The Rise of the Added Worker Effect[*]

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Abstract

We document that the added worker effect (AWE) has increased over the last three decades. We develop a search model with two earner households and we illustrate that the increase in the AWE from the 1980s to the 2000s can be explained through i) the narrowing of the gender pay gap, ii) changes in the frictions in the labor market and iii) changes in the labor force participation costs of married women.

JEL Classification: E24, J12, J64

Keywords: Heterogeneous Agents; Family Self Insurance; Dual Earner; Unemployment; Labor Market Search.

1 Introduction

Figure 1 shows the added worker effect (AWE), the increase in the probability that a married woman joins the labor force (LF) when her husband becomes unemployed, estimated from the Current Population Survey (CPS).[1] The figure shows that the AWE has increased over the last decades.

We explain the rise of the AWE through the interplay of several factors: i) the gender pay gap has decreased over the last three decades; ii) search frictions for prime aged married men and women have also changed; iii) there has been a strong increase in the employment rate of married women. To the extent that this increase cannot be explained by i) and ii) it may reflect a drop in the labor market participation costs of married women.[2]

We present a simple model, where households consist of a male and female spouse. Men can be either employed or unemployed in any given period, their transitions between these two states are determined by the arrival rate of job offers ($p_{U,m}$) and by exogenous separation shocks (s). Married women may be employed (E), unemployed (U) or out of the labor force (O). As in Garibaldi and Wasmer (2005) (hereafter GW), their labor market status is determined by the frictions - they receive offers with probability $p_{U,f}$ when U ($p_{O,f}$ when O) - and by the disutility of labor (ω) which varies across households. Women who derive a moderate disutility from market activities are 'marginal workers': when their husbands are employed they remain in state O; however, when their husbands become unemployed they flow into the LF.

These assumptions allow us to characterize analytically the labor supply of women and the AWE in the model. In quantitative experiments we shift the frictions, the gender gap, and the mean of the distribution of ω. We find that the joint impact of these forces can account for the entire increase in the AWE observed in Figure 1.

2 Model

Time is discrete and the horizon is infinite. β denotes the discount factor. Let (w_m, w_f) denote the wages and assume all individuals supply a unit of labor when they work. Households pool resources, and consume total income (I) every period. The utility of consumption is $u(I)$. Let S be the joint labor market status of the household members. We have:

$$S \quad \in \quad \{EE,\ EU,\ EO,\ UE,\ UU,\ UO\}$$

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[1]Many authors have presented static estimates of the AWE, using various household surveys (e.g. Lundberg (1985), Stephens (2002) and Mankart and Oikonomou (2015) (hereafter MO) among many others). The fact that the AWE is significant echoes that financial markets are incomplete and labor markets are fraught with frictions. If these conditions were not met, the AWE would be equal to zero.

[2]This can be justified by lower fertility (Bloom et al., 2009), higher productivity in the production of home goods (Greenwood et al., 2005), changes in cultural norms (Fernández, 2013) and so on.

Figure 1: The Added Worker Effect: from the 1980s to the 2000s
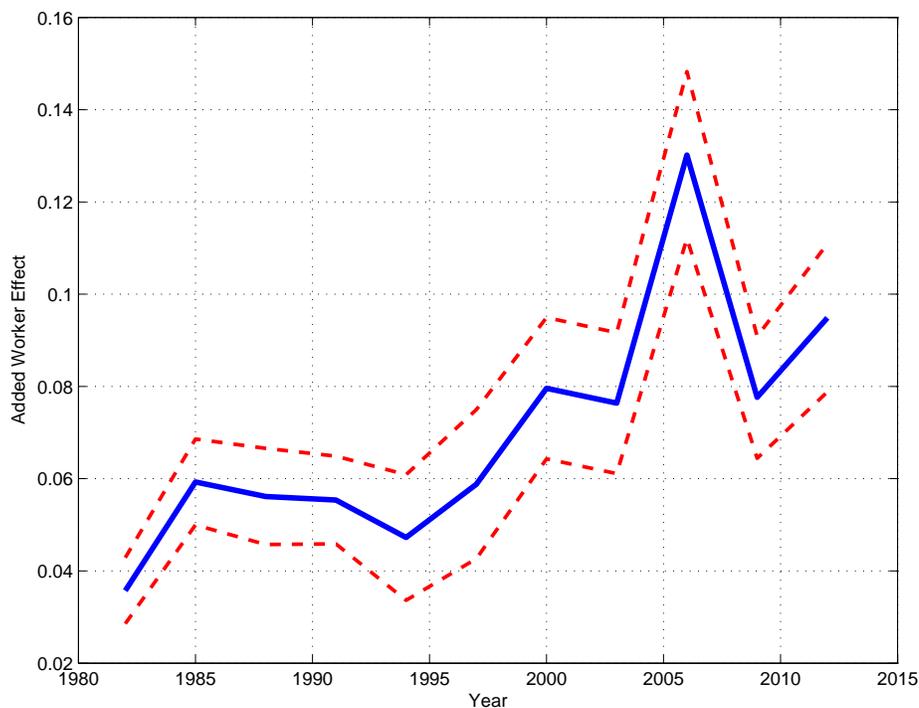
Note: The graph shows the increase in the probability that the wife enters the labor force when her husband becomes unemployed (relative to when he remains employed). The sample covers households where both spouses are 25-55 years old. The data are monthly observations from the CPS. The coefficients plotted in the figure are estimated from a linear probability model. The dependent variable is a dummy variable which takes the value 1 when the wife joins the LF. The coefficients correspond to dummy variables defined as follows: they take a value of 1 if the husband becomes unemployed between month t and $t + 1$ and these months fall within a predetermined 3 year interval. The value of the dummy is zero otherwise. The regressions include demographic variables (age, education, children). Details on the data and the estimation can be found in the online appendix.

where the first (second) element denotes the husband's (wife's) state. We assume that I_S takes the following values: $I_S \in \{w_m + w_f, w_m, w_m, b + w_f, b, b\}$. b denotes the level of consumption of the household when the husband is unemployed. It is meant to capture the income earned from benefits but also income and transfers from other sources (any insurance arrangement, formal or informal, not modeled here). To simplify we assume that women do not earn any benefits during unemployment since our focus is on women who are O and then (following an unemployment shock suffered by the husband) join the LF. The utility cost of working ω remains constant through time. Search effort costs $\kappa \omega$ are proportional to the disutility of labor with $\kappa \in (0, 1)$.

Value functions Let $W_S{}^3$ denote the lifetime utility of a couple in state S. We have that:

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\begin{align}
W_{EE} &= u(w_m + w_f) - \omega + \beta[(1-s)^2 Q_{EE} + s(1-s)(Q_{EN} + Q_{UE}) + s^2 Q_{UN}] \tag{1} \\
W_{EU} &= u(w_m) - \omega\kappa + \beta[p_{U,f}((1-s)Q_{EE} + sQ_{UE}) + (1 - p_{U,f})((1-s)Q_{EN} + sQ_{UN})] \tag{2} \\
W_{EO} &= u(w_m) + \beta[p_{O,f}((1-s)Q_{EE} + sQ_{UE}) + (1 - p_{O,f})((1-s)Q_{EN} + sQ_{UN})] \tag{3} \\
W_{UE} &= u(b + w_f) - \omega + \beta[p_{U,m}(1-s)Q_{EE} + p_{U,m}sQ_{EN} + \tag{4} \\
&\quad (1 - p_{U,m})(1-s)Q_{EN} + (1 - p_{U,m})sQ_{UN}] \\
W_{UU} &= u(b) - \omega\kappa + \beta[p_{U,m}(p_{U,f}Q_{EE} + (1 - p_{U,f})Q_{EU}) + (1 - p_{U,m})(p_{U,f}Q_{UE} + (1 - p_{U,f})Q_{UU})] \tag{5} \\
W_{UO} &= u(b) + \beta[p_{U,m}(p_{O,f}Q_{EE} + (1 - p_{O,f})Q_{EN}) + (1 - p_{U,m})(p_{O,f}Q_{UE} + (1 - p_{O,f})Q_{UN})] \tag{6}
\end{align}
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where $Q_{EE} = \max\{W_{EE}, W_{EU}, W_{EO}\}$, $Q_{EN} = \max\{W_{EU}, W_{EO}\}$, $Q_{UE} = \max\{W_{UE}, W_{UU}, W_{UO}\}$, and $Q_{UN} = \max\{W_{UU}, W_{UO}\}$ denote the envelopes of the value functions and N denotes that the female spouse does not have a job offer at hand (she chooses between U and O). In (1) the couple has both of its members employed. With probability $(1-s)^2$ their jobs are not destroyed next period, the wife can chose to remain in E, or flow to U or to O. With probability $(1-s)s$ his job continues but her job is destroyed, in this case she chooses between U and O. The remaining cases are defined analogously.[4]
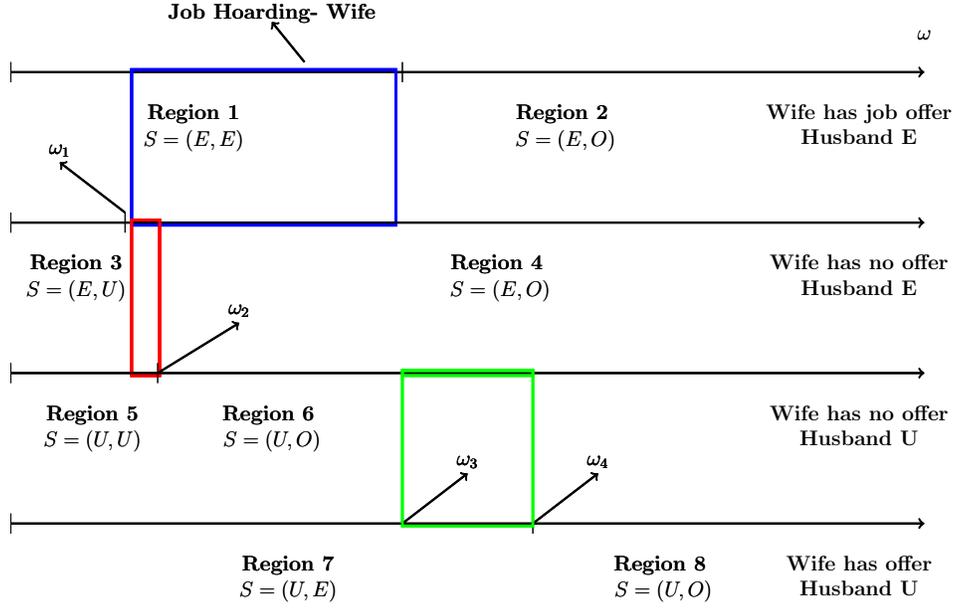
Policy Functions Figure 2 shows the policy rules $S(\omega)$.[5] The figure is organized in 4 panels. The top one shows S when both spouses have job offers. In 'Region 1' they both remain employed. When 'Region 2' is reached the optimal allocation is to set $N = O$ since the disutility ω of effort is too high. The second panel shows the case when the husband is E and the wife is N. In 'Region 3' the wife is U and in 'Region 4' she is O. The third panel assumes that the husband has lost his job. The wife is now U in 'Region 5' and O in 'Region 6'. Finally, the 4th panel shows the case where the wife has an offer and the husband is U. The wife is now E in 'Region 7' and O in 'Region 8'.

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[3]For brevity $W_S(\omega) = W_S$ since ω is a fixed effect.

[4]The options Q may appear meaningless (since ω is constant), however, treating the Qs explicitly makes the value functions applicable to all values of parameters. For example, when $\kappa \to \infty$ and $\omega > 0$ it is never optimal to set $N = U$. In contrast, when $\kappa = 0$ we always have $N = U$.

[5]The parameters are chosen to generate an AWE.

Figure 2: Female Labor Supply - the Added Worker Effect in the Model

Job Hoarding- Wife

ω

| **Region 1** $S = (E,E)$ | **Region 2** $S = (E,O)$ | Wife has job offer Husband E |

ω_1

| **Region 3** $S = (E,U)$ | **Region 4** $S = (E,O)$ | Wife has no offer Husband E |

ω_2

| **Region 5** $S = (U,U)$ | **Region 6** $S = (U,O)$ | Wife has no offer Husband U |

ω_3 ω_4

| **Region 7** $S = (U,E)$ | **Region 8** $S = (U,O)$ | Wife has offer Husband U |

Note: The figure shows the policy rules S as functions of ω. See text for a description of each of the 4 panels of the figure.

Consider the red and the green areas in the figure. These show ranges of ω which give an AWE. In the red rectangular, we have that $S = (E,O)$ (second panel) but when the husband becomes U it is optimal to set $S = (U,U)$ (third panel). The AWE is a flow into unemployment which would not have occurred if the husband remained employed. In the green rectangular, the AWE is a flow directly to E. If the husband is E and the wife receives an offer, she will not accept it (first panel). However, when the husband becomes U the wife accepts the offer (fourth panel).[6]

Finally, the blue rectangular in the figure is used to denote the part of the state space where women 'hoard jobs' (see GW). Because search is costly, individuals keep their jobs, and wait for an s shock to quit to O.

Analytical Results We characterize analytically the thresholds ω_i, $i = 1, 2, 3, 4$ shown in Figure 2.

Proposition 1. *The solution for ω_1 satisfies*

$$\omega_1 = \frac{\beta(p_{U,f} - p_{O,f})}{\Delta_1 \widetilde{\kappa}_1} \left[s\widetilde{\xi}_2 + \lambda_1 \widetilde{\xi}_1 \right] \tag{7}$$

where $\widetilde{\xi}_1 = u(w_m + w_f) - u(w_m)$, $\widetilde{\xi}_2 = u(b + w_f) - u(b)$, $\Delta_1 = [1 - \beta(1 - s - p_{U,f})][1 - \beta(1 - s - p_{U,f})(1 - s - p_{U,m})]$, $\lambda_1 = (1 - s - \beta(1 - p_{U,m} - s)(1 - s - p_{U,f}))$, $\widetilde{\kappa}_1 = [\kappa + (1 - \kappa)\frac{\beta(p_{U,f} - p_{O,f})}{1 - \beta(1 - s - p_{U,f})}]$.

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[6]MO have shown that the AWE, nearly 2/3 of the times in the U.S. data, consists of a direct flow to E.

The solution for ω_2 satisfies

$$\omega_2 = \beta \frac{p_{U,f} - p_{O,f}}{\Delta_2 \widetilde{\kappa}_2} \left[p_{U,m} \widetilde{\xi}_3 + \lambda_2 \widetilde{\xi}_4 \right] \tag{8}$$

where $\lambda_2 = (1 - p_{U,m} - \beta(1 - s - p_{U,m})(1 - s - p_{O,f}))$, $\widetilde{\kappa}_2 = \left[\kappa + \beta \frac{(p_{U,f} - p_{O,f})}{1 - \beta(1 - s - p_{O,f})} \right]$, $\widetilde{\xi}_3 = u(w_m + w_f) - u(w_m)$, $\widetilde{\xi}_4 = u(b + w_f) - u(b)$ *and* $\Delta_2 = [1 - \beta(1 - s - p_{O,f})][1 - \beta(1 - s - p_{O,f})(1 - s - p_{U,m})]$.

Moreover we have that

$$\omega_3 = \frac{1}{\widetilde{\kappa}_3} \left[u(\sum_g w_g) - u(w_m) + \beta s(1 - s - p_{O,f}) \frac{u(b + w_f) - u(b)}{1 - \beta(1 - s - p_{O,f})(1 - p_{U,m})} \right] \tag{9}$$

where $\widetilde{\kappa}_3 = \left[1 + \beta \frac{s(1 - s - p_{O,f})}{1 - \beta(1 - p_{U,m})(1 - s - p_{O,f})} \right]$, *and finally*

$$\omega_4 = u(b + w_f) - u(b). \tag{10}$$

Proof: see online appendix.

The above results can be used to derive qualitative effects of parameter changes. To assess the quantitative impact of these changes, we proceed with the numerical solution of equations (1) to (6).

Calibration (1980s) Table 1 shows the baseline calibration. We set $\beta = 0.99$. We let $u(I) = \log(I)$ and normalize $w_m = 1$. The other parameters are chosen to be consistent with the situation in the 1980s. The female wage is set to generate a pay gap of 32% in line with Siegel (2014). The labor market frictions are chosen to match the corresponding moments in our CPS sample: We set $p_{U,m} = 0.30$ to match the monthly job finding rate of men of around 29%. We set $s = 0.0137$ to get an unemployment rate for men of 4.37%.[7] We set $p_{U,f} = 0.21$ to match the job finding rate of women. In the US many O individuals are 'marginally attached'. These agents have a transition rate to E nearly half as large as of unemployed agents (Jones and Riddell (1999) and MO). In our model 'marginally attached' are women who are O but accept job offers. They have $\omega_1 < \omega < \omega_3$ (i.e. the 'labor hoarding' region). Therefore, we set $p_{O,f} = 0.105$.

We set $\kappa = 0.25$ to match the unemployment population ratio of 3.24%. ω is uniformly distributed in $[-\overline{\omega}, 1 - \overline{\omega}]$, where $\overline{\omega}$ is chosen the match the female employment rate in the 1980s (61.08%). We obtain $\overline{\omega} = 0.131$.[8]

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[7]Assuming the same separation rate for married men and women is a good approximation of the US data since the EU rate in the 1980s has been 0.0109 for men and 0.0105 for women. Moreover, in MO we showed that with the same s, the EO rate of women can be considerably larger than the rate for men if we assume the presence idiosyncratic productivity shocks. Our aim is to offer a simple framework here, in future work we will enrich it with productivity shocks and household wealth.

[8]This implies that some women dislike staying at home or being unemployed. Negative values of leisure are common in the micro-search literature.

Table 1: Model calibration

Parameter	Value	Target (80s)
$p_{U,m}$	0.30	CPS
$p_{U,f}$	0.21	CPS
$p_{O,f}$	0.105	Jones and Riddell
s	0.0137	$u - rate_m = 4.37\%$
κ	0.25	$u - pop_f = 3.24\%$
w_m	1	Normalization
w_f	0.68	Gender Gap
b	0.7	AWE of 4.68%
$\overline{\omega}$	0.131	$e - pop_f = 61.08\%$

Note: The table shows the parameter values assigned in the 1980s calibration of the model.
The data moments refer to married individuals of ages 25-55. See online appendix for details.

Finally, we set $b = 0.68$ to obtain an AWE of 4.68%. Recall that b captures income from UI payments, but also income from assets, severance payments and other insurance arrangements.[9]

3 Experiments

Decline in the gender gap We first investigate the effects of narrowing the gender gap ($\frac{w_f}{w_m} = 0.8$). The results are in the Column 3 of Table 2. The higher w_f increases employment and increases the AWE. The new AWE is 6.35% nearly halfway between the moment in the 1980s and the 2000s.

Since women join the LF to provide insurance, a drop in the gender gap increases the value of insurance: women can make up for a larger fraction of the lost family income. However, since now more women participate, their employment rate increases from 61% to 67.5%, the cost of insurance measured in terms of ω increases.[10]

Changes in frictions We keep $w_f = 0.68$ and consider only changes in the frictions. We set $(p_{U,m}, p_{U,f}, p_{O,f}, s) = (0.34, 0.25, 0.125, 0.0117)$, consistent with our estimates for the 2000s. The results are shown in Column 4 of Table 2. Female employment increases to 62.1% and unemployment drops due to the looser frictions.

Recall that when the job finding rate of men increases, the AWE drops. When it is easier to

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[9]If we focus on UI and set $b = 0.5$, the model produces a larger AWE, however, the quantitative effects of the next section are unaffected. We also experimented with allowing benefits to be received by households with a low ω, so that the wife is always in the LF. Again our results were unaffected.

Ideally to introduce benefits for women we would allow for 4 states (e.g. unemployed .with benefits' and 'without benefits') as in GM. This requires to keep track of employment histories. Our model is as a first step towards this agenda.

[10]The region $[\omega_1, \omega_2]$ shifts towards the right. 'Marginal workers' now incur higher costs, but since the higher wage dominates, the interval expands.

Table 2: The experiments

	Data	Gender Gap	Frictions	Gender Gap & Frictions	Gender Gap & Frictions & Preferences
AWE	8.33%	6.35%	5.71%	7.73%	8.27%
$e - pop_f$	70.54%	67.49%	62.12%	68.76%	70.53%
$u - pop_f$	2.55%	3.58%	2.39%	2.63%	2.71%

Note: The table shows changes in model outcomes when we shift the parameters (gender gap, frictions and preferences) as in the 2000s. The column *Gender Gap* shows the effect of the lower gender gap; the column *Frictions* the effect of smaller frictions. The column *Gender Gap & Frictions* puts together the new gender gap and the changed frictions. The final column adds a shift in preferences to match the employment rate of married women in the 2000s.

find jobs, providing insurance becomes less urgent, in the limit, when $p_{U,m} = 1$, the AWE equals zero. However, there are now two forces which go in the opposite direction: First, the rise in $p_{U,f}$ lowers expected search costs and women flow more readily to U. Second, the rise in $p_{O,f}$ means that direct flows from O to E increase; the AWE attributed to these flows increases as well. The net effect is positive and the AWE increases to 5.71%.

Gender gap and frictions In Column 5 we consider the joint impact of the changes in the frictions and the lower gender pay gap. We find that with these two changes together the AWE increases to 7.73%.

Adding shifts in preferences In the previous models, the female employment rate always remained below its value observed in the 2000s. Therefore, we additionally calibrate the distribution of ω to generate an employment population ratio of 70.5%. Thus, in Column 6 we set $\overline{\omega} = 0.1495$ which lowers the costs of market activities.[11]. We now obtain an AWE of 8.27% remarkably close to the data moment. A drop in the utility cost of working increases the number of 'marginal workers' in the economy. More households have $\omega < \omega_4$ and utilize female labor supply as an insurance mechanism against unemployment risks.

Changing the distribution of ω, while leaving the gender pay gap and the frictions at their initial values, leads only to a small increase in the AWE to 4.95% (not reported in the table). Thus, the change in preferences contributes only slightly to the increase in the AWE. The change in the gender pay gap and the frictions explain roughly 85% of the observed increase in the AWE.

4 Conclusion

We documented a new data fact, an increase in the AWE since the 1980s. We constructed a simple model which accounts for the rise in the AWE. Our analysis is a first step towards a more elaborate model, which includes wealth, shocks to preferences and productivity, and which accounts jointly for the labor market flows and the AWE.

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[11]This is in line with, for example, Heathcote et al. (2009)

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