On Marriage and Labor Market Transitions: A Structural Dynamic Model *

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April, 2011

Abstract

This research investigates women's marriage and employment choices by estimating a joint dynamic model relying on data from the Egyptian Labor Market and Panel Survey (ELMPS) of 1998 and 2006 as well as a retrospective information from 1990. A major objective of this study is to disentangle the causal relationship between both decisions. For the employment decision, the model distinguishes between four different labor market alternatives. These are inactivity, public, private and subsistence employment. This study infers new results with regards to state dependence and dynamic transitions among the different employment alternatives. The results show greater state dependence for the public than for the private sector. Also, significantly important transitions between the different employment status alternatives are observed. Married women working in the private sector tend to have higher probabilities to move to inactivity than women in the public sector, which goes in line with my expectations. In other words, Marriage decreases the public employment probability by 18% and the private one by almost the double (30%). Following these results, public sector jobs seems to be more convenient for married women since they allow them a better reconciliation between family and professional lives simultaneously.

JEL classification: C14, C33, C35, J21, J88.

Keywords: Marriage, Dynamic models, Endogeneity, Unobserved heterogeneity, Egypt.

*I am very grateful to Thierry Kamionka, Ragui Assaad, Catherine Sofer and Moshe Bushinsky for their valuable suggestions and discussions. I also thank Maxime To and Raul Sampognaro for their helpful comments and assistance. I also thank all the participants of the European Society for Population Economics (ESPE) conference, Journée de Microéconomie appliquée (JMA), the Middle East Economic Association (MEEA) conference and the GDRI-DREEM conference for their useful comments.

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1 Introduction

Marriage and labor force participation in a women's life cycle are two factors likely to affect her welfare. On the one hand, marriage is considered to bring financial benefits (Becker, 1973; 1974) regarding scale economies of living in a couple in addition to happiness from private life. In developing economies, in particular Arab ones, marriage also bring satisfaction as it is the unique acceptable type of unions. On the other hand, labor force participation directly contributes to women's financial situation.

Furthermore, labor force participation and family structure are deeply related to a woman's welfare through the allocation of time (Becker, 1965; Gronau, 1973). This is particularly the case in Egypt where the husbands' time spent on domestic production is generally set to zero.

Each woman in every period makes joint choices regarding the marital status and the sector of employment. Women in this model make different choices due to differences in observable characteristics. Note that state dependance and labor market dynamics are important aspects of this chapter. The model is estimated using techniques of maximum likelihood.

A number of of empirical studies have shown that the female labor supply is closely related to the family background such as income of the husband or the existence of children (Killingsworth and Heckman, 1986). However, most of these studies analyzed the female labor supply by focusing only on married women and treating family conditions as exogenous.

Recently, a growing literature has applied estimable dynamic models for women's life cycle choice problems (Eckstein and Wolpin, 1989b).

The present research investigates women's marriage and employment choices by estimating a joint dynamic model relying on data from the Egyptian Labor Market and Panel surveys of 1998 and 2006 as well as a retrospective information from 1990. A major objective of this study is to disentangle the causal relationship between both decisions. For the employment decision, the model distinguishes between four different alternatives. These are inactivity, public, private and subsistence employment. Note that the subsistence work includes all activities involving the production and processing of primary goods for

purposes of household consumption, such as feeding and caring for livestock poultry, or making butter or cheese (see Assaad et al., 2010).

This study considers only the choice of marital status of unmarried women. It is assumed that any unmarried woman is able to get married whenever she wishes. Although it is ideal to introduce the marital search process as in Van Der Klaauw (1996), the present study avoids this complicated decision process in order to focus on the joint decision with employment. Married women are assumed to continue to be married. Work by Van Der Klaauw (1996) marks the first contribution to an integration of decisions regarding marital status into the labor supply behavior of women. That study finds that utility from gains from marriage are affected by female wage rates and the husband's earnings.

The paper is organized as follows: Section 2 exhibits some stylized facts on marriage and employment transitions in Egypt. Section 3 shows the data used and the sample selection. Section 4 is devoted to the presentation of the model as well as the estimation method. Section 5 displays the empirical results. And, section 6 concludes.

2 Some Stylized Facts

In the early nineteens Egypt has adopted the Economic Reform and Structural Adjustment Program (ERSAP). The latter mainly consists of the privatizing the public enterprisers. In addition to this, the Egyptian government no longer guarantees a governmental employment for all university graduates as it was the case during the last decade.

Women in Egypt are likely to have high labor supplies when before they get married. One explanation for that is the high costs of marriage in Egypt. Women are then in need to work to be able to afford these costs. Once married, women's patterns generally differs with according to the employment sector. Women working in the public sector are expected to have higher probabilities to continue working in the market after marriage. Thanks to family-friendly policies that are more respected in the public sector. In contrast, the private sector employment is expected to impose stronger constraints which force women to leave the labor market after marriage and to move to inactivity. The latter is generally known for its long working hours as well as for its discrimination against women (especially married ones) and the deep shortage of presence of family-friendly policies.

This section aims at having a glance on patterns of women's labor market and marriage transitions between 1998 and 2006. Within this period, Egypt witnessed several vagues of economic structural reforms, trade liberalization and privatization policies.

Table 1 shows the women's labor market transitions between the different sectors from 1998 to 2006[1]. Egyptian women are observed to have important state dependence. Interestingly, 82.74 percent of women working in the public sector in 1998 are observed in the same sector in 2006. We also observe observe important transitions from the informal sector to the inactivity state, with 48.15 percent moving from informal jobs to inactivity between 1998 and 2006. Not surprisingly, the large majority of inactive women (75.66 percent) are likely to remain inactive.

[Table 1 about here]

Tables 2 and 3 displays the same information of Table 1 but for single and married women separately. Note that, in these tables, we only observe women who did not change their marital status between the two dates. The same aspects of labor market transitions are observed for both groups of women. Though, only 73.17 percent of singles working in the public sector are state dependents compared to 86.08 percent of their married peers. Larger proportions of married women tend to stay in public sector's jobs than singles women. In contrast, singles have larger state dependance for the private employment relative to married ones.

[Tables 2 and 3 about here]

Turning our analysis to women who changed their marital status between the two dates. Table 4 shows labor market transitions for women who changed their marital status to became married between 1998 and 2006. These women are observed singles in 1998 and married in 2006. As expected, 82 percent of those working in the public sector before marriage (in 1998) continue working in the same sector after marriage. This results confirms our assumption that public sector's jobs are more efficient to help women to reconciliate between family and professional lives. Women working in this sector are then encouraged to remain active after marriage.

[1]The employment choices are the public, private, subsistence employment and non-employment.

Clearly, Table 4 shows that 50 percent of women working in the private sector quite the labor market and transit into inactivity after marriage. This result largely confirms our hypothesis. When women transit into marriage, the state dependance to the private sector completely disappears.

Furthermore, 62.50 percent of women working in the informal sector's jobs transit into inactivity after they marry. One explanation for this could be the domination of uncertainty and insecurity in this sector.

[Table 4 about here]

Table 5 shows labor market transitions for women who were married in 1998 but became singles in 2006. These women are whether divorced or widowed. Note that, in the present study, this women's group is not considered in the econometric model. Contrarily to the results showed in Table 4, these "newly single" women are high private sector dependents. For instance, 56 percent of those working in the private when they were married continue working in this sector when they become singles. Moreover, 56.58 percent of these women transited from the informal sector to inactivity after changing their marital status.

[Table 5 about here]

3 Data

I use data from the Egyptian Labor Market and Panel Surveys of 1998 and 2006. Only the panel sample is used in order to observe the same individuals in both dates. Additionally, I also use of the retrospective information on the individuals' employment status from 1990. All individuals, whether married or singles, aged between 16 and 50 years old in 1990 are considered in the analysis. Students, retired, pre-retired, and handicapped persons are excluded from the sample. As explanatory variables, I control for the individual's level of education, the region of residence, the parental level of education and the individual's age.

In 1990, we do not directly observe these individuals' characteristics. Nevertheless, relying on some variables such as the date of birth and the year of marriage, I am able

to observe the age and the marital status in 1990. Similarly, the individuals' levels of education in 1990 can be informed from the available information on the individual's age when completed or dropped out the school. And, the parental levels of education are assumed to not vary in time.

Following Assaad and Zouari (2003), to instrument the marriage decision, I use the median age at marriage in the district where the woman lives as well as the number of sisters she has. Yet, the latter are far to be convenient instruments. For this, further research consist of testing new instruments from the 10 percent sample of the 1996 Egyptian census data.

4 Econometric Model

This section presents the basic structure of the model. The solution to the model and the estimation method are also discussed. The model corresponds to the decision problem of a single individual choosing her marital status and employment status in each time period which are functions of previous decisions. Each period is associated with a certain age (ages 16 to 50). There is also unobserved heterogeneity in women. Incorporating these into the model is intended to capture the selection on unobservables that could be correlated with the observable choices of women and therefore could bias the estimated structural parameters if not incorporated into the model.

The individuals are observed at 3 points of time (1990;1998;2006) $t \in 1; 2; 3$. The marital choice set contains two options, denoted by $m_t = 1$ if the women gets married between 1998 and 2006 and to zero otherwise. However, the actual choice set is conditional on the marital state in the previous period $m_t - 1$. Regarding the employment status, each women can choose between four possible alternatives[2]. Thus, the full choice set contains four career options and two potential marriage options, The four career choices are observable as well as the marital status of each women in our sample.

In considering women's choices, some choice can be re-selected whereas other may not be easily canceled; divorce is legally impossible without the husband's consent in Egypt. In addition, women face difficulties when trying to re-enter the labor market after a rest

[2]The alternatives are: 1. public; 2. private; 3. subsistence work; 4. non-employment.

period.

Therefore, the dynamic framework presented here integrates a woman's decisions as regards marriage and labor force participation. Furthermore, these issues are considered simultaneously. Note that the model accounts for the endogenous relationship between marriage and employment decisions. Women's selection into marriage is instrumented by a set of instrumental variables. Following Assaad and Zouari (2003), I temporarily use the median age of marriage in the district where the woman lives as well as the number of sisters she has. Still, these are far to be convenient as good instruments for a woman's marriage decision. Hence, research in progress aims at finding out variables that could serve as better instruments. On that account, I am willing to make use of the 10 percent sample of the 1996 Egyptian census data where I can find such variables.

The women chooses jointly the employment status that depends on her employment status at the previous date $t-1$. The following sections present the model with and without unobserved heterogeneity. This is the first study that is able to analyze directly the impact of marriage on labor market dynamics in Egypt taking into account the endogeneity of marriage. The model is estimated using the Egyptian Labor Market Panel Surveys of both 1998 and 2006 as well as on retrospective information from 1990. And, the estimation is done via the Maximum Likelihood method.

4.1 Model Without Unobserved Heterogeneity

In the present section, I do not introduce unobserved heterogeneity to the model. Two decisions are jointly estimated. The marriage decision is modeled as follows,

$$Prob[m_{it} = 1|x_{it}^{'}; Z_{it}; m_{it-1}] \tag{1}$$

where m_{it} is a dummy variable that shows the marital status of individual i at date t. m_{it} equals to one if the individual is currently married and to zero otherwise. $x_{it}^{'}$ represents a vector of individual characteristics at date t. m_{it-1} is a dummy variable showing the marital status at $t-1$. Z_{it} is a vector of 'excluded' variables. These variables play the role of 'instrumental' variable since they are affecting the mariage decision but not the employment status choice.

The model can then be written as follows,

$$m_{it}^{*} = x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it} + u_{it} \tag{2}$$

where β is the vector of parameters. m_{it-1} indicates the marital status of individual i at $t-1$. And, u_{it} represents the error term of individual i at time t. The latter follows a symmetric distribution of $F(u_{it})$. Note that $F(u_{it}) = \Phi(u_{it})$ follows a normal distribution $N(0,1)$.

The contribution to the individual likelihood function is,

$$\begin{aligned} L(\beta,\gamma,\delta) &= \Pi_{i=1}^{n}\Pi_{t=2}^{3}[(\Phi(x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it}))^{m_{it}} \\ &\quad (1-\Phi(x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it}))^{(1-m_{it})}] \end{aligned} \tag{3}$$

And the log-likelihood is,

$$\begin{aligned} \ln(L(\beta,\gamma,\delta)) &= \Sigma_{i=1}^{n}\Sigma_{t=2}^{3} m_{it}\ln[(\Phi(x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it})) \\ &\quad +(1-m_{it})\ln(1-\Phi(x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it}))] \end{aligned} \tag{4}$$

Jointly, each woman chooses between four different employment alternatives denoted as $k_{it} \in \{1,2,3,4\}$. These alternatives are modeled using a dynamic multinomial logit that takes into full consideration not only the employment choice at the previous date $t-1$ but also the current marital status,

$$Prob[Y_{ikt} = k | x_{it}^{'}; y_{it-1}; m_{it}] \tag{5}$$

Y_{ikt} denotes the employment state choice k of individual i at time t. This is function of individual characteristics $x_{it}^{'}$, the previous employment state $y_{i(t-1)}$, and on m_{it} that represents the marital status at date t.

Thus, the model is written as follows,

$$Y_{ikt}^{*} = x_{it}^{'}\beta^{\flat} + \gamma^{\flat} y_{i(t-1=k)} + \delta^{\flat} m_{it} + \nu_{ikt} \tag{6}$$

where Y^*_{ikt} is the utility of individual i of being in state k.
The the reference employment state is the inactivity state. The individual contribution to the likelihood when $y_{ikt} = 4$ can then be represented as,

$$Prob[Y_{ikt} = 4|x^{'}_{it}; y_{it-1}; m_{it}; \beta^{\flat}_j; \gamma^{\flat}_j; \delta^{\flat}_j] = \frac{1}{1 + \sum_{j=1}^{3} exp(x^{'}_{it}\beta^{\flat}_j + \gamma^{\flat}_j y_{i(t-1=j)} + \delta^{\flat}_j m_{it})}$$

And, the contribution to the likelihood for the three other states is as follows,

$$Prob[Y_{ikt} = k|x^{'}_{it}; y_{it-1}; m_{it}; \beta^{\flat}_k; \gamma^{\flat}_k; \delta^{\flat}_k] = \frac{exp(x^{'}_{it}\beta^{\flat}_k + \gamma^{\flat}_k y_{i(t-1=k)} + \delta^{\flat}_k m_{it})}{1 + \sum_{j=1}^{3} exp(x^{'}_{it}\beta^{\flat}_j + \gamma^{\flat}_j y_{i(t-1=j)} + \delta^{\flat}_j m_{it})}$$

Note that, $\gamma^{\flat} = \{\gamma^{\flat}_1; \gamma^{\flat}_2; \gamma^{\flat}_3\}$ and $y_{i(t-1)} = \{y_{i(t-1=1)}; y_{i(t-1=2)}; y_{i(t-1=3)}\}$.

Note that the two decisions are jointly estimated using Maximum Likelihood.

4.2 Model With Unobserved Heterogeneity

This section consists in introducing individual unobserved heterogeneity to the model. In the first step, the residual term μ_{it} is then replaced by an individual unobserved heterogeneity α_i and u_{it}. Then, the model can be re-written as follows,

$$m^*_{it} = x^{'}_{it}\beta + \gamma m_{it-1} + \delta Z_{it} + \alpha_i + u_{it} \tag{7}$$

where u_{it} are independent and identically distributed (i.i.d.). Similarly, the individual heterogeneity α_i are assumed to be i.i.d. and follow a Normal distribution $N(0, \sigma^2_\alpha)$. And, we assume that the term u_{it} follows a Normal distribution $N(0, 1 - \sigma^2_\alpha)$.

The contribution to the likelihood function of individual i is represented by,

$$L_i(\theta) = \int_{-\infty}^{+\infty} f(m_{i1}, m_{i2}, m_{i3}|x_i; \alpha_i; \theta) f(\alpha_i; \theta) d\alpha_i \tag{8}$$

$$= \int_{-\infty}^{+\infty} \Pi^T_{t=2} f(m_{it}|x^{'}_{it}; m_{it-1}; Z_{it}; \alpha_i; \theta) f(mi1|x_{i1}; \alpha_i; \theta) f(\alpha_i|\theta) d\alpha_i \tag{9}$$

where θ represents the vector of parameters $\theta = (\gamma, \beta, \delta, \sigma^2_\alpha)'$.

Then,

$$f(m_{it}|x_{it}^{'};m_{it-1};Z_{it};\alpha_i;\theta) = \Phi(\frac{x_{it}^{'}\beta+\gamma m_{it-1}+\delta Z_{it}+\alpha_i}{\sqrt{1-\sigma_\alpha^2}}) \quad (10)$$

$$= 1-\Phi(\frac{x_{it}^{'}\beta+\gamma m_{it-1}+\delta Z_{it}+\alpha_i}{\sqrt{1-\sigma_\alpha^2}}) \quad (11)$$

$\Phi(u)$ being the repartition function and follows a Normal distribution $N(0,1)$.

Otherwise,

$$f(\alpha_i|\theta) = \frac{1}{\sqrt{2\pi\sigma_\alpha}} exp(-\frac{\alpha_i^2}{2\sigma_\alpha^2}) \quad (12)$$

Let us turn our attention now to the initial conditions' issue. Two approaches are proposed in order to model the initial conditions' distribution $f(m_{i1}|x_{i1};\alpha_i;\theta)$. The first approach consists in considering the initial conditions as exogenous,

$$f(m_{i1}|x_{i1};\alpha_i;\theta) = f(m_{i1}|x_{i1};\theta) \quad (13)$$

This can be done if and only if the initial conditions at date $t-1$ is the same for all the individuals. However, in the present study, each individual has a different work status at 1998. Therefore, the endogenous character of the initial conditions needs to be taken into consideration. To do this, two methods can be used. On the one hand, the method proposed by Heckman (1981). On the other hand, the method of Wooldridge (2005). The latter is the one considered in the present research and it consists in considering that the conditional distribution of the individual effects α_i depends on the initial state m_{i1} as well as on a vector of individual characteristics x_i.

The conditional distribution of m_{i1} can then be represented as follows,

$$f(m_{it}|x_{it}^{'};Z_{it};m_{i1};m_{it-1};\alpha_i) = f(m_{it}|x_{it}^{'};Z_{it};m_{it-1};\alpha_i) \quad (14)$$

The individual effect is therefore,

$$\alpha_i = \alpha_0 + \alpha_1 m_{i1} + x_i\alpha_2 + \xi_i \quad (15)$$

where ξ_i represents the random variable and $\xi_i|m_{i1}, x_i \sim N(0, \sigma_\alpha^2)$.
And, by substituting the equation 3.15 in the initial marriage probability model, we obtain the conditional probit dynamic model taking into account both unobserved heterogeneity and the model of the initial conditions,

$$m_{it}^* = x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it} + \alpha_0 + \alpha_1 m_{i1} + x_i\alpha_2 + \xi_i + u_{it} \quad (16)$$

where $u_{it}|(x_i, m_{i1}, ..., m_{it-1}, \xi_i) \sim N(0, 1)$.
Then, the contribution of $(m_{i2}, ..., m_{iT})$ conditional on (x_i, m_{i1}, ξ_i) is as follows,

$$\Pi_{t=2}^{T}\Phi(x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it} + \alpha_0 + \alpha_1 m_{i1} + x_i\alpha_2 + \xi_i)^{m_{it}}$$

$$[1 - \Phi(x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it} + \alpha_0 + \alpha_1 m_{i1} + x_i\alpha_2 + \xi_i)]^{1-m_{it}} \quad (17)$$

By integrating relatively to the density of the $N(0, \sigma_\alpha^2)$, we get the contribution of $(m_{i2}, ..., m_{iT})$ conditional on (x_i, m_{i1}),

$$\int_{-\infty}^{+\infty} \Pi_{t=2}^{T}\Phi(x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it} + \alpha_0 + \alpha_1 m_{i1} + x_i\alpha_2 + \xi_i)^{m_{it}}$$

$$[1 - \Phi(x_{it}^{'}\beta + \gamma m_{it-1} + \delta Z_{it} + \alpha_0 + \alpha_1 m_{i1} + x_i\alpha_2 + \xi_i)]^{1-m_{it}} \frac{1}{\sigma_\alpha}\phi(\frac{\xi_i}{\sigma_\alpha})d\xi_i \quad (18)$$

where α_2 is a vector of parameters.
And, the parameters $\alpha_0, \beta, \gamma, \delta, \alpha_1, \alpha_2, \sigma_\alpha^2$ are estimated via maximum likelihood.

Now, regarding the woman's employment choice, it is modeled as,

$$Y_{ikt}^* = x_{it}^{'}\beta^\flat + \gamma^\flat y_{i(t-1=k)} + \delta^\flat m_{it} + \alpha_{ik} + \mu_{ikt} \quad (19)$$

The latter represents the dynamic multinomial logit model of labor market choices that I estimate taking into account the unobserved heterogeneity α_{ik}.

Then,

$$Prob[Y_{ikt} = k|x_{it}^{'}; y_{it-1}; m_{it}; \beta_k^\flat; \gamma_k^\flat; \delta_k^\flat, \alpha_{ik}] = \frac{exp(x_{it}^{'}\beta_k^\flat + \gamma_k^\flat y_{i(t-1=k)} + \delta_k^\flat m_{it} + \alpha_{ik})}{1 + \sum_{j=1}^{3} exp(x_{it}^{'}\beta_j^\flat + \gamma_j^\flat y_{i(t-1=j)} + \delta_j^\flat m_{it} + \alpha_{ij})}$$

Using the method of Wooldridge (2005) presented above, the individual unobserved term $\alpha_i = (\alpha_{i1}, ..., \alpha_{i4})$ is modeled as follows,

$$\alpha_i|y_{i1} \sim N(\alpha_1 + \Sigma_{k=1}^{K-1}\beta_k^\flat 1_{y_{i1=k}}, \Omega) \tag{20}$$

Consequently,

$$\alpha_{ij} = \alpha_{oj} + \Sigma_{k=1}^{K-1}\beta_k^\flat 1_{y_{i1=k}} + \eta_{ij}, \tag{21}$$

where $\eta_{ij} \sim N(0, \Omega)$.

The individual likelihood contribution is then,

$$Prob[Y_{ikt} = k|x_{it}^{'}; y_{it-1}; m_{it}; \beta_k^\flat; \gamma_k^\flat; \delta_k^\flat; \eta_{ik}] = \frac{exp(x_{it}^{'}\beta_k^\flat + \gamma_k^\flat y_{i(t-1=k)} + \delta_k^\flat m_{it} + \eta_{iy_{it}})}{1 + \sum_{j=1}^{3} exp(x_{it}^{'}\beta_j^\flat + \gamma_j^\flat y_{i(t-1=j)} + \delta_j^\flat m_{it} + \eta_{iy_{it}})}\phi(\eta_i|y_{i0})$$

5 Empirical Results

Tables 6 and 7 display the estimation results for both models with and without individual heterogeneity. Note that, for now, random effects are only estimated for the employment equation. Nonetheless, estimating a model that takes into full consideration the unobserved heterogeneity issue for the marriage decision as well as for the employment choice is indispensable. However, due to time constraints, the latter's results are still in progress and hence, will be presented in future versions of this study[3].

The first column of Table 6 shows the coefficients of the two decisions. Turning to the bivariate marriage decision, we observe that the age as well as the level of education significantly increase the probability of being married. For instance, individuals aged from 56 to 63 being the reference age group, women aged between 24 and 35 years old

[3]This estimation is highly time consuming. Furthermore, when looking to the results of the employment equation, we observe that the latter do not significantly change when introducing random effects which justifies the results' robustness.

at date t (in 1998) tend to have greater marriage probability compared to the reference age group. Similarly, the probability of being married also increases with the level of education. Having an above intermediate education increases the probability of marriage of about 71 percent relative to being illiterate. Furthermore, being married at date $t-1$ significantly increases the probability of remaining married at date t. And, interestingly, the parental level of education does not seem to have important effects on their daughters' probability of marriage.

As instruments for marriage, I temporarily use the median age of marriage in the district where the woman lives as well as the number of sisters she has. Still, these are far to be convenient as good instruments for a woman's marriage decision. And, as showed in Table 6, these variables coefficients are not significant. Hence, research in progress aims at finding out variables that could serve as better instruments. On that account, I am willing to make use of the 10 percent sample of the 1996 Egyptian census data where I can find such variables. Also, the region does not seem to affect the Egyptian women's marriage decision.

Now, looking at the joint decision; e.g. the employment status choice, women face four different labor market alternatives. In the present study, the non-employment status is being the reference option. The second bloc of Table 6 presents the determinants of having a public sector employment. Whether we control or not for the individual heterogeneity, results are quite robust and change slightly. Nonetheless, as expected, standard errors tend to be higher in the second model with random effects.

[Table 6 about here]

Greater state dependence for the public than for the private. Transition from public to private is of 20% and 17% from private to public. Greater chances to work in public/private sectors if living in the capital. Greater chances to work in subsistence activities if living in rural areas.

In line with my expectations, the marriage decreases the probability of working in the public sector relative to inactivity by 17 percent. And, this probability is of 30 percent for the private employment. Then, women working in the private sector have greater chances to move into inactivity compared to those employed in the public sector.

However, the lagged variables denoted by $lagY11$ and $lagY22$ show that public sector employees tend to have higher state dependence compared to employees of the private sector. In other terms, working in the public at date $t-1$ increases by 21.30 percent the probability of remaining in the same sector till date t. And, this probability is higher than the one observed for the private sector (20.31 percent). Then, as state dependance is greater in public than in private employments, public employees have higher chances to remain in their jobs and less chances to move to the inactivity status.

Furthermore, living in big cities such as Cairo and Alexandria have higher chances to be working in the public sector. This result is also valid for the private sector employment. This is because the majority (if not all) of the governmental institutions and public enterprizes are based in these cities. Moreover, having a high level of education significantly increases the probability of being a public employee relative to inactivity[4].

In addition, labor market transition variables denoted by $lagY21$ and $lagY41$ show that, on the one hand, there is less chances to move from a private to a public employment than from the private sector to non-employment. On the other hand, being a non-employed individual at the previous period increases the probability of remaining in this employment status rather than moving to a public employment.

Similarly, Table 7 displays these results for the private employment alternative. Interestingly, transition to the private sector are positive and significant. For instance, a subsistence worker has greater chances to move to the private employment rather than inactivity. And, the same result is observed for women working in the public sector.

Not surprisingly, the subsistence employment is more present in rural areas rather than in big cities. Then, women living in rural regions are more likely to be involved in subsistence activities than women living in urban areas or in Cairo. Note that these subsistence activities are more common in rural areas[5].

Interestingly, transitions to the subsistence sector are negative and positive for women, who worked at the previous period, in public and private jobs respectively. Moreover, mainly, the less educated women are involved in such activities and, the probability of entering the subsistence sector rather than non-employment decreases with the level of

[4]The non-employment sector regroups both inactive and unemployed individuals.

[5]Such as feeding and caring for livestock poultry, or making butter or cheese

education. This results is in line with the literature since these activities are concentrated in rural areas and call for low qualification levels.

[Table 7 about here]

In Table 8, we observe the random parameters estimated for the employment equation. These represent the variance covariance matrix where the variances are likely to be significant.

[Table 8 about here]

6 Summary and Conclusion

This study investigates women's marriage and employment choices by estimating a joint dynamic model drawn from the Egyptian Labor Market and Panel surveys of 1998 and 2006 as well as a retrospective information from 1990. The major objective of this study is to disentangle the causal relationship between both decisions.

The model distinguishes between four different labor market status' alternatives. These are the non-employment, the public, the private and the subsistence employment. Note that the subsistence work includes activities involving the production and processing of primary goods for purposes of household consumption, such as feeding and caring for livestock poultry, or making butter or cheese (see Assaad et al., 2010). That's why, the results show that women living in rural regions are more likely to be involved in such activities.

The dynamic framework estimated here integrates women's decisions with regards to marriage and labor force participation. Furthermore, these issues are jointly considered. The model accounts for the endogenous relationship between marriage and employment decisions. For this, women's selection into marriage is instrumented by a set of instrumental variables. However, still, the main limitation of this research remains the choice of instruments. Further research will consist of using the 10 percent sample of the 1996 Egyptian census data in order to find out better instruments.

The novelty of this research is, on the one hand, that it is the first study that is able to directly analyze the impact of marriage on labor market dynamics in Egypt. On the

other hand, it infers new results with regards to state dependence and dynamic transition patterns in Egypt.

Interestingly, the results of the present study show that the transition from the public to the private sector and from the private to the public is of 20% and 17% respectively. Also, significantly important transitions between the different employment status alternatives are observed. Married women working in the private sector tend to have higher probabilities to move to inactivity than women in the public sector, which goes in line with my expectations. In other words, Marriage decreases the public employment probability by 18% and the private one by almost the double (30%). Similarly, the lagged variables show that public employees have higher chances to remain in their jobs between $t-1$ and t, and less chances to move into the inactivity status compared to their private counterparts. Moreover, the empirical results display that women living in the capital have greater probabilities to be employed in the public/private sector. And contrarily, living in rural areas increases the probabilities of having a subsistence work. Following these results, public sector jobs seems to be more convenient for married women since they allow them a better reconciliation between family and professional lives simultaneously.

Tables and Figures

Descriptive Statistics

Table 1: Women Labor Market Transitions Between 1998 and 2006

	State in 2006				
State in 1998	**Public**	**Private**	**Informal**	**Inactivity**	**Total**
Public	484	12	1	88	585
	82.74	2.05	0.17	15.04	100.00
	85.06	2.80	0.16	4.17	15.76
Private	11	125	35	88	259
	4.25	48.26	13.51	33.98	100.00
	1.93	29.21	5.77	4.17	6.98
Informal	9	138	301	416	864
	1.04	15.97	34.84	48.15	100.00
	1.58	32.24	49.59	19.72	23.27
Inactivity	65	153	270	1,517	2,005
	3.24	7.63	13.47	75.66	100.00
	11.42	35.75	44.48	71.93	54.00
Total	569	428	607	2,109	3,713
	15.32	11.53	16.35	56.80	100.00
	100.00	100.00	100.00	100.00	100.00

Source: Author's calculations using the ELMPS of 1998 and 2006

Table 2: Single Women's Labor Market Transitions Between 1998 and 2006

	State in 2006				
State in 1998	**Public**	**Private**	**Informal**	**Inactivity**	**Total**
Public	60	2	0	20	82
	73.17	2.44	0.00	24.39	100.00
	88.24	2.74	0.00	5.03	13.58
Private	2	37	1	29	69
	2.90	53.62	1.45	42.03	100.00
	2.94	50.68	1.54	7.29	11.42
Informal	0	17	35	79	131
	0.00	12.98	26.72	60.31	100.00
	0.00	23.29	53.85	19.85	21.69
Inactivity	6	17	29	270	322
	1.86	5.28	9.01	83.85	100.00
	8.82	23.29	44.62	67.84	53.31
Total	68	73	65	398	604
	11.26	12.09	10.76	65.89	100.00
	100.00	100.00	100.00	100.00	100.00

Note: Constructed only for females who are singles in 1998 and 2006.
Source: Author's calculations.

Table 3: Married Women's Labor Market Transitions Between 1998 and 2006

	State in 2006				
State in 1998	**Public**	**Private**	**Informal**	**Inactivity**	**Total**
Public	371	7	1	52	431
	86.08	1.62	0.23	12.06	100.00
	85.29	2.40	0.21	3.67	16.43
Private	6	67	26	40	139
	4.32	48.20	18.71	28.78	100.00
	1.38	22.95	5.44	2.82	5.30
Informal	9	107	241	284	641
	1.40	16.69	37.60	44.31	100.00
	2.07	36.64	50.42	20.03	24.44
Inactivity	49	111	210	1,042	1,412
	3.47	7.86	14.87	73.80	100.00
	11.26	38.01	43.93	73.48	53.83
Total	435	292	478	1,418	2,623
	16.58	11.13	18.22	54.06	100.00
	100.00	100.00	100.00	100.00	100.00

Note: Constructed only for females who are married in 1998 and 2006.
Source: Author's calculations.

Table 4: Women Married Between 1998 & 2006 and Labor Market Transitions

	State in 2006				
State in 1998	**Public**	**Private**	**Informal**	**Inactivity**	**Total**
Public	23	2	0	3	28
	82.14	7.14	0.00	10.71	100.00
	71.88	16.67	0.00	3.80	20.44
Private	2	7	4	13	26
	7.69	26.92	15.38	50.00	100.00
	6.25	58.33	28.57	16.46	18.98
Informal	0	2	4	10	16
	0.00	12.50	25.00	62.50	100.00
	0.00	16.67	28.57	12.66	11.68
Inactivity	7	1	6	53	67
	10.45	1.49	8.96	79.10	100.00
	21.88	8.33	42.86	67.09	48.91
Total	32	12	14	79	137
	23.36	8.76	10.22	57.66	100.00
	100.00	100.00	100.00	100.00	100.00

Note: Constructed only for females singles in 1998 and married in 2006.
Source: Author's calculations.

Table 5: Women Divorced Between 1998 & 2006 and Labor Market Transitions

	State in 2006				
State in 1998	**Public**	**Private**	**Informal**	**Inactivity**	**Total**
Public	30	1	0	13	44
	68.18	2.27	0.00	29.55	100.00
	88.24	1.96	0.00	6.07	12.61
Private	1	14	4	6	25
	4.00	56.00	16.00	24.00	100.00
	2.94	27.45	8.00	2.80	7.16
Informal	0	12	21	43	76
	0.00	15.79	27.63	56.58	100.00
	0.00	23.53	42.00	20.09	21.78
Inactivity	3	24	25	152	204
	1.47	11.76	12.25	74.51	100.00
	8.82	47.06	50.00	71.03	58.45
Total	34	51	50	214	349
	9.74	14.61	14.33	61.32	100.00
	100.00	100.00	100.00	100.00	100.00

Note: Constructed only for females married in 1998 and singles in 2006.
Source: Author's calculations.

Empirical Results

Table 6: Results Obtained by Maximum Likelihood (1/2)

	Model without random effects				Model with random effects			
	Coeff.		**Marg. Effects**	**Sd. Error**	**Coeff.**		**Marg. Effects**	**Std.Error**
Marriage Choice								
Constant	-1,888	***	0,151	0,663	-1,917	***	0,147	0,663
age 24-35 at t	1,977	***	7,224	0,118	1,980	***	7,245	0,118
age 36-45 at t	0,967	***	2,629	0,086	0,967	***	2,631	0,086
age 46-55 at t	0,543	***	1,722	0,082	0,543	***	1,722	0,082
educ. 2	0,040		1,041	0,094	0,039		1,039	0,094
educ. 3	0,327	***	1,387	0,098	0,325	***	1,384	0,098
educ. 4	0,713	***	2,040	0,223	0,709	***	2,032	0,223
educ. 5	0,512	***	1,669	0,143	0,512	***	1,669	0,143
father educ. 2	0,011		1,011	0,113	0,016		1,016	0,113
father educ. 3	-0,045		0,956	0,154	-0,047		0,955	0,154
father educ. 4	0,074		1,077	0,366	0,075		1,078	0,366
father educ. 5	-0,103		0,903	0,218	-0,100		0,905	0,218
mother educ. 2	-0,092		0,912	0,184	-0,091		0,913	0,185
mother educ. 3	0,417		1,518	0,375	0,423		1,527	0,375
mother educ. 4	0,166		1,180	0,515	0,158		1,172	0,513
mother educ. 5	-0,541		0,582	0,423	-0,545		0,580	0,423
marital status at t-1	2,146	***	8,550	0,083	2,147	***	8,561	0,084
urban regions	-0,049		0,952	0,076	-0,047		0,954	0,076
rural regions	0,053		1,055	0,085	0,056		1,058	0,085
instrument1	0,006		1,006	0,032	0,006		1,006	0,032
instrument2	-0,028		0,972	0,018	-0,021		0,979	0,018
Employment Choice								
Y=1: Public Employment								
marital status at t	-1,708	***	0,181	0,223	-1,691	***	0,184	0,236
age 24-35 at t	0,988	***	2,685	0,293	1,016	***	2,762	0,308
age 36-45 at t	1,343	***	3,829	0,261	1,397	***	4,042	0,274
age 46-55 at t	0,117		1,124	0,257	0,023		1,023	0,277
urban regions	-1,246	***	0,288	0,184	-1,329	***	0,265	0,197
rural regions	-1,521	***	0,219	0,222	-1,528	***	0,217	0,243
less than interm. educ.	-2,261	***	0,104	0,554	-2,291	***	0,101	0,554
interm. educ.	1,327	***	3,772	0,238	1,421	***	4,140	0,258
above interm. educ.	1,097	***	2,995	0,356	1,136	***	3,114	0,382
university and above educ.	1,786	***	5,963	0,283	1,888	***	6,607	0,306
lag Y11: state dependance	2,130	***	8,419	0,254	2,281	***	9,784	0,280
lag Y21: transition from 2 to 1	-1,723	***	0,179	0,419	-1,718	***	0,179	0,437
lag Y41: transition from 4 to 1	-2,493	***	0,083	0,220	-2,534	***	0,079	0,246

Note: i. educ. 1 denotes being iliterate, educ. 2 is the less than intermediate level of education; educ. 3 is the intermediate level; educ. 4 is the above intermediate level and, educ. 5 is for university and above.
ii. Three dummy variables for regions. The reference is Cairo and Alexandria.
iii. The reference age group is the 56-63.
Source: Author's calculations.

Table 7: Results Obtained by Maximum Likelihood (2/2)

	Model without random effects				Model without random effects			
	Coeff.		**Marg. Effects**	**Sd. Error**	**Coeff.**		**Marg. Effects**	**Std.Error**
Y=2: Private Employment								
marital status at t	-1,204	***	0,300	0,133	-1,286	***	0,276	0,149
age 24-35 at t	0,245		1,278	0,186	0,247		1,280	0,202
age 36-45 at t	0,121		1,128	0,163	0,133		1,142	0,179
age 46-55 at t	-0,530	***	0,588	0,151	-0,572	***	0,565	0,168
urban regions	-0,850	***	0,427	0,135	-0,878	***	0,416	0,148
rural regions	-0,299	**	0,742	0,139	-0,254	**	0,776	0,144
less than interm. educ.	-1,504	***	0,222	0,194	-1,615	***	0,199	0,208
interm. educ.	-1,148	***	0,317	0,208	-1,202	***	0,301	0,229
above interm. educ.	-0,894	**	0,409	0,382	-0,911	***	0,402	0,410
university and above educ.	-1,262	***	0,283	0,337	-1,339	***	0,262	0,374
lag Y12: transition from 1 to 2	0,720	**	2,054	0,357	0,708	*	2,029	0,425
lag Y22: state dependance	2,031	***	7,620	0,179	2,102	***	8,182	0,205
lag Y32: transition from 3 to 2	0,777	***	2,175	0,141	0,914	***	2,495	0,152
Y=3: Subsistence Employment								
marital status at t	-0,873	***	0,418	0,118	-0,935	***	0,393	0,132
age 24-35 at t	0,128		1,137	0,160	0,127		1,136	0,177
age 36-45 at t	-0,022		0,978	0,145	-0,007		0,993	0,160
age 46-55 at t	-0,527	***	0,590	0,133	-0,569	***	0,566	0,148
urban regions	-0,587	***	0,556	0,122	-0,563	***	0,570	0,134
rural regions	0,556	***	1,744	0,118	0,609	***	1,839	0,131
less than interm. educ.	-1,041	***	0,353	0,145	-1,173	***	0,309	0,161
interm. educ.	-1,075	***	0,341	0,179	-1,168	***	0,311	0,196
above interm. educ.	-2,365	***	0,094	0,716	-2,389	***	0,092	0,703
university and above educ.	-2,400	***	0,091	0,612	-2,416	***	0,089	0,600
lag Y13: transition from 1 to 3	-1,983	**	0,138	0,945	-1,998	**	0,136	1,045
lag Y23: transition from 2 to 3	0,210		1,233	0,224	0,306		1,358	0,225
lag Y33: state dependance	0,659	***	1,932	0,113	0,730	***	2,075	0,124
N	**3516**				**3516**			

Note: i. educ. 1 denotes being iliterate, educ. 2 is the less than intermediate level of education; educ. 3 is the intermediate level; educ. 4 is the above intermediate level and, educ. 5 is for university and above.
ii. Three dummy variables for regions. The reference is Cairo and Alexandria.
iii. The reference age group is the 56-63.
Source: Author's calculations.

Table 8: Random Effects Parameters of the Employment Equation

Random Parameters	**Coefficients**		**Std.Error**
r11	-0,565		0,386
r21	0,835	**	0,396
r22	-0,176		0,282
r31	0,804	***	0,192
r32	1,106		0,211
r33	-0,247		0,243

Source: Author's calculations.

References

[1] Amin, S. and H. Al-Bassisi, N. (2003). Wage work and marriage: Perspectives of Egyptian working women. Population Council Working Paper 171.

[2] Assaad, R. et El-Hamidi, F. (2002). Female Labor Supply in Egypt: Participation and Hours of Work, in Human Capital: Population Economics In The Middle East. Ismail Sirageldin (Ed.). London: I.B. Tauris.

[3] Assaad, R. et El-Hamidi, F. (2001). Is All Work the Same? A Comparison of the Determinants of Female Participation and Hours of Work in Various Employment States in Egypt, in The Economics of Women and Work in the Middle East and North Africa. Mine Cinar (Ed.) Research in Middle East Economics, Vol. 4. Greenwich, Conn.: JAI Press.

[4] Assaad, R. and Zouari S. (2003) Estimating the Impact of Marriage and Fertility on the Female Labor Force Participation when Decisions are Interrelated: Evidence from Urban Morocco. Unpublished.

[5] Assaad, R. (2007). Labour supply, employment and unemployment in the Egyptian economy: 1988-2006. Population Council Working Paper 0701.

[6] Arcidiacono, P. and Miller, R. A. (2008). CCP Estimation of Dynamic Discrete Choice Models with Unobserved Heterogeneity. working paper.

[7] Altug, S., and R. A. Miller (1998). The Effect of Work Experience on Female Wages and Labour Supply, Review of Economic Studies, 62, 45-85.

[8] Aguirregabiria, V., and P. Mira (2007). Sequential Estimation of Dynamic Discrete Games, Econometrica, 75, 1-54.

[9] Aguirregabiria, V., and P. Mira (2010). Dynamic Discrete Choice Structural Models: A Survey, Journal of Econometrics 156, 38-67.

[10] Aguirregabiria, V., (2007). Another look at the identification of dynamic discrete decision processes: With an application to retirement behavior. Manuscript. University of Toronto.

[11] Barssoum, G. (2007). Egypt labour market panel survey 2006: Report on methodology and data collection. Economic research forum Working Paper 0704.

[12] Belzil, C. (2006). The Return to Schooling in Structural Dynamic Models: A Survey. Institute for the Study of Labor Working Paper 06-09.

[13] Bourguignon, F., Browning, M., Chiappori, P.-A., and Lechene, V. (1994). Income and outcomes: A structural model of intrahousehold allocation. Journal of Political Economy 102, 1067-1096.

[14] Buchinsky, M., J. Hahn, and V. J. Hotz (2005). Cluster Analysis: A Tool for Preliminary Structural Analysis, working paper. 47

[15] Chiappori, P.-A., Fortin, B., and Lacroix, G. (2002). Marriage market, divorce legislation and household labor supply. Journal of Political Economy, 110, 37-72.

[16] Eckstein, Z., Wolpin, K. (1989). The specification and estimation of dynamic stochastic discrete choice models. Journal of Human Resources 24, 562-598.

[17] Ericson, R., and A. Pakes (1995). Markov-Perfect Industry Dynamics: A Framework for Empirical Work, Review of Economic Studies, 62, 53-82.

[18] Greene, H. W. (2003). Econometric Analysis (5th ed.). Person International.

[19] Geweke, J., Keane, M. (2000). Bayesian inference for dynamic discrete choice models without the need for dynamic programming. In: Mariano, Schuermann, Weeks (Eds.), Book Simulation Based Inference and Econometrics: Methods and Applications. Cambridge University Press, pp. 100-131.

[20] Haan, P. (2004). Discret Choice Labour Supply: Conditional logit vs. random coefficient models. DIW Discussion Paper 394.

[21] Heckman, J. (1979). Sample selection bias as a specification error. Econometrica 47(NO), 153-161.

[22] Heckman, J. (1981). The incidental parameters problem and the problem of initial conditions in estimating a discrete time-discrete data stochastic process. In: Manski,

C., McFadden, D. (Eds.), Structural Analysis of Discrete Data with Econometric Applications. MIT Press.

[23] Heckman, J., Lochner, L., Taber, C. (1998). Explaining rising wage inequality: Explanations with a dynamic general equilibrium model of labor earnings with heterogeneous agents. Review of Economic Dynamics 1, 1-58.

[24] Heckman, J., Singer, B. (1984). A method for minimizing the impact of distributional assumptions in economic models for duration data. Econometrica 52, 271-320.

[25] Heckman, J., Navarro, S. (2007). Dynamic discrete choice and dynamic treatment effects. Journal of Econometrics 136, 341-396.

[26] Hotz, V. J., and R. A. Miller (1993). Conditional Choice Probabilities and Estimation of Dynamic Models, Review of Economic Studies, 61, 265-289.

[27] Hotz, V. J., R. A. Miller, S. Sanders and J. Smith (1994). A Simulation Estimator for Dynamic Models of Discrete Choice, Review of Economic Studies, 60, 265-289.

[28] Kasahara, H., and K. Shimotsu (2007a). Nonparametric Identification and Estimation of Finite Mixture Models of Dynamic Discrete Choices, working paper.

[29] Keane M., and K. Wolpin (1994). The Solution and Estimation of Discrete Choice Dynamic Programming Models by Simulation and Interpolation: Monte Carlo Evidence" The Review of Economics and Statistics, 76, 648-672.

[30] Keane M., and K. Wolpin (1997). The Career Decisions of Young Men, Journal of Political Economy, 105, 473-522.

[31] Newey, W. K., and D. McFadden (1994). Large Sample Estimation and Hypothesis Testing, Chapter 36 in Handbook of Econometrics, 4, editors R. Engle and D. McFadden, Elsevier Science, Amsterdam, 2111-2245.

[32] Rashad, H., Osman, M. and Roudi- Fahimi, F. (2005). Marriage in the Arab world. Population Reference Bureau. www.prb.org.

[33] Pakes, A., M. Ostrovsky, and S. Berry (2004). Simple Estimators for the Parameters of Discrete Dynamic Games (with Entry/Exit Examples), working paper.

[34] Small, K., and Rosen, S. (1981). Applied welfare economics with discrete choice models. Econometrica, 49, 105-130.Mimeo, Cergy- Pontoise: Universitet' de Cergy-Pontoise.

[35] Train, K.E. (2003). Discrete choice methods with simulation. Cambridge: Cambridge University Press.

[36] Van Soest, A. (1995). Structural models of family labor supply: A discrete choice approach. Journal of Human Resources, 30, 63-88.

[37] Wolpin, K. (1984). An Estimable Dynamic Stochastic Model of Fertility and Child Mortality, Journal of Political Economy, 92, 852-874.