical information.

5.2 Studies related to family-based firms

Both small family firms and self-employment violate the usual dichotomy in economics between capitalists and workers. In this essay, the notion of a family-based firm is used to characterise a situation where capitalists and workers are the same individuals or belong to the same (extended) family. In the formal analyses of Section 5.3, the family-based firm is a way to avoid paying the regulated wage rate. Various studies consider other aspects of family-based firms. The selected survey below points to some of these different approaches.

Many authors study the theory of the firm. Fallon and Verry (1988, p.98) discuss some limitations of the profit maximisation assumption and outline a different model. *'Another case in which a firm may maximise its objective without minimising costs is as the firm (or more realistically the firm's manager) obtains satisfaction from employment per se.'* This point stems from Scitovszky (1943) who emphasised that entrepreneurs maximise utility, not income. This is a realistic model for grandparents/parents who want to see their family members employed. When both profit and employment are arguments in the manager's utility function, there is still a downward sloping labour demand curve. In addition to different examples of traditional labour managed firms, Drèze (1989, p.3) writes: *'Labour management is a useful paradigm to study economic decisions in at least three additional sets of circumstances:(ii)Small business ventures owned and operated by members of a family (farms, vineyards, stores, fishing boats, garages an the like) also come close to the labour-management model.'* In the overall conclusion Drèze (1989, p.114) states: *'In economies operating with uncertainty and incomplete markets, it is natural to find capital hiring labour, because efficient labour contracts in capitalist firms are easier to draw and monitor than efficient equity contracts for labour-managed firms. ... Smaller firms with closely held equity could be labour managed, if working conditions call for frequent and subtle adjustments, or could practise profit-sharing and participatory decision-making.'*

Coase (1937) discusses the size of the firm. The types of transactions the entrepreneur will keep within the firm are related to the costs of using external markets versus internal production. According to the classification of Coase (1937), the reasons for family-based firms staying small are (i) the entrepreneur is better informed about family members, (ii)

hiring costs of family members are smaller, or family members claim lower wages or create lower non-wage labour costs. Holmström and Roberts (1998) review the Coase-inspired literature on the market boundaries of the firm, and Gibbons (1998) surveys the literature on the incentive problems stemming from the separation of owner and manager. The core of the Coase-inspired literature comprises large firms and enterprises. Garen (1998) relates self-employment to the theory of the firm by viewing self-employment as a pay system alongside hourly pay and salary pay.

The social science literature on entrepreneurs is large. Many studies attempt to identify the factors involved in entrepreneurial success. When studies are policy-oriented, conditions for credit and the role of realistic advice to entrepreneurs are emphasised. Blanchflower and Oswald (1998) survey literature on entrepreneurs and conclude that psychology is not a crucial factor in deciding who becomes an entrepreneur, even though children anxious for acceptance are slightly less likely to run their own businesses. Empirical results support the two hypotheses that lack of financial capital constrains self-employment, and that the self-employed are happier. For 33-year-old Britons questioned in 1991, the self-employed were marginally more likely to have inherited their wealth, and the average amount inherited was much higher than for employees. Most small businesses started with an individual's own money or their family's, not with bank loans. Avery et al. (1998) find that unincorporated firms are more likely to have loans with personal collateral and that personal commitments are substitutes for business collateral. Firms with few assets available to pledge tend to be more dependent on personal commitments.

Economists have studied the role of labour and capital subsidies in promoting employment, and the standard result is that labour subsidies are the most effective. According to Østbye (1996) a certain set of assumptions modify this standard result. Furthermore, if second-hand real capital markets function better in urban than in rural areas, the potential losses are, on average, larger in rural areas, which implies fewer firm entries in rural areas, and fewer jobs. The difficulty associated with raising collateral in rural areas leads to a reduced chance of regular loans. All things being equal, the credit argument implies an inverse industry pattern. In rural areas, wage employment by national and international firms should be relatively more common, and self-employment less frequent. Lack of credit for rural development is one of

the reasons why regional policies to promote rural employment contain public subsidies of investment in real capital.

Blanchflower (1999) surveys the literature and raise several questions at individual- and country-level about self-employment in the OECD countries. He points to the disagreement over whether high unemployment discourages self-employment because of the lack of market opportunities or, alternatively, encourages self-employment because of the lack of jobs.

Blanchflower (1999, p. 26) concludes that: *'For most countries there is a negative relationship between the self-employment rate (variously defined) and the unemployment rate. From the time series regressions there is evidence of positive effects only in Iceland and Italy. The effects are more strongly negative in the agricultural sector. There is more evidence of positive unemployment effects in the individual level equations.'* These results indicate that if self-employment compensates for lack of wage employment and reduces unemployment, it is rather more of a short-term business-cycle effect than a structural effect. However, Blanchflower does not consider the regional dimension within each country, where institutions and policies are common to several regions. I focus upon regions within a country, thereby controlling for differences in social security system and tax rules. I consider the industry mix (i.e. the extent to which self-employment is a substitute for wage employment in both the private and the public sector).

Oinas (1995) discusses the interdependence among types of firm and types of communities. He classifies enterprises and local relations according to mutual dependence. Family ownership is classified as having high enterprise dependence and high locality dependence, whereas ownership divorced from management is classified as low enterprise dependence and low locality dependence. To formalise and narrow the types of firm and location, I use an international trade model in Section 5.3 to capture aggregate regional and sectoral dimensions.

5.3 A model of industry structure in urban and rural areas

My model is a Heckscher-Ohlin model in accord with the textbook presentation and figures by Norman (1993, Chap.5), where Dixit and Norman (1980, Chap.4) is the theoretical basis. The model has two sectors (with different capital intensities) and two regions. *Higher transport costs for products are assumed for both sectors in the rural area.* To simplify the exposition, it is assumed that no firm has the power to influence the market prices of inputs or outputs. *Constant returns to scale in both sectors are also assumed. Further, workers are homogeneous with respect to skills.* Throughout, superscripts denote sectors and subscripts denote regions. Appendix A in section 5.7 presents the formal model.

Figure 5.1 The urban region: a) Industry composition, b) Labour demand by two sectors

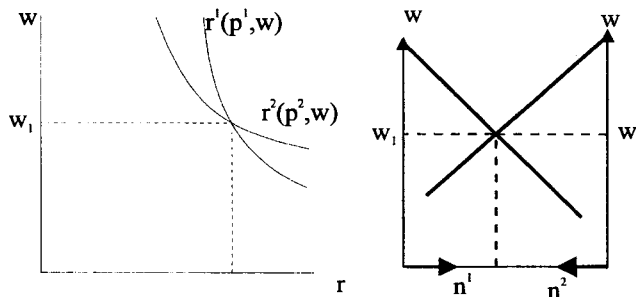


Figure 5.1a illustrates the determination of the equilibrium wage rate and return on real capital in the urban region with two sectors. Figure 5.1b illustrates, for the urban region, how the demand for labour by the two sectors varies by wage rate, and the division of labour between the two sectors at the equilibrium wage rate. Sector 1 consists of capital intensive, private firms as analysed by the economics of production. In the real world this is the situation of typical firms in many lines of manufacturing industry. In Figure 5.1a $r^1(p^1, w)$ denotes how the return on real capital in sector 1, r^1 , depends on the producer price in sector 1, p^1 , and the wage rate for workers in the region, w . The return curve for sector 1 reflects the functional income distribution (i.e. how the producer price is divided between workers and owners). The return curve is not a straight line because labour intensity varies in accordance with the factor prices (the returns to labour and capital). Let $r^2(p^2, w)$ describe how the revenue per unit in sector 2 is divided between workers and owners. The flatter shape of this curve indicates that sector 2 is

less capital-intensive than sector 1. Sector 2 represents labour intensive industries that consists of firms in the service sectors, indicated by the term tourism for sector 2. The shape of the return curve for sector 2 reflects a different composition for sector 2 depending on the relative prices of the production factors. For example, in the upper left corner of Figure 5.1a, where wage rates are very high, the tourism sector consists of self-service apartments. In the lower right corner, where wages are low, it consists of full-service hotels. A certain reduction in wage rate increases the return on real capital more for sector 2 than sector 1 because sector 2 is the most labour intensive.

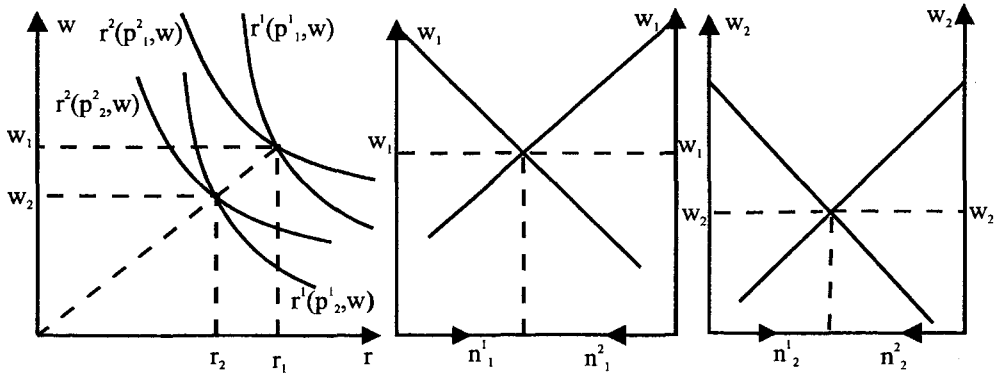
Figure 5.1a shows that there exist an equilibrium wage rate, w_1 , and an equilibrium return to real capital, r^1 , that make no worker or capitalist want to change sector. Figure 5.1b illustrates the corresponding labour market equilibrium of the urban region. The horizontal axis represents the total amount of homogeneous labour in the urban region. The number of workers in sector 1 is measured from left to right. The vertical axis represents the wage rate. The downward sloping curve in Figure 5.1b shows how the demand for workers in sector 1 varies with the wage rate. The curve that falls from right to left represents the demand, depending on the wage rate, for workers in sector 2. The intersection between the two labour demand curves represents the equilibrium where the sum of workers in demand is equal to the supply of workers. The term w_1 represents the equilibrium wage rate in the urban region.

The assumption of higher transport costs for products in the rural area captures the disadvantage associated with production in a rural region. In Figures 5.2 to 5.4 *transport costs are assumed to reduce the producer price by the same proportion in both sectors in the rural region*. This is a standard way of modelling transport costs. Samuelson (1954) illustrated transport cost by the fraction of ice export that melted during transport and von Thünen (1895) by the fraction of grain eaten by the horse while bringing it to the market. I avoid discussing the effects of different transport costs in different sectors while assuming equal proportional reductions of value added in both sectors in rural areas.

In Figure 5.2a, the state of the urban region is marked with the subscript 1 to denote the urban equilibrium wage rate w_1 , and the urban equilibrium return to capital r_1 . The assumption that all sectors in the rural region have higher transport costs create rural return curves that are

located as equal inward shifts of the urban return curves in Figure 5.2a. Figure 5.2a shows the rural equilibrium wage rate, w_2 , and the rural equilibrium return to capital, r_2 . The assumption that the transport costs in the rural region reduce producer prices by the same fraction for all sectors locates the rural equilibrium on the line from origo to the urban equilibrium.

**Figure 5.2 a) Equilibrium capital returns and wage rates in the urban and rural regions
Labour demand by both sectors in b) the urban or c) the rural region**



Compared to the urban region, the rural factor prices decrease proportionally. Figure 5.2 depicts an unstable situation. All else being equal, workers and capitalists would choose the urban area to take advantage of the higher wage and higher return to capital.

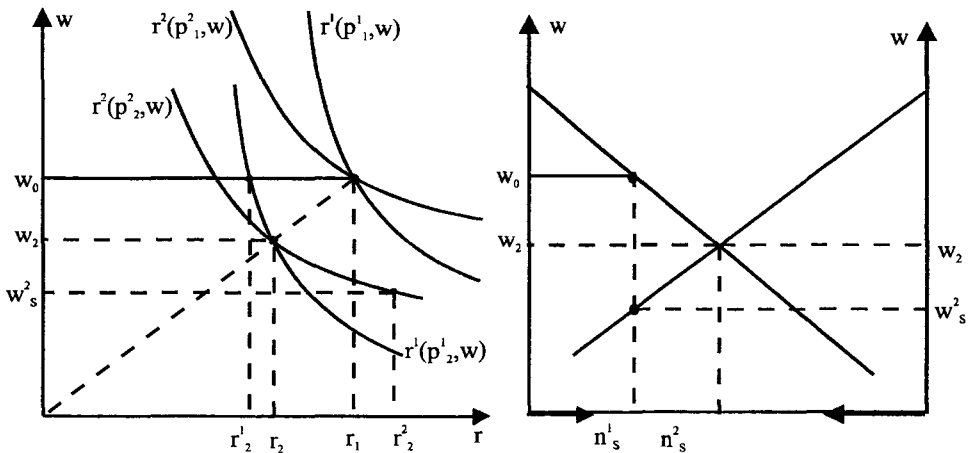
However, some living costs may be lower in rural areas. Living in the breath of the country may be valued above urban life, which implies that some workers choose the rural region. Moreover, capitalists may receive rural investment subsidies to start firms in rural areas. In addition, persons living rurally face a trade-off between various transaction costs, moving costs and the higher wage rate of urban jobs. Finally, according to Figure 5.2, capitalists who move production to urban areas may suffer a loss on rural real capital that counterbalances the higher return to real capital in urban areas. To simplify the model, migration is not taken into account. To use a comparative static analysis, I use the two following assumptions:

- 1) *Rural people do not move to the city.*
- 2) *Rural sector-neutral capital subsidies make capitalists invest in the rural region so that the overall capital-intensity is sufficiently equal in both regions to avoid full specialisation.* Given these assumptions, Figure 5.2 shows that the industry mix and return to private capital are

equal in both regions, while both return to total capital and wages are lower in rural areas. It is an unrealistic conclusion that the industry mix does not differ between urban and rural areas. In all countries, primary industries are over-represented in rural areas, while manufacturing and business services are over-represented in urban areas. Can these phenomena be explained by the above model while maintaining the assumption that the overall regional capital intensity is equal in both regions?

Registered unemployment is often higher in rural than urban areas, indicating that whatever the wage formation process in rural areas might be, wages are not set according to the equilibrium wage rate of the rural region in Figure 5.2. In many sectors a bargaining process between the employer and the employee heavily influences the wage rate. Assume that the wage rate of sector 1 (manufacturing) is nationally determined through union bargaining and equal for the urban and the rural region. For simplicity, assume that the wage rate of sector 1 is equal to the equilibrium wage rate of the urban region (thereby avoiding a full discussion of what happens in the urban area). Figure 5.3 shows the short-run equilibrium when the national wage for sector 1 has been introduced in both regions, whereas Figure 5.4 presents the more important long-run equilibrium once real capital adjustments have taken place.

Figure 5.3 The short-run rural effects of national wages in sector 1 given rural capital subsidies for a) industry mix, returns and wages, and for b) labour demand

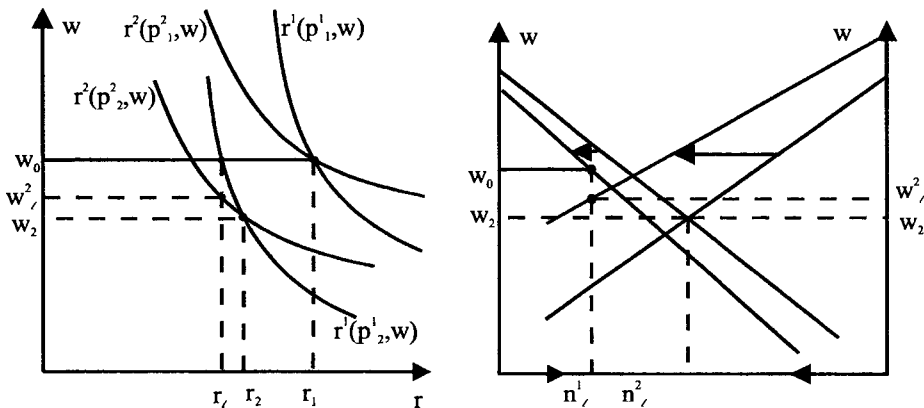


Given that the wage rate w^0 applies to sector 1 in both regions, sector 1 in rural areas will run at a smaller scale and higher capital intensity than it would in a situation without national

wage determination. Returns on real capital are reduced in sector 1. To reach a new equilibrium in the rural labour market, sector 2 must demand the workers that are laid off from sector 1. For sector 2 (tourism) to demand the workers that are laid off by sector 1 (manufacturing), the wage rate in tourism in the rural area, w_2^r , must be very low. The assumption that rural people do not move to the city is important to avoid migration to urban areas in this case. The low wage rate creates a high return on investments in rural tourism (shown in Figure 5.3).

The assumption of rural capital subsidies make capitalists invest in sector 2 in the rural region since the difference in capital returns between sectors 1 and 2 in the rural region ($r_2^r - r_1^r > 0$) will start a process in rural areas where real capital is reduced in sector 1 and increased in sector 2. Returning to the rural labour market, the demand curves for workers depend on the real capital in each sector. The closing down of capacity in rural manufacturing reduces labour demand as illustrated in Figure 5.4b by the movement of the sector 1 demand curve to the left. Investments in rural tourism increase capacity. For example, building and renovation of cabins and hotels, and increased tourism services move the rural labour demand curve for tourism to the left in Figure 5.4b.

Figure 5.4 Long run rural effects from national wages in sector 1 and rural capital subsidies for a) industry mix, returns and wages and b) labour demand



Since sector 1 is more capital intensive than sector 2, a certain transfer of real capital reduces sector 1 labour demand by a relatively small amount compared to the bigger rise in labour

demand from the enlarged capacity in the labour intensive sector 2. This is reflected in the sizes of the shifts in the labour demand curves of the two sectors in Figure 5.4b. When sector 1 has adjusted capacity to the nationally set wage level, sector 1 only demand n_1 workers in Figure 5.4b. To employ the rest of the rural workers in sector 2, the wage rate will have to be w^2 , which is higher than the first best equilibrium rural wage rate, w_2 . Given that there are sector-neutral rural subsidies, the overall return on capital will be equal in all rural sectors, as shown in Figure 5.4a. If capital owners are compensated through rural investment subsidies, returns for private investors will reach the return level of the urban region, r_1 , while the returns on total real capital in the rural region will equal r_2 .

Given the assumptions in the model, Figure 5.4 shows that wages in sector 1 are equal in both regions, while wages in sector 2 and returns to total capital are lower in rural areas. In addition, the industry mix differs between the two regions. The capital-intensive industries that have agreed to pay high national wages are over-represented in urban areas. The model shows that production and employment in rural areas (i) decrease in manufacturing with fixed wage rates and (ii) increase in sectors where wage rates are unregulated and lower.

If labour costs, such as negotiated wage rates and payroll taxes, do not compensate regional differences in the value added per worker, then the model with rural capital subsidies predicts that industries with unregulated (lower) wages, will be relatively more important as a source of earnings in rural areas than in urban. This is in line with arguments for a regional differentiated minimum wage rate related to the cost of living. Krumm (1981) has pointed to national minimum wages as representative of relatively stronger regulations in rural regions with good climate and low cost of living compared to urban areas in the US. He argues that if urban areas with a relatively high cost of living influence the national minimum wage to the greatest extent, then employment opportunities become scanty in rural areas with low costs of living.

However, wage rates differ among rural industries because (i) the wage rate in sector 2 is subject to individual agreements or (ii) some businesses do not make regular wage payments (for example, self-employment and small family firms where the same individual supplies both capital and labour inputs). Blanchflower (1999) asserts that this is an important source of

raising unpaid self-employment, especially in agriculture. In the real world, unregulated wages are more common in small firms and service industries. By interpreting sector 2 firms as family-based firms, the analysis illustrated in Figure 5.4 shows that self-employment may be a sign of an absence of wage employment at the prevailing wage rate. A particular aspect of the ownership structure is this self-employment where earnings are pooled, and separate returns to capital and labour supply by family members is neither calculated nor paid. Examples are family farms and lodgings where a family uses its real capital and family members' supply hours with no formal wage payments. This essay has presented a model suggesting a greater importance of such family based self-employment in rural areas. Is there any empirical support for this finding?

5.4 Empirical studies

Blanchflower (1999, pp. 30-31) reports that self-employment varied among the OECD countries in 1996 as a percentage of the total labour force from 7.4 in Luxembourg to 53.6 in Turkey. Self-employment was low in both the US with 7.9 per cent and Norway with 8.2 per cent. In all the OECD countries self-employment is a way to stay employed beyond 64 years of age. One reason why the regional difference in self-employment and family-based employment has not been studied is that data sources are scarce (see Blanchflower, 1999, for a discussion).

Norway is a European country where regional policy has had an explicit and strong urban-rural dimension since the Second World War. Mønnesland (1997) distinguishes between the 'broad' Norwegian regional policy, which includes public sector and agricultural policy, and the 'narrow' regional policy, which includes, for example, rural, sector-neutral investment subsidies and regionally differentiated payroll tax. If Norwegian data indicates that family-based employment is more important in rural areas, it should be more so in other countries with higher self-employment shares. In the case of Norway, employment may be classified by industry, and divided into wage earners and self-employment. Some family-based employment will inevitably be registered as wage-earning even though the employer is a family member, and some unpaid employment by family members will escape measurement. The social security tax of the self-employed is smaller than the sum of the taxes from the employee and the employer's payroll tax. Self-employment is, therefore, the least expensive form for a one-person business or a business run by a married couple. While regular wage workers are counted and hours and wage rates are measured, industry statistics and wage censuses omit very small establishments, typically family firms. The Employer-Employee register in Norway contains only formal wage workers. Neither of these data sources indicates whether or not owners and employees of a firm are relatives. Hence, the line of demarcation between regular employment and family-based employment cannot be properly drawn.

5.4.1 Self-employment by industry

The size-distribution of firms in an industry depends on factors such as tradition, regulations, entry costs of new firms, economies of scale, and so on. A person may do various types of

work during a certain period. Thus, Table 5.1 examines individuals according to their major source of earnings. According to Table 5.1 column 2, the overall share of self-employment was 8 per cent in Norway in 1996. The percentage self-employment of total employment varies among industries. Offshore extraction of petroleum and natural gas, supplies of power and water and financial services, had zero per cent self-employment.

Table 5.1 Norwegian earners in 1996 by industry and type of employment

Industry code, Industry	Self-empl. Empl.pers	Number of empl. pers.	Number of wage workers	Number of self-employed
Total	8 %	1985545	1819413	166132
Unreported industry	85 %	40347	6179	34168
01-05 Agriculture, forestry and fishing	65 %	90615	31853	58462
2 Extraction of crude petrol.and nat.gas	0 %	23345	23343	2
3 Manufacturing and mining	2 %	294069	287831	6238
4 Electricity and water supply	0 %	19828	19821	7
5 Construction	16 %	119940	101215	18725
6 Wholesale, retail trade, restaur.,hotels	5 %	356071	339252	16819
7 Transport and communication	5 %	152466	144266	8200
8 Financing and insurance	0 %	46125	46122	3
9 Real estate and business services	6 %	150299	141924	8375
10 Public and other services	2 %	692440	677607	14833
01 Agriculture and hunting	56 %	52287	23122	29165
02 Forestry	48 %	5084	2647	2437
05 Fishing, hunting and sea farming	44 %	10925	6084	4841
Unspecified primary industry	100 %	22319	0	22319
17 Manufacture of textiles	6 %	5079	4789	290
18 Manufacture of apparel	12 %	2924	2572	352
20 Manufacture of wood and wood prod.	5 %	16219	15432	787
33 Manufacture of instruments	4 %	5308	5104	204
36 Manufacture of furniture, other prod.	6 %	14200	13414	786
52 Retail trade and repair services	6 %	145720	136378	9342
60 Land transport and pipeline transport	15 %	53910	46092	7818
74 Other business services	7 %	107564	99808	7756
93 Other personal services	33 %	18772	12583	6189
95 Domestic services	1 %	1431	1410	21

Source: Statistics Norway.

The primary sector of agriculture, forestry and fishing, has 65 per cent self-employment. The 85 per cent self-employment among persons with no industry registered indicates, presumably, that they find it hard to categorise their activities. The lower part of Table 5.1 contains examples of industries that deviate from the national average of 8 per cent self-

employment. I find the 1 per cent self-employment in domestic services surprisingly low. In all likelihood, it is due to a 'black' labour market where income is neither reported nor taxed. Some industries have relatively high self-employment, see Table 5.1. Apparel had 12 per cent self-employment compared with 2 per cent for the entire manufacturing industry. Industries stemming from crafts tend to have a higher share of self-employment. The 15 per cent self-employment in land transport arises from 'a man and a car' businesses. Lastly, one in three is self-employed in other personal services.

5.4.2 Self-employment by region

To account for the regional dimension of wage work and self-employment, I had to strike a balance between too few characteristics at the community level (430 municipalities) and fewer regions and more characteristics at the county level (19 counties). Furthermore, a county is a problematic heterogeneous unit that does not really separate urban and rural areas; when most counties contain both urban administrative centres and remote areas. The capital Oslo is a separate county. Akershus is the county bordering on Oslo with a great deal of Oslo-based commuting. Table 5.2 presents employment information for persons categorised by county of residence from the 'county-tables' of the 'tax return statistics' of Statistics Norway for the year 1996. It distinguishes between formal wage earnings and income from self-employment (i.e. both labour and capital income). Self-employment earnings stem from industries such as farming in the primary sector, businesses in other sectors, as well as income from real property such as cabins. Deductions were made for reported losses in these trades. The ratio of self-employment income to wage earnings was 10 per cent for Norway in 1996. At the county level, this ratio ranges from 6 per cent in Akershus and 7 per cent in Oslo to 15 per cent in Hedmark, Nord-Trøndelag, Møre- og Romsdal and Oppland, and 17 per cent in Sogn og Fjordane. The five latter counties are rural counties with no large urban agglomeration.

The 'take-home message' is that family based employment fills in for an absence of formal wage employment. However, it might work in the opposite direction. Entrepreneurs might create family-based employment with high income-levels, whereas individuals with less initiative enter wage employment with low income-levels. If so, regions with a higher ratio of self-employment to wage work, should have the higher income per person. This alternative hypothesis is not in accordance with the model in Section 5.3.

Table 5.2 Earnings ratio and average total income by county, Norway 1996

County	Earnings ratio of self-empl/wagew		Average total income	
	Self-employed earnings wage earnings	Rank	Average income NOK	Rank
Norway	10 %		183 361	
Østfold	11 %	10	169 218	10
Akershus	6 %	1	218 131	18
Oslo	7 %	2	225 234	19
Hedmark	15 %	15	158 486	2
Oppland	15 %	18	158 722	3
Buskerud	10 %	6	183 344	16
Vestfold	10 %	7	179 965	14
Telemark	9 %	4	168 483	8
Aust-Agder	11 %	12	167 719	6
Vest-Agder	11 %	9	172 878	13
Rogaland	11 %	8	193 872	17
Hordaland	8 %	3	182 122	15
Sogn og Fjordane	17 %	19	168 700	9
Møre og Romsdal	15 %	17	170 461	11
Sør-Trøndelag	9 %	5	171 777	12
Nord-Trøndelag	15 %	16	155 262	1
Nordland	12 %	14	162 220	4
Troms	12 %	13	168 040	7
Finmark	11 %	11	164 589	5

Source: Statistics Norway, the county tables of the tax return statistics 1996.

Table 5.2 shows the total income per person, and by county, for Norway in 1996. The top average income is found around the area of the capital, Oslo and Akershus. Oppland, Hedmark and Nord-Trøndelag are in the bottom range. Furthermore, self-employment rises as the level of average income lowers. This supports the view that self-employment partly fills the earnings gap in areas with few employment opportunities. To analyse the relations between different characteristics, a correlational analysis was performed using the SPSS 8.0 program. Due to the small number of regions, I have used bi-variate calculations. The nonparametric rank correlation, Spearman's rho, between the rank of the ratio of self-employment to wage earnings and the rank of the average total income, is -0.751 and significant at the .01 level in a two-tailed test. This result makes me reject the hypothesis above that regions with a higher ratio of self-employment to wage work, should have the higher income per person. It supports the model in this essay: self-employment is relatively

more frequent in areas with low average earnings. However, this does not preclude alternative explanations.

5.4.3 The regional industry pattern

To study the industrial pattern by region, the correlation analysis was extended. In accordance with Table 5.2, Table 5.3 shows that counties with a high average income have a lower ratio of self-employment income to wage income. They co-inside with the densely populated areas, an indication of their urbanisation. Counties with a low population density have lower incomes and higher self-employment incomes relative to wage income. To some extent, these results support the theoretical results of the formal model of this essay. They stem from analyses of employment data from the Norwegian Employer-Employee Register for 1996. For individuals who hold more than one job at a time, only the main job is counted.

Table 5.3 Pearson's correlation coefficients of income, population density and industry mix indicators, 19 counties, Norway 1996 (Significance probabilities in brackets.)

Variable	Average income	Self-em inc	Inhabitants	Jobs per p.	Private jobs	Public jobs	Prim.sec.inc
		wage inc.	Square km	(16-74)	pp (16-74)	Private jobs	Wage inc.
Gross income per income earner (17+)	1,000	-0,735** (,000)	0,697** (,001)	0,774** (,000)	0,514* (,024)	0,165 (,501)	0,165 (,501)
Self-employment inc Wage income	-0,735** (,000)	1,000	-0,415 (,078)	-0,511* (,025)	-0,316 (,187)	0,072 (,770)	0,815** (,000)
Inhabitants Square km	0,697** (,001)	-0,415 (,078)	1,000	0,815** (,000)	-0,129 (,599)	0,319 (,184)	-0,554* (,014)
Jobs per person age 16-74	0,774** (,000)	-0,511* (,025)	0,223 (,358)	1,000	0,741** (,000)	-0,334 (,162)	-0,344 (,150)
Private jobs per pers. age 16-74	0,514* (,024)	-0,316 (,187)	-0,129 (,599)	0,741** (,000)	1,000	-0,877** (,000)	-0,180 (,462)
Public jobs Private job	-0,165 (,501)	0,072 (,770)	0,319 (,184)	-0,334 (,162)	-0,877** (,000)	1,000	0,028 (,909)
Primary sector inc. Wage income	-0,631** (,004)	0,815** (,000)	-0,554* (,014)	-0,344 (,150)	-0,180 (,462)	0,028 (,909)	1,000

Pearson's product moment correlation coefficients range from -1.0 to +1.0. Significance probabilities of 2-tailed tests are reported (in brackets in Table 5.3). The ** indicates a significant estimate at the 1% level, while * indicates significance at the 5% level.

Source: Variables reported by county, see Appendix B in section 5.8.

By definition, a job encompasses part-time and full-time work. The average number of main jobs in the age group 16-74 ranges from 0.54 in Nordland to 0.64 in Akershus. Employer location is the basis for the county classification of jobs. However, total job frequency correlates marginally with population density, which implies that the mere employment does differentiate between rural and urban areas.

Is family-based self-employment only another phrase for self-employment in agriculture and other primary industries? According to Blanchflower (1999, p. 32) agricultural self-employment varies among OECD countries for 1995 from 8 per cent of total self-employment in the UK to 74 per cent in Turkey. With regards to Norway, he reports agricultural self-employment at 37 per cent of total self-employment, and non-agricultural ratio of self-employment to total employment at 5 per cent. Agricultural earnings within Norway are highly correlated with total self-employment earnings and negatively correlated with population density according to Table 5.3. While the average primary sector self-employment income ranges from 2 per cent of wage earnings in Oslo to 7 per cent in Møre og Romsdal, other kinds of self-employment provide 6 per cent of wage earnings in Oslo and 8 per cent in Møre og Romsdal. Thus, regions with the highest self-employment in the primary sector have higher self-employment in the other sectors as well. Hence, agriculture is part of the rural self-employment picture.

What is the role of the public sector in the regional industry mix? The allocation of jobs towards the private and public sectors was not ready-made in the data set. According to Table 5.3, the public sector contains the following industries: (80) public administration, (85) education and (90) health and social work, all mainly public sector jobs in Norway. For this reason, I marginally overestimate the number of public jobs in these sectors and underestimate them in some other sectors. Private jobs are calculated as the difference between all jobs and public jobs. The ratio of public jobs per private job ranges from 0.35 in Akershus to 0.81 in Troms. The capital, Oslo, has a high value of 0.75 because of the government. The correlation between public jobs and private jobs is significant, negative and strong - as expected for a country where the Norwegian version of the 'Scandinavian welfare state' evens out both the municipality tax revenue per inhabitant and the basic public services for schooling and health care. Lots of public part-time jobs and a lower, regulated wage level in the public rather than

the private sector may explain the weak negative correlation between the ratio of public to private jobs and the income level. Furthermore, a bias towards the localisation of government jobs in urban areas may explain the small positive correlation between the ratio of public to private jobs and population density.

The central tenet of the model in this essay is that self-employment fills deficit of well-paid private jobs in rural areas. The frequency of private jobs in the age group 16-74 ranges from 0.31 percentage in Finnmark to 0.48 in Akershus. The frequency of private jobs correlates negatively with self-employment and population density as expected, but these estimates are neither strong nor significant. The frequency of private jobs correlates positively and strongly with the total number of jobs and with the average income level. This indicates that private jobs are better paid. Are urban wage rates higher? Studies of earnings functions often show significant regional differences in wage rates. According to Dale (1994), who studied Norwegian extracting and manufacturing industries in 1986, the highest wages were in the urban Stavanger area. These were 3 per cent higher than in Oslo and about 15 per cent higher than in rural areas of Sør-Trøndelag, Hedmark, Oppland, and Sogn og Fjordane. The regional variation in labour costs may exceed that of wages because of a regionally differentiated payroll tax in Norway. Blanchflower and Oswald (1994) argue that the regional unemployment rates influence wages. In Norway, rural areas have higher unemployment rates, although this is not the case in all countries (Marston, 1985).

What makes family-based self-employment unattractive to family members? Where taxes are progressive, as is the case in Norway, tax laws limit tax evasion by restricting the amount of self-employment earnings that other family members may report. The lack of formal registration of working hours by family members thereby deprives them of individual claims on Social Security. This is a common situation for wives of farmers (Dale, 1995). Gender and power relations within the household become complex, and, thus, become important for individual costs and benefits with regard to money, income and social security claims (see Agarwal, 1997, for a discussion of within household bargaining).

5.5 Concluding remarks

This essay analyses the mix of wage employment and family self-employment in rural and urban areas. Rural areas have an industry mix that differs in comparison with their urban counterparts. Farms, shops, restaurants, inns, together with other firms that enjoy low entry costs, are often family-based businesses. The formal model of this essay analyses the mix of wage employment and family self-employment in rural and urban areas. It has two sectors (one with wage employment, the other representing family self-employment) and two regions (rural areas, which have cost disadvantages, and urban areas). The model predicts increased importance of family self-employment in rural areas when wages are regulated nation-wide and rural capital intensity is maintained through capital subsidies. In accordance with the predictions of the model, empirical findings from Norway show that self-employment is relatively more frequent in rural than urban areas and that self-employment increases as the level of average income decreases.

This essay's model assumes that capital subsidies in rural areas encourage investment in real capital. If capital subsidies are not available, one can expect family businesses to enter industries associated with particularly low entry costs, such as those with substitute household production (see Essay Four). A 'bed-and-breakfast' would be a typical example of a family business with low entry costs when the family's real capital is utilised both for family consumption and a family business site. Another interesting aspect of low entry costs is the proportion of which that may be described as 'sunk cost' - because an investment was undertaken long ago to provide a family dwelling or develop agricultural production. According to Stringer (1981, p.362) most bed-and-breakfast landladies start primarily for economic reasons, and 'bed-and-breakfasts' enable them to live in a large house to which they are attached, and work at home and have greatly-valued contact with other people.

In Essay Four, industries with substitute household production were characterised by both low entry costs and employees with household skills. According to Stringer (1981, p.362), the job of the bed-and-breakfast landlady require no labour market training or 'unusual' skills from education. Solberg and Vestby (1987) maintain that children help in their parents' jobs. Children spend most time helping when fathers are farmers, fishermen or run retail businesses

and when mothers are farmers, cleaners or day-mothers. Youth work more hours in farming and fishing communities than in urban areas. This indicates that the scope of in-the-home training (discussed in Essay Two) is broader for children raised in small family businesses. Therefore, it is reasonable for family-run businesses to employ family members with relevant skills learnt through in-the-home-business training, even though they have no more educational qualifications than others. The assumption in the model of this essay - that workers are homogeneous with respect to skills - may seem satisfied when evaluated by the length of education. However, if in-the-home-business training is also considered, this assumption is presumably not fulfilled.

Family self-employment is seldom available to non-members of the family. Employment in large private firms and the public sector are, in principle, open to any applicant who possesses the formal skills required. Therefore, the availability of formal wage employment is attractive to entrants in a local labour market, whereas many family-run businesses are an impediment to potential entrants with no tie to such a business in the local labour market. This is illustrated by Kontogeorgopoulos (1998), who presents examples of differing behaviour between small family-based firms and large firms in the context of the tourist development of two islands in Thailand.

Family-based employment may have different short term and long term effects in rural areas. In the short term it may be a cheap way to provide earnings for rural people. When employment opportunities with regular firms and public employers are in short supply, the family-member is the 'insider' in the family-based employment. In the short term, family real capital discourages the owners from closure. The low, unregulated wages of family members will make them retain real capital as a basis for a family-based firm. Some may retain real capital for pure dwelling or leisure purposes. In this way, new entrants in the agricultural and tourism industries can have a hard time finding land for sale. Will new entrants have to provide not only labour with relevant skills – wage work – but, in addition, the real capital for self-employment or a firm? Do family businesses create a 'double-outsider' problem that constrains emigration to rural areas in the long term? These are issues for future research.

Regional policies that subsidise capital, together with policies that treat family-members and other employees differently, may reinforce rural self-employment and reduce the demand for regular employees. It is important to address the implications of the rural bias towards self-employment (both in primary and other industries): a person may have to invest not only human capital but also physical capital to acquire a rural job. In practice, the division between the capitalist and the worker disappears. In order to have a job in a rural area with a shadow price similar to the market wage, a person must be a capitalist and expect low profits. Unemployment policies and rural development policies that encourage entrepreneurs may reinforce the lack of wage employment opportunities in rural areas in the long run. Agriculture is a major employer in the rural areas of many countries, but tourism attracts increased attention with regards to economic restructuring (Montanari and Williams, 1995). Despite changes in the industry mix, family-based employment will probably play a major role in rural areas. Regional policy faces challenges from the regional variation in unemployment and industry patterns.

5.6 References

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5.7 Appendix A: The formal model

The purpose of this appendix is to formalise the graphical analysis of Section 5.3. Throughout, superscripts refer to sectors and subscripts refer to regions. The production in each sector is described by a production function, which is strictly increasing in each factor and strictly quasi-concave, and which exhibits constant returns to scale:

$$x^1 = F^1(k^1, n^1) = k^1 f^1(n^1 / k^1) \text{ in sector 1,}$$

$$x^2 = F^2(k^2, n^2) = k^2 f^2(n^2 / k^2) \text{ in sector 2, which is more labour intensive.}$$

If $j=1,2$, let $a^j(w/p)$ be defined implicitly by $df^j(a^j(w/p))/da = w/p$, i.e., $a^j(w/p)$ is the labour/capital ratio that makes the value of the marginal product of labour equal to the wage rate in sector j . The capital return in region i in sector j is given by:

$$r^j(p, w) = pf^j\left(a^j\left(\frac{w}{p}\right)\right) - wa^j\left(\frac{w}{p}\right)$$

It follows from Hotelling's lemma and the convexity of the profit function that

$$\frac{\partial r^j(p, w)}{\partial w} = -a^j\left(\frac{w}{p}\right) = -n^j / k^j$$

$$\frac{\partial^2 r_i^j(p, w)}{\partial w^2} > 0$$

It is assumed that there is a proportional cost disadvantage in the rural region (region 2), which is formally associated with lower producer prices in the rural area and is due to higher transport costs.

$$p_2^1 = (1-t)p_1^1$$

$$p_2^2 = (1-t)p_1^2$$

The initial long run equilibrium is characterised by the following equations in each region, where k_i and n_i , $i=1,2$, refer to the fixed amount of capital and labour available in region i (see also Figure 5.2).

Region 1:

$$r_1 = r^1(p_1^1, w_1) = r^2(p_1^2, w_1)$$

$$-\frac{\partial r^1(p_1^1, w_1)}{\partial w} = n_1^1 / k_1^1$$

$$-\frac{\partial r^2(p_1^2, w_1)}{\partial w} = n_1^2 / k_1^2$$

$$k_1^1 + k_1^2 = k_1$$

$$n_1^1 + n_1^2 = n_1$$

Region 2:

$$r_2 = r^1(p_2^1, w_2) = r^2(p_2^2, w_2)$$

$$-\frac{\partial r^1(p_2^1, w_2)}{\partial w} = n_2^1 / k_2^1$$

$$-\frac{\partial r^2(p_2^2, w_2)}{\partial w} = n_2^2 / k_2^2$$

$$k_2^1 + k_2^2 = k_2$$

$$n_2^1 + n_2^2 = n_2$$

Not full specialisation in the urban region:

$$-\frac{\partial r^1(p_1^1, w_1)}{\partial w} < \frac{n_1}{k_1} < -\frac{\partial r^2(p_1^2, w_1)}{\partial w}$$

Not full specialisation in the rural region:

$$-\frac{\partial r^1(p_2^1, w_2)}{\partial w} < \frac{n_2}{k_2} < -\frac{\partial r^2(p_2^2, w_2)}{\partial w}$$

Due to the assumption of a proportional cost disadvantage in the rural region (region 2), it follows that $r_2 = (1-t)r_1$ and $w_2 = (1-t)w_1$, and, given that there is not full specialisation, $n_2^1 / k_2^1 = n_1^1 / k_1^1$ and $n_2^2 / k_2^2 = n_1^2 / k_1^2$.

The short run equilibrium

When the wage in sector 1 is set at $w_0 = w_1 > w_2$, the equilibrium in the urban region is unchanged. In the short run equilibrium in the rural region (region 2), w_s^2 , n_s^1 and n_s^2 are determined by (see Figure 5.3)

$$\begin{aligned} -\frac{\partial^1(p_2^2, w_0)}{\partial w} &= \frac{n_s^1}{k_2^2} \\ -\frac{\partial^2(p_2^2, w_s^2)}{\partial w} &= \frac{n_s^2}{k_2^2} \\ n_s^1 + n_s^2 &= n_2 \end{aligned}$$

It follows that $n_s^1 < n_2^1$ since $-\partial^2 r^1 / \partial w^2 < 0$. Hence, $n_s^2 = n_2 - n_s^1 > n_2 - n_2^1 = n_2^2$. Since $-\partial^2 r^2 / \partial w^2 < 0$, this means that $w_s^2 < w_2$. We can conclude that

$$\begin{aligned} w_s^2 &< w_2 < w_0 \\ r^2(p_2^2, w_s^2) &> r_2 > r^1(p_2^1, w_0) \\ n_s^1 &< n_2^1 \quad \text{and} \quad n_s^2 > n_2^2 \end{aligned}$$

The new long run equilibrium (see Figure 5.4)

The short run situation, which has different returns, will lead to a transfer of real capital from sector 1 in the rural region. The assumption of no capital mobility between the regions implies that the real capital is not transferred to the urban region, but to sector 2 in the rural region. The new long run equilibrium in the rural region (region 2) is characterised by:

$$\begin{aligned} r_t &= r^1(p_2^1, w_0) = r^2(p_2^2, w_t^2) \\ -\frac{\partial^1(p_2^1, w_0)}{\partial w} &= \frac{n_t^1}{k_t^1} \\ -\frac{\partial^2(p_2^2, w_t^2)}{\partial w} &= \frac{n_t^2}{k_t^2} \\ k_t^1 + k_t^2 &= k_2 \\ n_t^1 + n_t^2 &= n_2 \end{aligned}$$

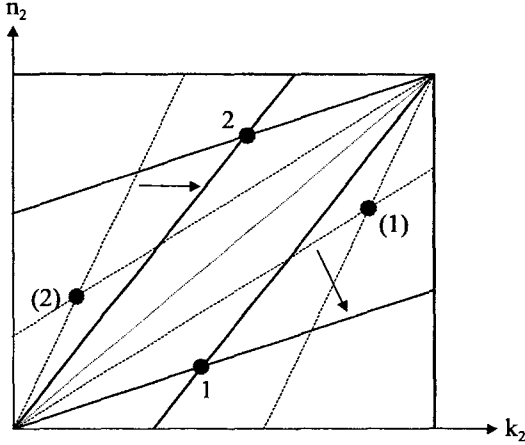
Not full specialisation if

$$-\frac{\partial^1(p_2^1, w_0)}{\partial w} < \frac{n_2}{k_2} < \frac{\partial^2(p_2^2, w_t^2)}{\partial w}$$

This implies that $r_1 < r_2$ because sector 1 must pay a higher wage. The fact that sector 2 is more labour intensive means that $w_1^2 < w_0$, while $w_1^1 > w_2$ since $r_1 < r_2$.

Because wages are higher in both sectors, it follows that both sectors have a higher capital intensity as illustrated by the following Figure 5.5. Figure 5.5 shows that full utilisation of both factors means that $k_1^1 < k_2^1$ and $k_1^2 > k_2^2$.

Figure 5.5 The Edgeworth box for the rural region



We can conclude that

$$w_0 > w_1^2 > w_2$$

$$\frac{n_1^1}{k_1^1} < \frac{n_2^1}{k_2^1} \quad \text{and} \quad \frac{n_1^2}{k_1^2} < \frac{n_2^2}{k_2^2}$$

$$k_1^1 < k_2^1 \quad \text{and} \quad k_1^2 > k_2^2.$$

5.8 Appendix B: Table

Table 5.4 Various kinds of taxable individual income for adult persons by county in 1996.

Share of persons reporting positive income and average income in NOK.

County	Total income				Wage earners				Primary sector				Other sectors				Real estates				Negative profits				Share of total income													
	no. pos. inc. Age:17+	Average income	Average wages	Persons %	Average income	Average wages	Persons %	Persons %	Average Earnings	Other sect. %	Persons %	Income %	Persons %	Amount deductible	Persons %	Wage Tot. inc.	Self-emp. Tot. inc.	W+S Tot. inc.	Self-emp. Tot. inc.	Wages	Persons %	Income %	Persons %	Amount deductible	Persons %	Wage Tot. inc.	Self-emp. Tot. inc.	W+S Tot. inc.	Self-emp. Tot. inc.	Wages								
Norway	3339545	183361	175075	72 %	175075	4 %	107660	6 %	164178	12 %	8414	2 %	70632	68 %	7 %	75 %	10 %																					
Østfold	186533	169218	166152	67 %	166152	3 %	95973	6 %	158681	11 %	8951	2 %	53878	66 %	7 %	73 %	11 %																					
Akershus	333059	218131	202812	77 %	202812	2 %	102319	6 %	171092	14 %	6428	2 %	112174	72 %	5 %	76 %	6 %																					
Oslo	383125	225234	206378	72 %	206378	0 %	49341	6 %	221730	35 %	4530	2 %	224555	66 %	5 %	70 %	7 %																					
Hedmark	146420	158486	153283	66 %	153283	7 %	97749	6 %	146830	7 %	9480	3 %	37524	64 %	9 %	73 %	15 %																					
Oppland	143825	158722	151104	68 %	151104	8 %	89476	7 %	141615	5 %	15281	4 %	30913	65 %	10 %	75 %	15 %																					
Buskerud	177755	183344	176889	71 %	176889	4 %	79106	6 %	158536	10 %	9162	3 %	62899	69 %	7 %	75 %	10 %																					
Vestfold	156818	179965	170148	69 %	170148	3 %	98172	6 %	156878	10 %	14309	2 %	74291	66 %	6 %	72 %	10 %																					
Telemark	125908	168483	167571	68 %	167571	4 %	56169	6 %	146723	10 %	6706	3 %	31281	67 %	6 %	73 %	9 %																					
Aust-Agder	75734	167719	159090	69 %	159090	4 %	62991	6 %	158863	4 %	28408	3 %	33750	66 %	7 %	73 %	11 %																					
Vest-Agder	111692	172878	163227	71 %	163227	3 %	72809	6 %	162362	8 %	16510	3 %	35510	67 %	7 %	74 %	11 %																					
Rogaland	259968	193872	188738	75 %	188738	4 %	127800	5 %	161800	15 %	15552	2 %	55561	73 %	8 %	80 %	11 %																					
Hordaland	319260	182122	178158	73 %	178158	2 %	111502	5 %	165026	12 %	8210	2 %	47728	72 %	6 %	78 %	8 %																					
Sogn og Fj.	81794	168700	155518	73 %	155518	10 %	106943	6 %	142129	5 %	14839	3 %	29612	67 %	11 %	78 %	17 %																					
Møre og Ro.	183538	170461	158316	72 %	158316	6 %	158468	5 %	152029	6 %	16855	2 %	53404	67 %	10 %	77 %	15 %																					
S.Trøndelag	197739	171777	168691	71 %	168691	4 %	100861	5 %	150903	12 %	6585	2 %	42711	70 %	7 %	76 %	9 %																					
N.Trøndelag	97120	155262	148649	70 %	148649	8 %	114129	5 %	135883	4 %	16498	3 %	37758	67 %	10 %	76 %	15 %																					
Nordland	184961	162220	155204	71 %	155204	5 %	127994	5 %	147347	6 %	11637	2 %	56510	68 %	8 %	76 %	12 %																					
Troms	115629	168040	160262	73 %	160262	5 %	127407	5 %	156838	6 %	14003	2 %	49976	70 %	8 %	78 %	12 %																					
Finmark	58667	164589	154353	76 %	154353	5 %	110588	5 %	148038	4 %	12392	2 %	61648	71 %	8 %	79 %	11 %																					

Sources: Tables from Statistics Norway, yearly income statistics by county, 1996.

Prepared from tables of number of individuals with non-zero entries for each income category, and tables of group income of each kind.

6.0 Appendix

Titlestad, Kristin Dale (1983)¹:

A model for the allocation of time within the family,
Unpublished paper, Institute of Economics, UiB, Bergen.

¹ Rødseth, Asbjørn (1985): *Innføring i konsumentteori*, Universitetsforlaget, Oslo and Lommerud, Kjell Erik (1989): Marital Division of Labor with Risk of Divorce: The Role of 'Voice' Enforcement of Contracts, *Journal of Labor Economics*, 7 (1) 113-27, have cited this unpublished paper.

A model for the allocation of
time within the family.

by
Kristin D. Titlestad

Institute of Economics,
University of Bergen, Norway, May 1983.

Why do husbands spend so much time working outside the home, and wives spend so much time on housework ? The aim of this paper is to study how an individual's allocation of time between work, home production and leisure depends on the composition of the household and the existence of markets for commodities produced in the household.

The work by Reuben Gronau has inspired this paper, and I draw heavily on several of his models. Gronau (1973) models a two person household where market goods and home goods are different goods in the household utility function. However, the household production function includes market inputs as well as home work and calls for the combination of inputs in fixed proportions. The model in Gronau (1977) starts with a single person household where home goods are perfect substitutes for market goods. Extending the model to the two person household, he discusses specialization within the family. If both persons participate in the labour force and there is no commodity or service which is supplied solely through home production, marriage does not yield any gains of trade. Discussing the supply of labour of married women, three important economic factors are mentioned; income, wage rate and education. The importance of market substitutes for home production for the supply of labour is not discussed, therefore this is the main point in my paper.

This approach to household decision-making assumes that the two persons who have formed the household, maximize a neoclassical household utility function subject to the household total income constraint and the two time constraints.

Let us consider a household consisting of two members: wife and husband. Assume that the preference ordering of this household can be represented by a household utility function (U):

$$(1) \quad U = U(X_M, X_H, L_1, L_2)$$

X_M denotes the amount of market goods enjoyed by the household, X_H the amount of home goods enjoyed by the household, L_1 the amount of leisure enjoyed by the husband, L_2 the amount of the wife's leisure.

This formulation assumes implicitly that the household is indifferent to the distribution of work between work at home and work in the market. The intrafamily distribution of goods is not discussed. Using the household utility function is not trivial. Strong assumptions must be met. If the members of the household agree upon the specification of the household utility function, or if the head of the household dictates its form, using the household utility function pose no problem.

It would be possible to avoid the problem of a single household utility function using bargaining theory. This theory allows for different individual utility functions and provides a means by which the differences are reconciled. Bargaining theory can help solving the allocation of consumption problem, see Manser and Brown (1979). Ashenfelter (1979) states that it is unclear whether there are any positive predictions whatever from a household bargaining framework. The conventional models are useful because of their strong implications which can be tested empirically. I therefore use the household utility function approach here.

Home goods are produced at home by the wife or by the husband:

$$X_H = f_2(H_2) + f_1(H_1)$$

f_i denotes person i 's production function for home goods, $i = 1, 2$.

H_i denotes person i 's work at home, $i = 1, 2$.

For simplicity market goods that enter into the production of home goods are ignored here. We also assume that the production of home goods by either person can be represented by a common production function (f), except for the productivity coefficient (a_i). Home goods production is subject to decreasing marginal productivity ($f' > 0$, $f'' < 0$).

Home goods produced by the wife: $f_2(H_2) = a_2 f(H_2)$

Home goods produced by the husband: $f_1(H_1) = a_1 f(H_1)$

Total production of home goods thus becomes:

$$(2) \quad X_H = a_2 f(H_2) + a_1 f(H_1)$$

The household pools its pecuniary resources. Adopting a one-period model, the budget constraint (3) states that the expenditure on market goods cannot exceed the household income:

$$(3) \quad p \cdot X_M = w_1 \cdot A_1 + w_2 \cdot A_2 + V$$

where p denotes the price of the market goods,

w_i denotes the wage rate of member i , $i = 1, 2$.

A_i denotes the amount of time member i spends working in the market, $i = 1, 2$; and V denotes unearned income.

The household faces two separate time constraints.

The amount of time spent by any person on work in the market, work at home, and leisure cannot exceed the total amount of time available (T).

$$(4) \quad A_1 + H_1 + L_1 = T$$

$$(5) \quad A_2 + H_2 + L_2 = T$$

Incorporating both time constraints into the budget constraint, we have the full income constraint (6). Full income is the income the household could have earned had it devoted all its time to work in the market.

$$(6) \quad pX_M + w_1 H_1 + w_1 L_1 + w_2 H_2 + w_2 L_2 = w_1 T + w_2 T + V$$

The maximization of the utility function (1) subject to the full income constraint (6), yields the household's optimal allocation of time. Assuming an interior solution the Lagrangian function, K , thus becomes:

$$K = U[X_M, a_2 f(H_2) + a_1 f(H_1), L_1, L_2] - \lambda [pX_M + w_1 H_1 + w_1 L_1 + w_2 H_2 + w_2 L_2 - w_1 T - w_2 T - V]$$

The first order conditions for an interior solution to the optimization problem are (6) and:

$$(a) \quad \frac{\partial K}{\partial X_M} = \frac{\partial U}{\partial X_M} - \lambda p = 0$$

$$(b) \quad \frac{\partial K}{\partial H_1} = \frac{\partial U}{\partial X_H} a_1 f'(H_1) - \lambda w_1 = 0$$

$$(c) \quad \frac{\partial K}{\partial H_2} = \frac{\partial U}{\partial X_H} a_2 f'(H_2) - \lambda w_2 = 0$$

$$(d) \quad \frac{\partial K}{\partial L_1} = \frac{\partial U}{\partial L_1} - \lambda w_1 = 0$$

$$(e) \quad \frac{\partial K}{\partial L_2} = \frac{\partial U}{\partial L_2} - \lambda w_2 = 0$$

Which yields:

$$\frac{\frac{\partial U}{\partial L_1}}{\frac{\partial U}{\partial X_M}} = \frac{w_1}{p} \qquad \frac{\frac{\partial U}{\partial L_2}}{\frac{\partial U}{\partial X_M}} = \frac{w_2}{p}$$

$$\frac{\frac{\partial U}{\partial L_1}}{\frac{\partial U}{\partial X_H}} = a_1 f'(H_1) \qquad \frac{\frac{\partial U}{\partial L_2}}{\frac{\partial U}{\partial X_H}} = a_2 f'(H_2)$$

$$\frac{\frac{\partial U}{\partial L_1}}{\frac{\partial U}{\partial L_2}} = \frac{w_1}{w_2}$$

This shows that:

$$\frac{\frac{\partial U}{\partial X_H}}{\frac{\partial U}{\partial X_M}} = \frac{\frac{w_1}{p}}{a_1 f'(H_1)} = \frac{\frac{w_2}{p}}{a_2 f'(H_2)}$$

The marginal rate of substitution between each persons leisure and market goods equals the persons own real wage rate. The marginal rate of substitution between each persons leisure and home goods equals his/her marginal productivity in home production. The marginal rate of substitution between leisure of the two person equals the ratio of their wage rates. The marginal rate of substitution between home goods and market goods equals the ratio between the real wage rate and the marginal productivity in home production for each person. When the household utility function is maximized, we also see that the ratio of the marginal productivity in home production of the two persons equals the ratio of their real wage rates.

From this we see that the optimal allocation of time for each person between leisure, home production and market work depends on the real wage rates and the productivities in home production for all persons in the household. Especially, the supply of home work from any person in a two person household depends not only on the persons own real wage rate and productivity in home production, but also on the spouses real wage rate and productivity in home production. Living in a two person household implies some degree of mutually beneficial specialization. For the household as a whole, consumption of market goods is determined by money income, and consumption of home goods by time devoted to home work. Because the household is an arena of exchange of goods, consumption is not fixed by production on an individual basis. The division of work in the market and work in the home is now determined by their comparative advantages.

In this model we see that the husband has a comparative advantage in work in the market and the wife in homework when

$$\frac{w_1}{a_1} > \frac{w_2}{a_2}$$

When the wife has a comparative advantage in home production, it follows from this model that she spends more time in home production than her husband does. That is: $H_2 > H_1$. When the husband has a comparative advantage in market work, it does not follow from this model that he spends more time in market work than does his wife. The amount of time each person spend on market work also depends on the household preferences for leisure for each of them. If the household utility function is symmetric in the two variables husband's leisure and wife's leisure, we can draw more conclusions from this model. In this case, if the husband has an absolute advantage in market work then the husband spends more time in market work than does his wife. That is: $A_1 > A_2$.

We now turn to the case where market goods and home goods are perfect substitutes. Apart from this we use the same household model as before. Suppose that the preference ordering of the two person household can be represented by the household utility function (7).

$$(7) \quad U = U(X, L_1, L_2) = U(X_M + X_H, L_1, L_2)$$

$X = X_M + X_H$ The household can either buy the goods in the market or produce the goods at home. The utility of the household is independent of the mix of market and home produced goods.

In the same way as before the household maximize its utility function (7) subject to the budget constraint (3) and the time constraints of the two persons (4 and 5). The first order conditions for maximum utility are almost unchanged (see page 5).

Since market goods and home goods are now perfect substitutes, we have

$$\frac{\partial U}{\partial X_H} = \frac{\partial U}{\partial X_M} = \frac{\partial U}{\partial X} \quad \Rightarrow \quad 1 = \frac{w_1}{a_1 f'(H_1) p} = \frac{w_2}{a_2 f'(H_2) p}$$

$$\frac{w_1}{p} = a_1 f'(H_1) \qquad \frac{w_2}{p} = a_2 f'(H_2)$$

Suppose we have an interior solution to the optimization problem and that market goods and home goods are perfect substitutes.

When a person spends time on market work and home work, the real wage rate equals the marginal productivity in home production for each person. The optimal allocation of working time for each person between home production and market work depends on the person's own real wage rate and productivity in home production when market goods and home goods are perfect substitutes. Especially, the supply of home work from any person in a two person household depends only on this person's own real wage rate and productivity in home production, independent of those of the spouse.

How does choice of spouse affect the predictions of the model for a person. Let us illustrate this in the case of a wife. If her husband dictates the specification of the household utility function, this naturally has obvious implications for her. Apart from this influence on the household utility function, how do his productivity coefficient and real wage rate influence the optimal allocation of time for his wife? If the husband's productivity coefficient in home production increases, the husband will change his production pattern spending more time in home work, substituting work time from market work to home work. There will also be an income effect of this productivity increase. The family can consume more goods or increase the leisure of any person. If the husband's real wage rate increases, we have a similar situation where the husband's time in home production decreases. The income effect on A_1 , L_1 , L_2 and A_2 is undetermined, but H_2 is unchanged.

In this model of perfect substitutes the productivity of the husband influences the wife's optimal allocation of time in the same way as unearned income. When market

goods and home goods are perfect substitutes, the wife's allocation of work time between the market and the home is independent of productivity characteristics of her husband.

The argument for this goes as follows. When goods either can be bought or produced at home, the decision of goods consumption and the decision of goods production can be separated because the utility obtained only depends on the amount of leisure time and the total amount of goods consumed, independent of whether goods are bought or produced at home.

Why do we see that marriage and giving birth to children make wives withdraw from market work while mens labour force participation remain more or less unchanged ? The model indicates that lack of market substitutes for home goods is a possible explanation of why one of **them** shift from market work to home work. The reason why this is the woman must be that she is the one with comparative advantage in home production.

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