Home and Market Hours, Human Capital Accumulation and Fertility*

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PRELIMINARY AND INCOMPLETE

Abstract

Sweden boasts high fertility and high female employment. Notably, also women with young children work. However, part-time employment is very prevalent. There is a notable gender gap in both wages and earnings, which widens substantially after women have children. In this paper we study the effect of family policies on female employment, fertility and the gender wage gap. We are particularly interested in understanding why part-time employment is so prevalent in Sweden, despite heavily subsidized daycare, and the effect of this on the widening of the gender wage gap. We are also interested in understanding the role of home production, particularly the unequal division of home work across genders, in shaping women's career paths. To this end, we develop a structural, life cycle model of heterogenous households which features endogenous labor supply, endogenous human capital accumulation, endogenous fertility and home production.

JEL classification: E24; J22; J26

Keywords: Life cycle; Labor supply; Home production; Human capital; Fertility

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1 Introduction

Sweden and the other Nordic countries provide substantial government support aimed at reconciling work and family life. Policies include generous parental leave, heavily subsidized daycare and the facilitation of part-time work for parents with young children. The Nordic countries spend much more on family policies than other countries, with childcare expenditures averaging 1.5% of GDP – compared with 0.5% in the United States. Consequently, out-of-pocket childcare expenses are very low in the Nordic countries. The net childcare cost to a dual-earner family in Sweden is roughly 6% of net income, compared with more than 19% in the United States.[1]

Family policies are often credited with promoting female employment and fertility. Sweden boasts high female employment, with 82% of women aged 25-54 working. It is also very common for mothers with young children to work. Namely, 81% of women with a child aged 3-5 work. Fertility is also relatively high, with 1.98 children born per woman aged 15-49 in Sweden. While maternal employment is very high in Sweden, part-time employment is very prevalent. Parents with a child under the age of eight have the option of working a reduced workweek of 75%. Consequently, 43% of couples with the youngest child aged 3-5 have one parent working part-time and the other working full-time.

There is a notable gender gap in both earnings and wages in Sweden, which widens substantially after women have children. By following matched husband and wife pairs, Angelov, Johansson, and Lindahl (2013) document an increase in the gender earnings gap of 28 percentage points and an increase in the gender wage gap of 10 percentage points, 15 years after the birth of the first child.

In this paper we study the effect of family policies on female employment, fertility and the gender wage gap. We are particularly interested in trying to understand why part-time employment is so prevalent in Sweden, despite heavily subsidized daycare, and the effect of this on the widening of the gender wage gap. Phrased differently, why are the

[1] See Thévenon (2011) for more details.

outcomes in terms of female employment and fertility not more different between, e.g. the U.S. and Sweden, despite the big differences in family policies?

We are also interested in understanding the role of home production, particularly the unequal division of home work across genders, in shaping women's career paths. Despite the fact that Swedish men do more housework than men in most other countries, Swedish women still work more in the home than their male counterparts. This is particularly true in families with small children, where women spend on average two more hours per day on home work than men. This is also the case in families where both spouses work full-time in the market.

We are interested in studying a broad range of government policies, and also their potential interaction over the life cycle. In order to do this, we develop a structural, life cycle model of heterogeneous households. Households differ with respect to labor market productivity and their preference for leisure. Our framework is quite rich and features: (1) endogenous labor supply, (2) endogenous human capital accumulation, (3) endogenous fertility, and (4) home production. We calibrate the model to match Swedish data.

Our paper is related to several strands of literature. There is an empirical literature on gender wage gaps and the penalties associated with time away from work. Angelov, Johansson, and Lindahl (2013) document that in Sweden the gender income/wage gap widens substantially after women have children. Albrecht, Björklund, and Vroman (2003) and Albrecht, Skogman Thoursie, and Vroman (2015) study the effect of parental leave on wages. There is also a notable empirical literature on the effect of childcare costs on female labor supply, dating back to Heckman (1974), which documents positive labor supply effects of childcare subsidies.[2] Our paper is closely related to a growing literature in macroeconomics which uses structural, dynamic models to study the labor supply behavior of heterogenous households. Guner, Kaygusuz, and Ventura (2013) and Bick (2015) study the effect of subsidized daycare on female labor supply, and in the case of

[2]See also Blau and Hagy (1998), Tekin (2007) and Baker, Gruber, and Milligan (2008) for more recent work.

Bick (2015) also on fertility. We add to this literature by incorporating home production, by studying a broader set of family policies and by studying the effect of said policies on female and male labor supply, fertility and gender wage gaps. We also model the full life cycle. Lastly, our paper is related to work by Siegel (2014) who studies the effect of rising wages on fertility and hours worked. However, he treats wages as exogenous and assumes a stand-in household.

An outline of the paper follows. Section 2 presents the model, and Section 3 describes the calibration procedure. Section 4 presents the results from our policy exercises, while Section 5 concludes.

2 Model

We develop a discrete time life cycle model of overlapping generations. All economically active agents live in two-adult households, comprised of one man ($i = m$) and one woman ($i = f$), along with potential children. For simplicity, we assume that both spouses are of the same age and face the same deterministic life-span. A model period is a year, and individuals live for 53 periods with certainty. We abstract from bequests. Model age zero corresponds to age 28 in the data. Households decide on how many children, if any, to have in the first period of the model. As such, this framework is not suited for studying the effect of the timing and spacing of multiple children. Households differ with respect to labor market productivity (here educational attainment) and their preference for leisure. To ease notation, we suppress the heterogeneity in what follows.

Preferences

Households have preferences over the consumption good (c), the home good (s), male and female market hours (h_m and h_f, respectively), male and female home hours (n_m and n_f, respectively) and children (b). Letting a denote model age, a household has

preferences given by:

$$\sum_{a=0}^{52} \beta^a \left[\ln\left(\frac{c_a}{\psi(b_a)}\right) + \alpha_s \ln\left(\frac{s_a}{\psi(b_a)}\right) + \alpha_b \frac{(b_a+1)^{1-\varepsilon}-1}{1-\varepsilon} - \frac{(\alpha_{hm}h_{ma}+\alpha_{nm}n_{ma})^{\gamma}}{\gamma} - \frac{(\alpha_{hf}h_{fa}+\alpha_{nf}n_{fa})^{\gamma}}{\gamma}\right], \tag{1}$$

where β is the discount factor. Preferences are assumed to be separable and consistent with balanced growth. Children deflate consumption. We allow for differing disutilities on home and market hours of work (this is similar to Siegel (2014)). There is, however, a relationship between the two. Namely, the marginal disutility of an additional hour of market work is increasing in home hours, and vice versa. We allow the utility weights to differ by gender and age. These features are necessary to match the life cycle profiles for market and home hours for men and women. The utility from children is increasing in the number of children, but exhibits decreasing returns.

Labor Supply

Each agent is endowed with one unit of time in every period. We assume agents face a discrete choice of market hours. Women with young children can work full-time, part-time or not all in the market. Men choose between working full-time and not at all, as do women with either no children or older children. To ease the computational burden, we assume that all men work until age 60 after which they endogenously decide when to retire. Home hours are a continuous choice variable.

Home Production

Household services are produced using a combination of the husband's and wife's time and a market purchased input (m):

$$s_a = (\alpha(n_{ma}+n_{fa})^{\rho} + (1-\alpha)m_a^{\rho})^{\frac{1}{\rho}}, \tag{2}$$

where $\frac{1}{1-\rho}$ is the elasticity of substitution between home hours and the market input. The relative weight on home hours is allowed to vary over the life cycle. We also consider an

alternative specification where the wife is better at home production than the man. We return to this in the Sensitivity Analysis.

Human Capital Accumulation

Labor income (y) is the product of the rental rate (w), human capital (e) and hours worked in the market. We model human capital accumulation in the spirit of Blundell, Costa Dias, Meghir, and Shaw (2015). Specifically, we assume that human capital next period depends on the amount of human capital in the current period and hours worked in the market in the following way:

$$e_{a+1} = (1-\delta)e_a + Ae^{da}g(h_a). \tag{3}$$

This specification captures several key features: (1) depreciation, (2) learning, (3) the possibility that learning becomes harder with age, and (4) a potential penalty associated with part-time work. The part-time penalty is governed by the $g(h)$ function.

The parameters of the human capital production function are education specific. An agent is endowed with an initial stock of human capital. We exogenously introduce an initial gender wage gap.

Budget Constraint

The household faces a sequence of budget constraints given by:

$$\begin{aligned} &c_a + m_a + k_{a+1} - (1+r)k_a + B\left(b_a, h_{ma}, h_{fa}\right) \\ =&(1-\tau(y_{ma}))y_{ma} + (1-\tau(y_{fa}))y_{fa} + P_a + R_{ma} + R_{fa}. \end{aligned}$$

The interest rate is denoted by r and the capital stock of the household by k. We implicitly allow for borrowing and lending by allowing households to hold negative amounts of capital.[3]

[3]We could formulate the problem with two assets, physical capital and one period ahead bonds. However, since they must offer the same rate of return in equilibrium (and there is no uncertainty to differentiate

Out-of-pocket childcare costs are denoted by $B(\cdot)$, and a function of the number of children and whether or not both parents are working. Childcare is heavily subsidized in Sweden.

P_a denotes the parental leave benefits. Parental leave benefits are of finite duration, and conditional on having just had a baby and the parent collecting the benefits not working in the market. Benefits are dependent on the past earnings history of the parent on leave. Specifically, parental leave benefits replace roughly 80% of the last wage. For simplicity, we assume that parental leave can only be claimed by the mother. We model the duration of benefits as one year (the actual duration is roughly 16 months). The retirement benefits of the husband and wife are denoted by R_{ma} and R_{fa}, respectively. Retirement benefits are dependent on the age and past earnings of the claimant. Workers accumulate 18.5% of labor income up to a cap (of roughly 30 000 USD per year) as pension capital. The pension capital is paid out as an annuity. There is no restriction associated with working and collecting benefits. For simplicity, in the model we assume that the annuity is paid out starting at age 65, regardless of when the agent stops working.

The government levies a tax on labor income (retirement income is part of taxable income). The effective labor tax in the model includes consumption taxes, social security taxes and income taxes. The progressivity of income taxes is modeled. The government uses the proceeds from the tax on labor income to finance parental leave benefits, the childcare subsidy, retirement benefits and government consumption. We assume that individuals value government consumption, but that it does not affect the marginal utility of private consumption (this is akin to assuming that the revenue allocated for government consumption is thrown away). We assume a balanced budget in equilibrium.

Recursive Formulation

We can write the household's decision problem in recursive form. The state x of the household is given by age (a), assets (k), the human capital of the husband and wife (e_m

them), individuals are indifferent about how to allocate their portfolio between the two. It is therefore simplest to formulate the problem with only one asset.

and e_f, respectively), the number of children (b) and the pension capital of the husband and wife (PC_m and PC_f, respectively). Households know x at the start of the period and decide how much to spend on the consumption good and the market purchased input, how much to save, whether or not the wife works in the market, whether or not the husband works in the market (only a choice after age 60), how much the wife works in the home and how much the husband works in the home. The number of children is decided in the first period.

The value of state x is:

$$V(x) = \max_{\substack{c,m,k',h_m,h_f,\\ n_m,n_f}} u(c,s,b,h_m,h_f,n_m,n_f) + \beta EV(x') \tag{4}$$

$$\begin{aligned} s.t. \quad & c+m+k'-(1+r)k+B \\ & = (1-\tau(x))y_m(x) + (1-\tau(x))y_f(x) + P(x) + R_m(x) + R_f(x) \end{aligned} \tag{5}$$

$$s = (\alpha(n_m+n_f)^\rho + (1-\alpha)m^\rho)^{\frac{1}{\rho}} \tag{6}$$

$$e' = (1-\delta)e + Ae^{da}g(h) \tag{7}$$

2.1 Solving the Model

Each period the couple chooses consumption, investment in physical capital, expenditure on the market input in home production, male and female home hours, and male and female market hours. The household does this for each combination of physical capital, male and female pension capital, male and female human capital and number of children. The number of children is chosen in the first period. Men and women with older children choose between not working and working full-time in the market. Women with the youngest child below the age of eight, choose between not working, working part-time (75% of full-time) and working full-time in the market. To ease the computational bur-

den, we assume that men work full-time from age 28 to 60, after which they optimally choose when to retire. We allow women with small children to cycle between employment and non-employment. For simplicity, however, we assume that a transition into non-employment after the youngest child turns eight is an absorbing one. We assume that both spouses are retired by 70.

The decision rules are solved for via backward induction. Assuming zero utility when dead, we know the value function at age 81. This enables us to solve the couple's problem at age 80, for each possible combination of state variables. Given this, we know the value function at age 80, which in turn allows us to solve the couple's problem at age 79. Working iteratively backwards we are able to solve the full decision problem.

Once we have solved for the decision rules, we simulate the model given initial physical capital, male and female pension capital and male and female human capital.

3 Calibration

In this section we discuss the process of assigning values for the model parameters. We calibrate the model to Swedish data.

Recall that the length of a period is calibrated to a year, and that model age zero corresponds to age 28 in the data. All households enter the model with zero assets and zero pension capital. We normalize initial human capital to one for all males and females. We assume an annual interest rate equal to 3%.

Households differ with respect to education and their preference for leisure. We model two education categories, college and non-college. This means that households fall into one of four educational bins: husband and wife are both high school educated, husband is college educated and wife is high school educated, husband is high school educated and wife is college educated, or husband and wife are both college educated. The weights for these bins are taken from the data. Assortative matching is quite prevalent in Sweden;

in roughly 62% of Swedish households both spouses have a high school degree and in roughly 15% of households both spouses have a college degree. In approximately 11% of households the husband has a college degree, while the wife has a high school degree. In the remaining 12% of households the wife has a college degree and the husband a high school degree.[4] We allow for preference heterogeneity within each of these educational bins.

Preference and Home Production Parameters

For simplicity, we set the discount factor, β, equal to $1/(1+r)$.

The parameters governing the disutility of male and female market hours (α_{hm} and α_{hf}, respectively) and the parameters governing the disutility of male and female home hours (α_{nm} and α_{nf}, respectively) are critical for targeting the life cycle profiles for male and female market hours and the life cycle profiles for male and female home hours. We set the disutility parameters to match the prevalence of full-time vs. part-time employment of women with young children, the average male and female retirement ages by education bin and the average male and female home hours at different stages of the life cycle (young children in household, older children in household, children out of household, retirement). In order to match all of these moments, the disutility parameters must be allowed to differ by gender, education, age (assume linearly increasing) and type of hours (market vs. home). Also, in order to generate variation in the market hours of women (part-time vs. full-time), we allow for heterogeneity in the parameters governing the disutility of market work of women. Specifically, we assume four disutility types for women. We set the parameter governing the elasticity of hours worked (γ) based on estimates in the literature for models with endogenous human capital accumulation.[5]

The weight and curvature parameters in the utility from children (α_b and ε) are set to target the average number of children by education bin. Recall that children deflate consumption.[6] This results in richer/more educated households having more children

[4] Based on Longitudinal Individual Data for Sweden (LINDA) for year 2005.
[5] See, e.g., Wallenius (2011).
[6] We use the OECD equivalence scale.

than poorer/less educated households. This is in line with what we observe in the data.

The level of average home hours at different points in the life cycle and the average ratio of consumption goods to market purchased services pin down the utility weight on the home good (α_s) and the relative weight of home hours (α) in the home good production function. To match the variation in average home hours over the life cycle, we allow the relative weight on home hours to vary over the life cycle. Our value for the ratio of consumption to market purchased services is taken from Olovsson (2009). The parameter governing the substitutability of time and goods in the home production function is taken from the literature (see, e.g., Ragan (2013)).

Life Cycle Earnings Profiles

The parameters of the human capital production function, namely δ, A and d, are chosen to match the age-earnings profiles of college and non-college educated men (i.e., parameters education-specific). We use the LINDA dataset to construct life cycle earnings profiles for college and non-college educated men in Sweden. We limit the sample to men born between years 1925 and 1935. Incomes are made comparable across years by adjusting with the base-amount for the year in question. We delete all observations with income below one base-amount. For the two education groups separately, we run a regression of annual earnings on age and age squared.

In the model, labor income is the product of a rental rate, human capital and hours worked. The initial stocks of human capital are all normalized to one. For men, the rental rate is set so as to match age 28 earnings in the data, separately for the college and non-college educated. We assume that the human capital parameters δ, A and d are the same for men and women. To match the initial gender wage gap, we follow Jones, Manuelli, and McGrattan (2015) and assume that the rental rate for women is given by $w_f = gwg \cdot w_m$, where $gwg < 1$. We exogenously impose that the gender wage gap is slightly bigger for college educated women than for non-college educated women. In the benchmark, we assume that there is no additional penalty from part-time work. In

other words, working a reduced workweek of 75% accrues 75% of the human capital of working full-time.

Taxes

The effective tax on labor income in the model includes consumption taxes, social security taxes and income taxes. Of these three, only income taxes are progressive. The income tax rate is 0.31 on income up to a threshold of roughly 33 000 USD. On income above the threshold, the income tax rate is 0.51. The consumption tax is set equal to 0.25, which is the value-added tax on most goods in Sweden. The social security tax of 0.23 includes employer and employee contributions.

The government uses the proceeds from the tax on labor income to finance parental leave benefits, the childcare subsidy, retirement benefits and government consumption. We assume that individuals value government consumption, but that it does not affect the marginal utility of private consumption (this is akin to assuming that the revenue allocated for government consumption is thrown away). We assume a balanced budget in equilibrium.

3.1 Calibrated Economy

Table 1 summarizes the calibrated parameter values for the benchmark Swedish economy. Our benchmark economy is able to replicate the salient features of labor supply behavior in Sweden. In particular, in our benchmark economy almost half of the women with young children work part-time. This generates roughly 70% of the widening in the gender wage gap documented by Angelov, Johansson, and Lindahl (2013) 15 years after women have their first child.

Parameter	Description	Target	Value
Utility			
α_{hm}	male disutility market work	male market work	12/10/11/9
α_{nm}	male disutility home work	male home work	5.5
α_{hf}	female disutility market work	female market work	See Table 2
α_{nf}	female disutility home work	female home work	3.5
γ	related to elasticity of hours	literature	2
α_b	utility children	number of children	0.7
ε	elasticity of children	number of children	1.5
α_s	utility home good	home hours & c/m	0.75
Home production			
α	weight on home hours in production	home hours & c/m	0.8/0.65/0.6
ρ	related to elasticity of substitution	literature	0.8
Human capital			
δ	depreciation rate	male age-earnings	0.020/0.017
d	age effect	male age-earnings	-0.021/-0.019
A	learning	male age-earnings	0.093/0.047
w_m	male rental rate	male income at 28	3.884/7.633
gwg	gender wage gap	initial gender gap	0.9/0.87

Table 1: Calibrated Parameter Values. Four values for α_{hm} depending on couple type (non-college/non-college, non-college/college, college/non-college, college/college). Three values for α depending on age. Human capital parameters reported for non-college/college.

Disutility Type	Non-CL/Non-CL	Non-CL/CL	CL/Non-CL	CL/CL
1	$1 \rightarrow 15.9$	$1 \rightarrow 16.4$	$1 \rightarrow 10.0$	$1 \rightarrow 13.4$
2	$3 \rightarrow 15.0$	$3 \rightarrow 15.5$	$3 \rightarrow 9.1$	$3 \rightarrow 12.5$
3	$5 \rightarrow 14.1$	$5 \rightarrow 14.6$	$5 \rightarrow 8.2$	$5 \rightarrow 11.6$
4	$7 \rightarrow 13.3$	$7 \rightarrow 13.8$	$7 \rightarrow 8.0$	$7 \rightarrow 10.8$

Table 2: Calibrated Parameter Values. Profiles of α_{hf} for each couple type (linearly increasing by age).

4 Policy Exercises

Having calibrated the model, we turn to the policy analysis and some counterfactual exercises. In order to understand the driving forces behind the time allocation decisions of couples over the life cycle, we consider five different exercises: (1) eliminating the part-time work option, (2) reducing the initial gender gap, (3) increasing the penalty for part-time work, (4) reducing the childcare subsidy and (5) introducing a subsidy on the market input in home production.

4.1 Results

Eliminate Part-Time Option

Entirely eliminating the part-time work option is of course rather extreme. The purpose of this exercise is to understand whether the women currently working part-time would choose to work full-time or rather stay home with young children, if the part-time work options were limited.

We find that most women who work part-time in the benchmark economy move to full-time work when the part-time work option is no longer available. However, some high school educated women who are matched with a college educated husband choose to stay home when their children are young. Interestingly, the aggregate increase in labor supply is slightly dampened by the fact that some men reduce their labor supply in response to their spouses working more. This implies that also modeling a male labor supply choice, instead of focusing solely on female labor supply, is important for accurately capturing the aggregate effects of policies. The aggregate effect of eliminating the part-time work option is to increase labor supply by roughly 2.3% relative to the benchmark economy. We find that fertility is unaffected by the elimination of the part-time work option.

Reduce Initial Gender Gap

In most couples the husband is still the higher earner. It therefore makes sense from and economic stand point that, if one spouse is going to cut back on market work after the birth of the child, it be the woman. In the benchmark economy, the initial gender gap is 10% for high school educated women and 13% for college educated women. Here we consider the effect of reducing this gap by half. We find a modest reduction in the prevalence of part-time work in response to the narrowing of the initial gender gap. Additionally, we observe some women working a larger fraction of their life. The aggregate effect is to increase labor supply by roughly 1.2% relative to the benchmark economy. According to our model, the narrowing of the initial gender wage gap has no effect on fertility.

Increase Part-Time Penalty

In the benchmark economy, human capital accrual is proportional to the hours worked. So, one accrues 75% of the human capital of full-time work from working a reduced workweek of 75%. The empirical evidence is somewhat mixed for Sweden, but some estimates suggest that the part-time penalty is relatively low in Sweden. In contrast, Blundell, Costa Dias, Meghir, and Shaw (2015) suggest that in the UK one essentially does no accrue human capital by working part-time. Would Swedish women work more full-time and less part-time, if the penalty for part-time work was greater? We consider the case where working a reduced workweek of 75% accrues only 50% of the human capital of full-time work. We find that this does indeed result in a marked reduction in the prevalence of part-time work. However, this increase in labor supply along the intensive margin is partially offset by a reduction in labor supply along the extensive margin (primarily for women, but also for some men). The effect of the increase in the part-time penalty on aggregate labor supply is positive but small, roughly 0.9%. Fertility remains unaffected.

Reduce Childcare Subsidy

Previous literature has found that childcare subsidies boost female employment. We are particularly interested in effect of childcare subsidies on the prevalence of part-time work. When childcare is very expensive, it does not make sense for a woman with children to work part-time – she either works full-time and incurs the cost of paid childcare or stays at home with the children. Childcare in Sweden is heavily subsidized. Based on a comparison of out-of-pocket expenditures and the true cost of a childcare spot, we estimate the subsidy rate to be roughly 86%. Does the large subsidy on daycare promote part-time employment? Or would a reduction in the subsidy result in lower female employment? We consider the effect of cutting the childcare subsidy in half. This leads to more divergence across couples. Our model predicts that some women will work more and have fewer children, while others will stay home when children are young (and potentially also have more children). The effect on aggregate labor supply is small, but fertility declines.

Introduce Subsidy on Market Input in Home Production

Angelov, Johansson, and Lindahl (2013) hypothesize that the widening of the gender wage gap after women have children is linked to the unequal division of home work across men and women, particularly when children are young. According to time-use data for Sweden, women with young children (living as a couple) spend on average two hours more per day on domestic work than men.[7] Albrecht, Skogman Thoursie, and Vroman (2015) speculate that the poor market substitutes for home goods – other than childcare – contribute substantially to the gender wage gap in Sweden. In the context of our model, we are able to study the importance of this channel. We introduce a subsidy on the market input in home production equal to...

4.2 Discussion

Home Production

In the previous section we focused on effect of various policies/exercises on market work. It is also of interest to look at the effects of these policies on home production. We find that when women increase market work, they reduce home work. This reduction occurs primarily once children are a bit older. In couples where female market work increases the most, men increase home hours a bit. The increase in male home hours does not fully compensate for the reduction in female home hours.

It is also of interest to ask whether the inclusion of home production in our model affects the conclusions we draw from the policy analysis. Some experiments, such as the subsidy on the market input in home production, are of course directly linked to home production. But what about the ones that are not? To gauge the importance of home production for our results, we considered an alternative model version without home production. We find that the effect of policies on market work are more pronounced in a model with home production relative to one without.

[7] Based on Harmonized European Time Use Data (HETUS) for year 2000.

5 Conclusions

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