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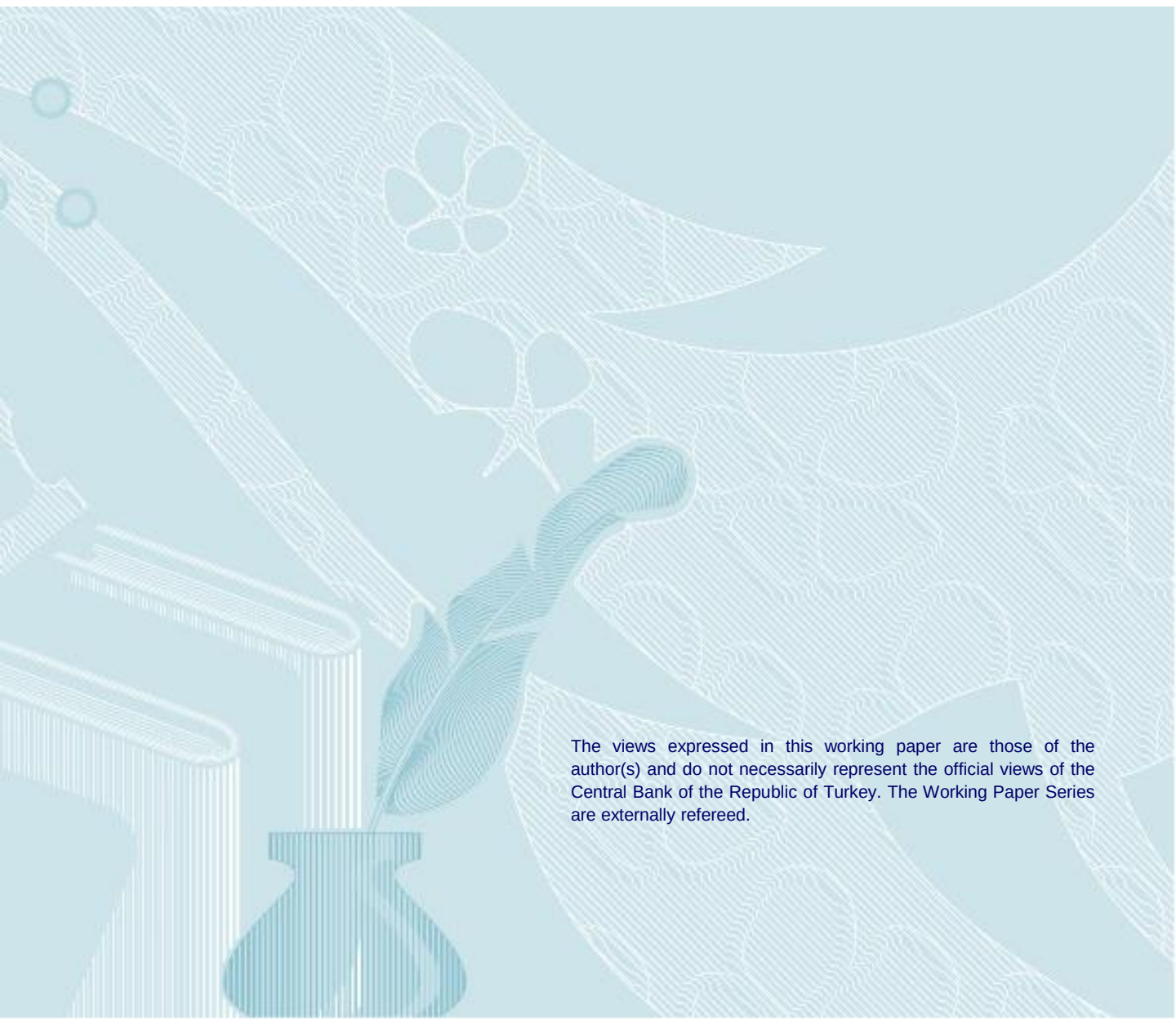
Şerife GENÇ İLERİ
Gönül ŞENGÜL

Address:
Central Bank of the Republic of Turkey
Head Office
Structural Economic Research Department
İstiklal Caddesi No: 10
Ulus, 06050 Ankara, Turkey

Phone:
+90 312 507 80 04

Facsimile:
+90 312 507 57 33



Rise of Services and Female Employment: Strength of the Relationship*

Serife Genc Ileri†
Central Bank of Turkey

Gonul Sengul‡
Central Bank of Turkey

Abstract

Recent literature focuses on the relationship between rise of services and female employment, arguing that the former is the driving force behind the rise in the latter in developed economies. In this paper we challenge this link by focusing on a developing country. Turkey stands out among other OECD countries with its unusually low female employment rate accompanied with a quite low service employment share. We investigate whether the female employment rate in Turkey will ascend to the current ranks of developed countries when it catches up with the current service shares of employment of those countries. We address this question in a multi sector structural transformation model with goods, service and home production. Using the calibrated model, we simulate the structural transformation path of the economic activity in Turkey away from other sectors into services. Our results suggest that rise of services by itself is not sufficient to generate the increase in female employment that is comparable to the experiences of developed countries. High comparative advantage of females in service sector is needed to achieve the desired increase, the channel that lacks in the Turkish case. More research is needed to understand the roots of female comparative advantage in service sector and its links to structural transformation.

Keywords: Female labor supply, structural transformation, home production, sectoral labor allocation.

JEL Code: E24, J16, J22.

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†Istanbul School of Central Banking, Central Bank of the Republic of Turkey. Email: Serife.Genc@tcmb.gov.tr.

‡Corresponding author. Istanbul School of Central Banking, Central Bank of the Republic of Turkey. Email: Gonul.Sengul@tcmb.gov.tr.

1 Introduction

Women make up around the half of the world's population, but their participation to the economic activity is limited (Elborgh-Woytek et al. (2013)). This makes female labor supply an important policy issue (OECD (2012); World Bank (2012)). Since the seminal work of Goldin (1995), rise of services is shown to be an important driving force behind the increase in female employment observed in developed countries (See Akbulut (2011); Ngai and Petrongolo (2013); Olivetti (2014), and Olivetti (2006)). This paper seeks further evidence on the relationship between structural transformation and female employment using Turkey as a laboratory.

Turkey deserves a special attention on female employment issue as it has the lowest female employment rate among the OECD countries. Figure 1 shows female share of employment along with the service share in 2007 for many OECD countries.[1] Turkey lags the closest country in female employment share by around 10 percentage points. Along with a low female employment rate, Turkey falls behind other OECD countries in terms of structural transformation of economic activity from other sectors to services.[2] Figure 2 compares female employment share of Turkey with that of other OECD countries in years in which their service share of employment is similar to that of Turkey in 2007 (which is around 50 percent). We observe from this figure that, once we condition on the service employment share, female employment in Turkey does not stand out as an outlier. This observation, coupled with the recent papers discussed above, brings up the question whether female employment share in Turkey would be comparable to those of other OECD countries when its service employment share catches up.

We analyze this question in a structural transformation model with two sectors (goods and service) and home production. Our paper is an extension of Rogerson (2008) with both male and female labor. All sectoral labor productivity levels, including home, grow at an exogenous rate. Male and female members of the household allocate their time between these sectors and home production, and they pay taxes on labor income. The household gets utility from consuming leisure and a composite good of goods and services. Service good is also a composite of market services and home production.

The degree of substitution across these goods generates a reallocation of labor between them if they have uneven productivity growths. A higher growth in goods than services will move labor from the former to the latter. Moreover, there is subsistence level of consumption in goods, resulting in non-homotheticity in preferences. These two channels generate structural transformation. Substitutability of home and market service productions imply

[1] See Appendix A for data description.

[2] Herrendorf et al. (2014) define structural transformation as the reallocation of the economic activity across the broad sectors of agriculture, manufacturing and services.

Figure 1: Female and Service Shares of Employment in 2007

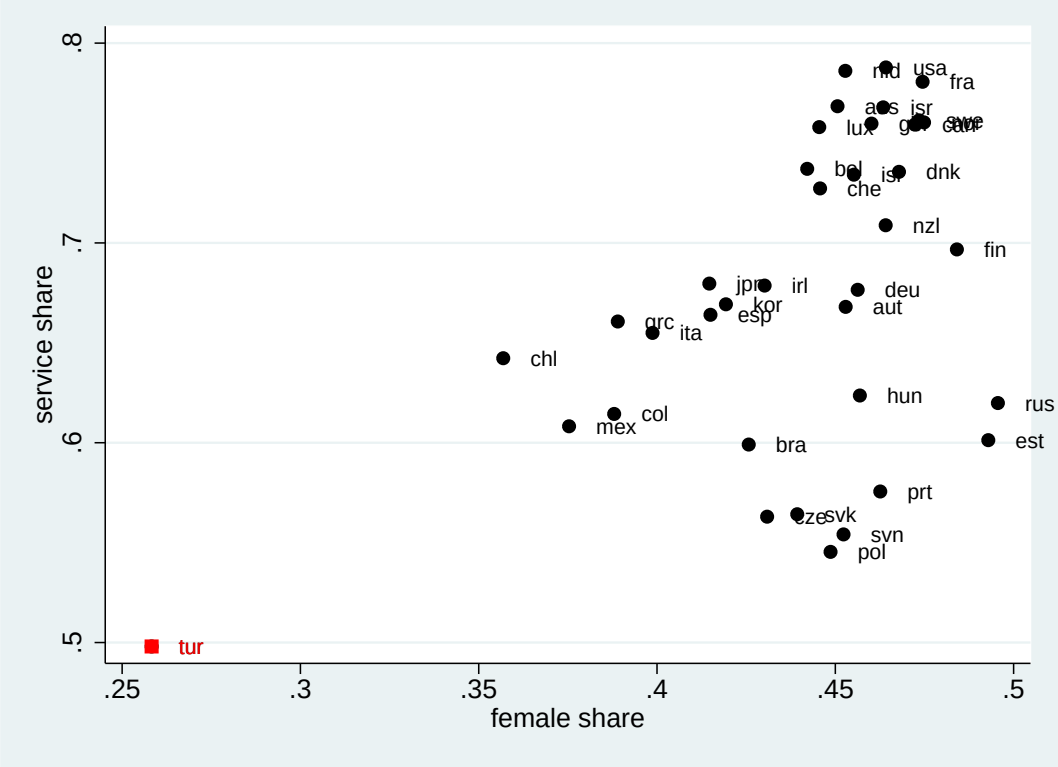
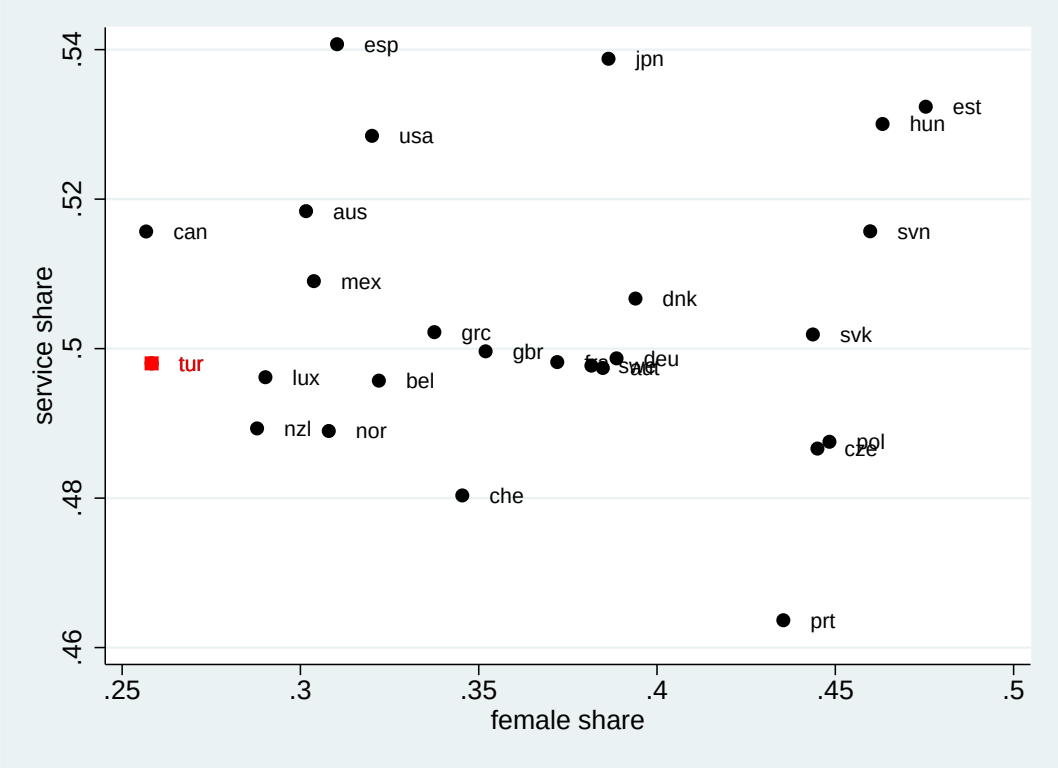


Figure 2: Female and Service Shares of Employment



that a higher productivity growth in market services than that of home moves labor from home production to the service sector. This channel is referred to as marketization and is the channel through which female employment increases.

Both male and female labor inputs are used in production of goods and services and home production. The intensities with which they are used changes exogenously across sectors and over time. These input share parameters also determine the comparative advantages of inputs in production as they determine relative use of female and male labor in each sector. The literature argues that females have the comparative advantage over males in service production while males have comparative advantage in goods sector production. The comparative advantage comes from the fact that goods sector is more "brawn" intensive while service sector is relatively "brain" intensive, and that males have relatively more "brawn". Even though this distinction is less relevant currently, women would still be expected to have higher comparative advantage in services as this sector relies more on interpersonal skills (see Ngai and Petrongolo (2013) and references therein for more discussion). We calibrate these intensity parameters and hence let the data reveal relative comparative advantages.

In our quantitative analysis, we compare the change in female employment share in Turkey that we can observe along with its structural transformation to the change we observed in the US. As such, we first calibrate the model to match the gender-sector employment shares observed in the US over the 1977-2007 time frame.[3] Using the preference parameters calibrated from this exercise, we calibrate the productivity and production technology related parameters to match some moments of Turkish employment data over the sample period 1988-2007. Then, we simulate the model for Turkey into the future until Turkey reaches the 2007 level of US service employment share under different scenarios and analyze the implied Turkish female employment share.

In the benchmark simulation we assume that the tax rate on labor income stays at its 2007 level and productivity and technology parameters grow at the rates observed over 1988-2007 period. We find that under this scenario, female employment share will rise from its 2007 level of 24% to 30% in around 20 years. This ratio is much below the shares we observe in many developed countries, which are around 45 to 50%. Then we conduct simulations under different alternatives in search of major determinants of the rise in female employment. We replace productivity growth rates of market sectors with the US growth rates, one at a time. We also replace the labor income tax in the future with 2007 US level. These alternatives do not have significant effect on female employment share we would observe in the future.

Turkey differs from the US substantially in the values of comparative advantage parameters. Data reveals that while women have high comparative advantage in service sector in

[3]Our sample is restricted by the data availability.

the US, their comparative advantage is very limited in Turkey.[4]. Hence, we also analyze scenarios in which Turkey also catches up with the technology parameters of the US. If service sector technology catches up, then we can observe a big rise in female employment to forming almost half of the labor force in the future. Our finding is robust to various modeling and calibration related assumptions. These results imply that expansion of the service sector by itself may not be enough to increase women's employment in the market. A strong female comparative advantage in service production along with service expansion is vital to reach a high female employment rate.

There are various papers that explore the determinants of female labor force participation in Turkey.[5] These papers focus on social and cultural factors, education, urbanization, marital status, and the economic cycle as essential factors affecting the participation of women into labor markets. Among these Dayıoğlu and Kırdar (2010) address the role of education, marital status and urbanization, Başlevent and Onaran (2003) analyze separately the impact of marital status on the labor force status of women especially during crisis times. Tansel (2002) finds empirical support of the U-shape of female labor force participation during economic development using cross-provincial data from Turkey. İlkkaracan (2012) emphasizes the role of demand side factors in reinforcing the patriarchal structure of the family and limiting the participation of women in Turkish labor markets.[6]

Investigating the low female employment rate in Turkey in relation to the sectoral reallocation of employment bonds this paper to the two strands of the literature. The first one consists of papers explaining dynamics of female employment. Most of these studies focus on the dramatic move of women into the labor market in the US after 1950s. Caucutt et al. (2002), Olivetti (2006) and Jones et al. (2014) claim that increases in the return to labor and the closing gender wage gap were important factors contributing to the increase in the employment of women. Several papers including Bailey (2006), Goldin and Katz (2002), Attanasio et al. (2008), Greenwood et al. (2005) and Coen-Pirani et al. (2010) have linked this increase to the reduction in the time women allocate to housework and their children as well as the decline in fertility rates. Several papers including Fernández et al. (2004), Fernández (2007), Fernández (2013) and Fogli and Veldkamp (2011) study the impact of changes in the preferences and attitudes on increasing female employment.

Our paper is also related to the literature that uses structural transformation models to understand cross country differences in sectoral shift of output and employment. Among

[4]Its value compared to the parameter for home production is much lower than that of US.

[5]See Figures A.1 through A.3 for an overview of employment by gender and by sector in Turkey.

[6]Also see Dildar (2015). Moreover, Kubota (2014) evaluates the importance of a stigma effect in a structural transformation model in addressing the declining female labor force participation between 1955 and 2011 in Turkey. In addition, Üngör and Kalafatçılar (2014) conduct a decomposition exercise and show the significant contribution of female concentration in service sector to increasing Turkish female employment rate for the 2004-2012 period.

these Rogerson (2008) explains the dramatic drop in hours worked in Europe relative to the U.S. Duarte and Restuccia (2010) examine the role of sectoral productivity levels in explaining the reallocation of labor across sectors and cross country differences in aggregate productivity. Adamopoulos and Akyol (2009) find that the poor performance of Turkey in terms of hours worked and output per hour relative to its peer countries is due to the exogenous differences in the evolution of sectoral productivity and taxes. İmrohoroğlu et al. (2014) also investigate the source of divergence of income per capita between Turkey and its peer countries. They identify low productivity growth in agriculture as the source of this divergence.

There are also papers that lie at the intersection of these two literature analyzing female employment in a structural transformation framework, similar to this paper.[7] Rendall (2014) computes difference of in hours worked between Europe and the United States from taxes, structural change and female employment. Ngai and Petrongolo (2013) study the role of the rise in service sector in the narrowing of gender wage gaps in hours and wages. We depart from these studies which have established the important role of structural transformation in rising female employment in our finding. Our results suggest that the rise in the service sector will have limited effect on elevating female employment unless there is a strong comparative advantage of females at services, a requirement already met by developed countries.

The rest of the paper is organized as follows. The following section explains the model and Section 3 discusses the calibration and results of the quantitative analysis. Section 4 provides further discussion and robustness on the findings. The last section concludes the paper.

2 Model

We extend the model in Rogerson (2008) by introducing male and female employment separately to conduct our analysis. There is a representative household with unit measure of male and female members. Household members enjoy leisure and consume a composite of goods, market services and home production. Both males and females work at the market (goods and services sectors) and at home. Labor productivity in each of these sectors grows at an exogenously determined pace. There is no intertemporal decision in the model, hence we suppress time subscripts and focus on the problem for a particular period. We can formally represent the household's utility as:

$$U(C, L) = \alpha_c log(C) + (1 - \alpha_c) log(L), \tag{1}$$

[7]There are also papers that look at changes in female employment in manufacturing and how changes in the composition of manufacturing affects female employment. See, for instance, Kucera and Tejani (2014) and references therein.

where C is the composite consumption good and L is leisure. The household combines goods (G) and services (S) to get the consumption good via the following functional form:

$$C = [\alpha_g(G - \bar{G})^{\epsilon} + (1 - \alpha_g)S^{\epsilon}]^{1/\epsilon}, \tag{2}$$

where $\bar{G}$ is the subsistence level of goods consumption.[8] In the identity above, α_g is the share of goods in the composite good and $\frac{1}{1-\epsilon}$ is the elasticity of substitution between goods and services. The degree of substitution between goods and services that is different from unity is necessary to have structural change with unequal technological progress. If goods and services are complements, then a higher productivity growth in one sector pushes the labor towards the other one.

Aggregate service good, S, is the CES (constant elasticity of substitution) composite of market services and home production, stated as below.

$$S = [\alpha_s S_m^{\eta} + (1 - \alpha_s)S_n^{\eta}]^{1/\eta}, \tag{3}$$

where S_m is market produced services and S_n is home production. α_s is the share of market services and $\frac{1}{1-\eta}$ is the elasticity of substitution between market and home produced services. If market services and home produced services are complements, then a higher productivity growth in one sector pulls the labor from the other.

Home production technology is expressed as a constant elasticity of substitution aggregator that uses both male and female labor as follows

$$S_n = \theta_{sn}[\phi_{sn}E_{fsn}^{\mu} + (1 - \phi_{sn})E_{msn}^{\mu}]^{1/\mu}, \tag{4}$$

where E_{fsn} and E_{msn} are female and male labor in home production, respectively. Moreover, ϕ_{sn} is the share parameter for female labor and μ is the elasticity of substitution between female and male labor in production. θ_{sn} is the productivity in home production and it grows exogenously over time.

Individuals enjoy leisure, the time remaining from market and home production. Leisure enjoyed by males and females are formally expressed as

$$L_m = 1 - E_{msm} - E_{mg} - E_{msn}, \tag{5}$$

$$L_f = 1 - E_{fSm} - E_{fg} - E_{fSn}, \tag{6}$$

respectively, where E_{fj}, E_{mj} are the female and male labor employed in sector j where

[8] As in Rogerson (2008), we do not take a stand on the source of structural transformation in this model; it can be due to uneven sectoral productivity growth rates as well as due to non-homothetic preferences.

$j \in \{g, sm, sn\}$ and L_m and L_f are leisure. The aggregator for total leisure, L, is given by

$$L = L_m^{\alpha_l} L_f^{1-\alpha_l}. \tag{7}$$

We assume that both types of labor move freely across all sectors therefore wages are the same in all sectors for each gender in equilibrium. We normalize male wages to 1 and denote (relative) female wages by w_f. Similar to Rogerson (2008), we introduce tax on labor income, (τ), to the model as this could be an important determinant of labor supply decision. This tax represents an average of the social security and labor income taxes that are paid by the household. Accordingly the budget constraint of the household is

$$(1-\tau_l)\big[(1-L_m-E_{msn})+w_f(1-L_f-E_{fsn})\big] \geq \big(p_g G + p_{sm} S_m\big) + T. \tag{8}$$

Here T represents the lump-sum transfers paid by the government to the household. Government runs a balanced budget, hence lump-sum transfers equal to the labor income tax revenue:

$$T = \tau\big[(E_{mg}+E_{msm})+w_f(E_{fg}+E_{fsm})\big]. \tag{9}$$

Goods and market services are produced by firms in competitive markets using both male and female labor as input. The production technologies for these sectors are given by

$$G = \theta_g[\phi_g E_{fg}^{\mu} + (1-\phi_g)E_{mg}^{\mu}]^{1/\mu}, \tag{10}$$

$$S_m = \theta_{sm}[\phi_{sm} E_{fsm}^{\mu} + (1-\phi_{sm})E_{msm}^{\mu}]^{1/\mu}, \tag{11}$$

Similar to home production technology, ϕ_j is the time-varying (exogenously) share parameter for female labor and μ is the elasticity of substitution between female and male labor in production in these equations. Lastly, θ_j is the productivity in sector $j \in \{g, sm\}$ and it grows exogenously over time.

2.1 Equilibrium

The solution to the competitive equilibrium is a set of allocations of the male and female labor time to goods, market services and home production $\{E_{mg},\ E_{msm},\ E_{msn},\ E_{fg},\ E_{fsm},\ E_{fsn}\}$, quantity of goods and market and home-produced services $\{G,\ S_m,\ S_n\}$ and relative prices $\{p_g,\ p_{sm},\ w_f\}$ that satisfy the following conditions for a given set of exogenous productivity levels $\{\theta_g,\ \theta_{sm},\ \theta_{sn}\}$ and tax rate τ.

1. Household utility in Equation (1) is maximized subject to Equations (2),(3),(4), (7) and (8).

2. Firms choose female and male labor that maximize their profits:

$$\underset{E_{fg},E_{mg}}{max}\ p_g G - (w_f E_{fg} + E_{mg}),$$
$$\underset{E_{fsm},E_{msm}}{max}\ p_{sm} S_m - (w_f E_{fsm} + E_{msm}).$$

3. Labor and good markets clear.

4. Government transfers are consistent with the government budget constraint as stated in Equation (9).

Relative female wage equals to the marginal rate of substitution between male and female leisure. Hence, we have

$$w_f = \frac{\partial U/\partial L_f}{\partial U/\partial L_m} = \frac{(1-\alpha_l)L_m}{\alpha_l L_f}.$$

Household allocates labor to the home production until the marginal rate of technical transformation across male and female labor is equal to the marginal rate of substitution between them:

$$\frac{\partial U/\partial L_f}{\partial U/\partial L_m} = \frac{\partial S_n/\partial E_{fsn}}{\partial S_n/\partial E_{msn}},\ \Rightarrow \frac{(1-\alpha_l)L_m}{\alpha_l L_f} = \frac{\phi_{sn}}{1-\phi_{sn}}\big(\frac{E_{fsn}}{E_{msn}}\big)^{\mu-1}$$

As the female wage is determined by the technical rate of substitution between male and female labor in the market service, the model requires a specific relationship between the female employment share and comparative advantage of females in each sector (including home production). If male and female labor are substitutes (i.e., if $\mu < 1$), then there will be relatively more females in sectors with relatively higher share parameters.

Using first order conditions of the household's optimization problem, we can explicitly write the relationship between home and market service good demands as

$$\big(\frac{S_n}{S_m}\big)^{1-\eta} = \frac{1-\alpha_s}{\alpha_s}\frac{P_{sm}}{1-\tau}\theta_{sn}\Big[\phi_{sn}\big(\frac{E_{fsn}}{E_{msn}}\big)^{\mu} + (1-\phi_{sn})\Big]^{\frac{1-\mu}{\mu}}.$$

Substituting the equilibrium value of prices into equation above, we have

$$\big(\frac{S_n}{S_m}\big)^{1-\eta} = \frac{\theta_{sn}}{\theta_{sm}}\frac{1-\alpha_s}{\alpha_s(1-\tau)}\frac{\Big[\phi_{sn}\big(\frac{E_{fsn}}{E_{msn}}\big)^{\mu} + (1-\phi_{sn})\Big]^{\frac{1-\mu}{\mu}}}{\Big[\phi_{sm}\big(\frac{E_{fsm}}{E_{msm}}\big)^{\mu} + (1-\phi_{sm})\Big]^{\frac{1-\mu}{\mu}}}$$

We can further manipulate this equation by replacing equilibrium values of S_m and S_n, and

rearrange terms to get

$$\left(\frac{E_{fsm}}{E_{fsn}}\right)^{\eta-1} = \left(\frac{\theta_{sn}}{\theta_{sm}}\right)^{\eta} \frac{(1-\alpha_s)}{\alpha_s(1-\tau)} \left(\frac{\phi_{sn}}{\phi_{sm}}\right)^{\frac{\eta-1}{\mu-1}} \left(\frac{1-\phi_{sn}}{1-\phi_{sm}}\right)^{\frac{\mu-\eta}{\mu-1}} \left[\frac{\phi_{sn}\left(\frac{w_f(1-\phi_{sn})}{\phi_{sn}}\right)^{\frac{\mu}{\mu-1}} + (1-\phi_{sn})}{\phi_{sm}\left(\frac{w_f(1-\phi_{sm})}{\phi_{sm}}\right)^{\frac{\mu}{\mu-1}} + (1-\phi_{sm})}\right]^{\frac{\eta-\mu}{\mu}} \tag{12}$$

This equation governs the marketization (reallocation of females from home work to market work).[9] The equilibrium allocation of female time across home vs. market service production depends on the productivity differences across these sectors, preferences of the household over service goods, taxes, and relative comparative advantage of females in these sectors, as well as the price of females' time.

3 Quantitative Analysis

For many developed countries, observed high entry of females to market work (which happened mainly through entry to services sector) is explained through the marketization. Given the low service sector productivity levels in Turkey, growth in service sector productivity would direct women from home work to market work. In this section we quantify the potential rise in female employment that can be expected with a rising service sector.

To use the model described above for a quantitative analysis, we need to assign values to the parameters of the model. We calibrate the preference parameters to the match the US data on employment. Given these parameters, we calibrate the parameters that can be country specific (such as taxes and technology parameters) to match the Turkish data. Then, we simulate the Turkish economy, under different scenarios, until it has service share in employment that is comparable to the current shares in many developed OECD countries and investigate the share of female employment at that point.

We begin with describing the calibration exercise, and then discuss the results.

3.1 Calibration

As Figure (1) shows, the US has one of the highest service share and female employment among OECD countries. Moreover, studies confirm that the increase in female employment is associated with the rise of services (Akbulut (2011); Ngai and Petrongolo (2013); Olivetti (2014), and Olivetti (2006)). Hence, we first calibrate the model to replicate the change in US employment data. This tests whether the model can generate such relationship quantitatively.

We need to assign values to preference parameters, elasticities, productivity levels and share parameters in production functions. Preference parameters and elasticities are constant while productivity levels and share parameters change over time. Our sample period is from 1977 to 2007, restricted by employment data availability. We set the elasticity of substitution parameter between male and female labor, μ, to 0.68 following Acemoglu et al. (2004) for all production functions.

[9] See Ngai and Petrongolo (2013) and Ngai and Pissarides (2008).

We set elasticity parameter between goods and services, ϵ, to -1.28 as in Rogerson (2008). We use labor tax rates reported in McDaniel (2014) and set τ to 23.4% and 27.5% for years 1977 and 2007, respectively.

We calibrate productivity levels (θ_j) using labor productivity data. Let labor productivity for sector j be $\hat{\theta}_j$. Then we have

$$\hat{\theta}_j = \frac{\theta_j \left[\phi_j E_{fj}^{\mu} + (1-\phi_j) E_{mj}^{\mu}\right]^{1/\mu}}{E_{fj} + E_{mj}}.$$

We normalize the labor productivity levels ($\hat{\theta}_j$) of all sectors in 1977 to unity. We use sectoral output and hours worked for the US from GGDC 10 sector data base to compute the average annual growth rates of sectoral labor productivity levels from 1977 to 2007. We then use these growth rates to find implied labor productivity levels in the model in 2007. The average annual growth rates we find are 1.95 and 1.1% for goods and service sectors, respectively.[10] Implied 2007 levels of productivity for goods and service sectors are 1.78 and 1.38, respectively.

The remaining parameters to be calibrated are preference parameters, α_c, α_g, α_{sm}, $\overline{G}$ and α_l; elasticity of substitution parameter between home and market service goods, η, level of home production productivity in 2007 for the US, (θ_{sn}^{2007}), and share parameters in production function for goods, home and market services, ϕ_g, ϕ_{sm} and ϕ_{sn}, for 1977 and 2007. We have 13 parameters to be calibrated while there are 12 data moments (male and female employment shares of all sectors in 1977 and in 2007). We normalize the relative female wages in 1977 to 1. We calibrate the share parameters in 1977 and 2007 to match female employment rates in three sectors in these two years. We target male employment rates in all sectors in 1977 and 2007 to jointly calibrate the remaining parameters. Data and computation of employment rate moments we use are explained in Appendix A while aggregate hours used in the model are presented in Table (1).

Table 1: Aggregate Hours - US

	Goods	Services	Home
Female			
1977	0.036	0.154	0.422
2007	0.022	0.213	0.306
Male			
1977	0.128	0.174	0.118
2007	0.091	0.205	0.168

Notes: Values reported in the table are total hours worked and it is computed using data from International Labor Organization and the OECD.

The calibrated parameter values that are fixed over time and across countries are presented in Table (2) while parameter values that are specific to the US are reported in Table (3). We compare

[10] Rogerson (2008) computes higher growth numbers (2.48 and 1.44%, respectively) using 1950-2003 US data.

Table 2: Parameters Common Across Countries

η	ϵ	μ	α_c	α_g	α_s	α_l	$\bar{G}$
0.50	-1.28	0.68	0.54	0.03	0.51	0.60	0.046

Notes: μ is technology parameter while all others are preference parameters.

these values to the ones in Rogerson (2008), and observe that they are very close in magnitude. The only parameter that displays a deviation is the end year home sector productivity level. Unlike the 1950-2003 period where the model implied growth rate of home sector productivity is nearly zero in Rogerson (2008), we find a small but negative growth rate for home sector productivity for the 1977-2007 period.

Our next step is to calibrate the parameters of the model that are specific to Turkey. Sectoral productivity data levels in the data are not comparable across countries. Hence we calibrate these values. We target 1988 values of male and female employment in goods and services to calibrate productivity levels θ_{sm} and θ_g, and share parameters ϕ_{sm} and ϕ_{sn} in that year. We use sectoral labor productivity growth rates computed from data and the calibrated levels in 1988 to get the productivity levels in 2007 for goods and services sectors. We target gender ratios in goods and service sectors in 2007 to pin down share parameters θ_{sm} and θ_g in that year. We compute the tax rate for Turkey from the data and our sample period is from 1988 to 2007.

Table 3: Country Specific Parameters

	US		TUR	
	1977	2007	1988	2007
τ	0.23	0.28	0.10	0.20
ϕ_g	0.40	0.33	0.44	0.37
ϕ_{sm}	0.49	0.44	0.33	0.33
ϕ_{sn}	0.60	0.49	0.56	0.49
$\hat{\theta}_g$	1	1.78	0.42	0.90
$\hat{\theta}_{sm}$	1	1.39	0.27	0.34
$\hat{\theta}_{sn}$	1	0.81	1.21	0.84

Notes: τ is labor tax, ϕ_i is the share parameter in production function while $\hat{\theta}_i$ is the labor productivity level for sector i. g, sm and sn are goods, market services and home production sectors, respectively.

Remaining parameters to be determined are home production share and productivity values in 1988 and in 2007. Due to data limitations on home work hours in Turkey, we assume that countries have the same share parameter in home production at any given year. We set ϕ_{sn} for Turkey in 2007 to the value calibrated for the US in 2007. Then, we compute the growth rate of this parameter between 1977 and 2007 for the US and using this growth rate we compute its value in 1988 to set the value of ϕ_{sn} for Turkey. We target aggregate Turkish labor productivity relative to the US to calibrate the value of θ_{sn} in 1988, and male employment in services in 2007 to calibrate the value of θ_{sn} in that year.

Table 4: Data and Model Aggregate Hours - Turkey

	Data		Model	
	1988	2007	1988	2007
Female				
Goods	**0.099**	0.047	0.099	0.042
Services	**0.015**	**0.032**	0.015	0.032
Male				
Goods	**0.171**	0.116	0.171	0.104
Services	**0.107**	**0.129**	0.107	0.129

Notes: Data values reported in the table are total hours worked and it is computed using data from International Labor Organization and the TurkStat. Values in bold are used as moments.

In Table (3) we present the parameter values of the model calibrated to Turkey. The growth rate of labor productivity values between 1988 and 2007 show that goods sector exhibited a faster productivity increase than the service sector. In addition, similar to our US calibration result, the model generates a decline in the productivity of home production, albeit at a faster rate than the US. The values of share parameters $\phi_{sm}, \phi_{sn}, \phi_g$ display that while women gained comparative advantage in home production, their share in goods production declined implying a loss in female comparative advantage in goods production. ϕ_{sm} staying almost constant over the sample period shows that women maintained their low share in this sector.

Table (4) shows the data and model implied values of the moments we used in our analysis. Besides matching the targeted data moments, the model also does well in replicating the non-targeted employment shares. These are 2007 values of male and female employment shares in goods sector (see Table (4)). The model produces 4.2 and 10.4% for male and female industry employment shares, respectively. The model slightly overpredicts the decline in these employment shares observed between 1988 and 2007, however all in all we can argue that it both matches the direction and magnitude of the change in employment shares of men and women well in goods sector and aggregate economy. These results imply that the current model calibrated to Turkey provides a sound framework to examine the possible future path of the female employment in the country.

3.2 Future of Female Employment in Turkey through the Lenses of the Model

Our main aim in this paper is to understand if the low female employment rate in Turkey can be associated with the fact that the structure of the economy did not transform away from other sectors into service at an adequate pace. To do this we use the calibrated model to examine how the projected female employment rate looks like in each sector when the economy reaches the same employment share of service sector as in US. We study different scenarios regarding productivity, tax rates and female employment share in service and goods production for the transition period.

While running these simulations, we consider different assumptions about sectoral productivity

growths, tax rate and the share of female employment in goods and service sectors, ϕ_g, ϕ_{sm}, for the Turkish economy. As a benchmark case, we use the 1988-2007 average sectoral productivity growth rates, 2007 tax rate and model implied rate of change in ϕ_g, ϕ_{sm} levels over the sample period. In alternative scenarios we replace each of the inputs to the simulations with their US correspondent. The results for these simulations are presented in Table (5).

Table 5: Simulation Results for Turkey

	2007	Alternative Scenarios					
		Benchmark	γ_g^{US}	γ_{sm}^{US}	τ^{US}	ϕ_g^{US}	ϕ_{sm}^{US}
T		22	30	22	24	21	18
E_{fg}	0.042	0.017	0.019	0.017	0.015	0.012	0.016
E_{fsm}	0.032	0.091	0.125	0.090	0.083	0.091	0.182
E_{mg}	0.104	0.059	0.072	0.058	0.054	0.064	0.069
E_{msm}	0.129	0.190	0.208	0.187	0.170	0.188	0.132
E_f	0.074	0.108	0.143	0.107	0.098	0.103	0.198
E_m	0.233	0.249	0.279	0.246	0.225	0.252	0.201
s_f	0.24	0.30	0.34	0.30	0.30	0.32	0.49

Notes: Benchmark uses 2007 levels of technology share parameters and taxes calibrated for Turkey and the Turkish productivity growth rates. All US share and tax rate values are 2007 levels.

If the economy continues with the 1988-2007 average productivity growth rates, and the 2007 tax rate, Turkey catches up with the US in terms of structural transformation in 22 years. In 22 years, the male employment rate becomes 24.9% and female employment rate rises to 10.8%. There is a remarkable shift of male workers from goods to service sector. We also observe a similar shift among females but the magnitude is smaller. The female employment rate in goods decreases by 2.5 percentage points whereas in service sector women's employment rises by 5.9 percentage points which drives the increase in female employment.

If we assume that the productivity of goods sector grows with 1977-2007 US average, the catch up period becomes 30 years. In this case it takes longer for the service employment share to reach the 2007 US level than the benchmark. The reason for this difference is that the 1977-2007 US average goods sector growth rate is slower than the 1988-2007 average in Turkey. As relative productivity increase in goods sector is slower, so is the reallocation of labor from this sector to services. But as it takes longer, there is more marketization in this scenario compared to the benchmark, generating further increase in female employment. At the end of 30 years, the model predicts that the female employment share will rise by 9.3 percentage points and reach 14.3%. A big fraction of employed women will be in the service sector with a few remaining in industry. When we replace the service sector productivity growth of Turkey, which is 1.38%, with the lower 1977-2007 US average (1.1%), the convergence takes place slightly longer than the benchmark case. Also the female employment share and its allocation to different sectors do not display considerable differences from the benchmark.

In addition to productivity growth rates, we simulate the economy with US tax rate and share

parameters. The results from these simulations are in the last three columns of Table (5). When we tax labor income at the higher 2007 US rate, Turkey catches up with US service employment share in 24 years. At the end of this transition, we observe a slight increase in female employment rate. Female employment in goods sector declines and counteracting this, a higher proportion of women are employed in services. Next we rerun the simulations with the 2007 US female share parameter in industry sector which is lower than the one calibrated for Turkey. In this case the convergence takes place in 21 years similar to the benchmark case and we observe around 3 percentage points increase in total female employment.

Lastly we set the female labor share in service sector to its 2007 US value which is 0.44. Note that this scenario implies that female labor has a higher comparative advantage in service production than the benchmark case. The transition to the targeted service employment share takes place in 18 years in this exercise. At that point in time, the employment rate of women reaches to 19.8% exhibiting the highest increase among all other alternative scenarios. There is a striking move of women into service sector. Goods sector on the other hand, loses 2.6 percentage points of its 2007 female employment rate. Among all alternative cases, imposing the US share parameter for service sector brings the Turkish female share employment rate closest to the US female share level of 44%.

The results from these simulations suggest that when Turkey catches up with the 2007 service employment share of the US in the future, we would observe an increase in female employment but it will still be much lower than the US female employment share of 2007. If the economy continues with its own productivity growth, share and tax parameters, this generates a modest improvement in the female employment rate upon completion of the transition. A similar outcome is observed when the service sector is assumed to grow at the US average annual rate. Setting the growth rate of the industry to its US average, we achieve 6.9 percentage points improvement in the female employment rate at the end of the structural transformation period to 14.3%. This is still not a noteworthy level for female employment rate when we compare it to the US level of 23.2% (or the 44% of female share of employment). On the other hand, if women in Turkey have the same share in service production as women in US, the female employment rate raises to a remarkably higher level. These results suggests that the expansion of the service sector is by itself not enough to observe improvement in female employment in an economy. As long as women keep their comparatively less advantaged position in service production, the structural transformation of the country will not carry women's employment in the market to levels comparable to the advanced economies.

4 Discussion

The model implies that Turkey may not reach female employment levels comparable with the levels currently observed in the US even though it reaches the same overall employment allocation in services. We can observe a rise in female employment that is comparable to the experiences of developed countries only if technology in service sector changes in a way that incorporates more females. Indeed, as Equation (12) displays, marketization not only depends on the relative productivity values, but also on relative comparative advantages. To make sure that this strong result is

not driven by a specific assumption in the paper, we perform a series of robustness checks in this section.[11]

One of the stylized facts of the Turkish labor market is that the share of agriculture is still large, especially compared to many OECD countries. Presence of a larger sector masks the poor condition of females at the market, rather than helping it. As figure A.4 shows, if we exclude agricultural employment from the sample, share of services in total employment in Turkey increases while the share of females in employment declines further, with little change in the positions of other countries. Moreover, agriculture is embedded in the goods sector in the model. Hence, explicitly modeling agriculture will not have significant effect on the results. Nonetheless, we extend the model to include the agriculture a la Duarte and Restuccia (2010) and Sengul and Üngör (2011). We observe small changes in the values of parameters calibrated, but the results of the paper passes through; we need a smaller difference between comparative advantage at home versus market work for females (or a higher comparative advantage at service sector) in order to see a large increase in female employment in the future.

Another assumption in the benchmark model is that wages are the same across sectors for each gender. Ilkkaracan and Selim (2007) argue that gender wage gap is narrower at the services sector, compared to manufacturing. Note that in the presence of perfect labor mobility we have

$$\frac{\phi_g}{1-\phi_g}\left(\frac{E_{fg}}{E_{mg}}\right)^{\mu-1} = w_f = \frac{\phi_{sm}}{1-\phi_{sm}}\left(\frac{E_{fsm}}{E_{msm}}\right)^{\mu-1}.$$

If there is wage differential across genders, then $w_{fsm} = xw_{fg}$, and this can potentially deliver a larger ϕ_{sm} in quantitative analysis. We calibrate a variation of the model, where there is extra cost (or benefit) to hiring workers in goods sector, as opposed to the service sector. Hence, firms in those sectors pay different wages. In our calibration exercise with frictions that give us relative wages that are comparable with the data (0.9 in services 0.7 in goods), we find that results of the benchmark economy follow through.[12]

We also assume that female and male labor have the same elasticity of substitution in production in all sectors. When we change the elasticity to make services or home production more elastic, the only change in the model is the level of share parameters in production. Results are unchanged in that a higher share parameter in service would be the main driver behind the rise in female services in Turkey. Similarly, adding a consumption tax to the model also does not alter the result we derive from the benchmark model.

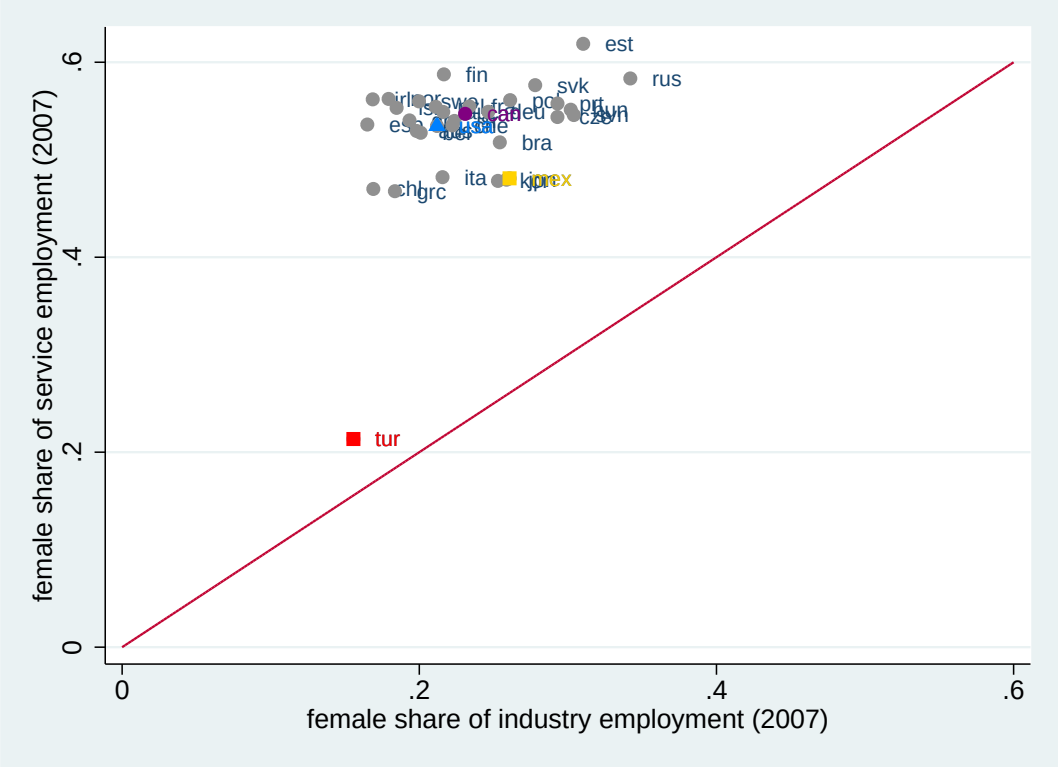
One possibly crucial assumption we make is that the female labor share in home production is the same in the US and Turkey. It is plausible that the cultural and other differences across these countries may result in different share parameters in home production. For the US, we get guidance from the time use surveys to pin down this parameter. For Turkey, time use survey begins in 2006, the end of our sample period. As an alternative to setting ϕ_{sn} in Turkey to that of US, we calibrate the end year share value for Turkey to match the gender share in home work implied

[11] Results are available upon request.

[12] The same is through if we model the friction in service sector instead of goods sector.

by Turkish time use survey. Then we compute the beginning year value using the growth rate for the US. With this calibration, model predicts a somewhat larger rise in female employment with increasing services. However, it also predicts that women earn higher wages compared to men, which contradicts the data.[13] Furthermore, comparing the share of females in industrial employment with their share in service employment across countries shows that Turkey stands out only in its female share of service employment (Figure 3). Supply related factors as well as cultural (gender biased) explanations are at odds with Figure 3. Hence, even though such factors would affect labor supply decisions of females, they cannot be the main reason behind the low female employment share of Turkey, which is driven by their low share in service sector.

Figure 3: Service and Industry Shares of Female Employment in 2007



Another possibility is that there is another channel effecting female employment in the data that the model lacks and thus puts more weight on ϕ_{sm} than there actually is. Hence, we incorporate a mechanism where effective female labor in home production can be different from the actual input used.

$$S_n = [\phi_{sn} x E_{fsn}^{\frac{1}{\mu}} + (1 - \phi_{sn}) E_{msn}^{\frac{1}{\mu}}]^{\frac{1}{\mu}}.$$

We calibrate this version of the model (assuming $x = 1$ for the US) where we take ϕ_{sm} to be the same as it is in the US, and calibrate the required coefficient on female labor at home production

[13] If we assume that female share in home production ϕ_{sn} is close to 1, then we can get a rise in female employment that is comparable to the rise we observed in the US, and female wages that are almost twice as much as what males earn in the model.

(x) and repeat our exercise. This model could generate large increase in female employment share as Turkey has the share parameter of the US. However, female wages should be significantly higher than male wages in this case and there should be a very large wedge in 1988, dropping very sharply.

4.1 A closer look at the data

After confirming the robustness of our results to various modeling choices, we turn to the data in search of further insight to the model results. We begin with female employment in sub-sectors of service to investigate whether the low female ratio is result of anomalies in some sub-sectors. Table (6) compares the employment shares of nine sub-sector of services and the share of women employed in each of these sub-sectors in 2007 for the US and Turkey. Results show that female shares are persistently lower in Turkey in all sub-sectors. The correlation between the share of females in these sectors in the US and Turkey is 89%, implying that ranking of the share of female employment across service sub-sectors is comparable in those two countries. Moreover, employment shares of sub-sectors differ significantly across countries. In Turkey, sub-sectors with higher female employment have a relatively smaller share in total service employment, compared to the US.[14]

Table 6: Service subsectors and female shares: US vs. Turkey

	US		Turkey	
	Female share	Sector share	Female share	Sector share
Transport, Storage and Communications	0.252	0.056	0.070	0.110
Real Estate, Renting	0.436	0.165	0.248	0.078
Public Administration and Defence	0.450	0.058	0.140	0.122
Wholesale and Retail Trade	0.452	0.184	0.159	0.346
Other	0.480	0.123	0.299	0.086
Hotels and Restaurants	0.530	0.087	0.140	0.096
Financial Intermediation	0.586	0.063	0.386	0.024
Education	0.691	0.110	0.438	0.084
Health and Social Work	0.788	0.154	0.533	0.054
Correlation with US Female Share		0.2691	0.8963	
Correlation with TR Female Share				-0.4692

Notes:"Other" refers to "Other Community,Social and Personal Service Activities".

Table (6) reveals that both in Turkey and in the US relative comparative advantage of women in service sub-sectors are qualitatively similar. However, in Turkey the share of females is significantly lower in all sub-sectors. Even though sectors with higher female share are relatively smaller in

[14]We repeated the same analysis for different years. There is a change in the classification of sectors in the sample period which leads to a break in the levels of these correlations. However it stands true that US has a significantly higher correlation than Turkey. Moreover we computed this correlation at different points in time for Spain, Canada and Mexico and found that Turkey has a significantly lower correlation than these countries as well.

Turkey compared to the US, this is not the main reason for low female employment in services. If female shares in all sub-sectors in Turkey were to be the same as they are in the US, female service employment in Turkey would be closer to that of the US. Increasing shares of females in all sub-sectors is much more effective than increasing the shares of sub-sectors with higher female shares to achieve high female employment in the service sector.[15]

To further investigate the low comparative advantage of women in the service sector in Turkey, we examine the female share of employment and gender ratio in services to some countries when they have service share of employments similar to Turkey, using ILO data. We choose Spain and Italy as they were similar to Turkey in 1960s in aggregate levels and diverged later on (see İmrohoroğlu et al. (2014)). We choose Mexico as it has the second lowest female employment among OECD countries and lastly we include Canada as it had female share very similar to that of Turkey when they had comparable service shares. Results are presented in Table 7. Conditioning on service employment share, Turkey has lower female employment share and even lower female ratio employed in service sector.

Table 7: Cross-country comparison of employment shares

Country	year	s_s	s_f	s_{fsm}	s_{fa}
Turkey	2007	0.50	0.26	0.21	0.47
Italy	1982	0.50	0.32	0.37	0.35
Spain	1987	0.51	0.30	0.40	0.24
Mexico	1993	0.50	0.31	0.43	0.13
Canada	1961	0.53	0.26	0.39	0.04
US	1966	0.58	0.36	0.46	0.18

s_s: share of services in total employment. s_f: share of females in total employment. s_{fsm}: share of female employment in service sector.

5 Conclusion

Turkey stands out as a special case having the lowest female employment rate among all other OECD countries. As of 2007, a little higher than 25% of employed were females in Turkey, while the second lowest value was around 35%. As the recent literature focuses on rise of services as the driving force behind increases in female employments in developed countries over the last decades, this paper studies whether the strong link of rise of services and rise of female employment can be observed in Turkey as well, providing further evidence on the association. We develop a structural transformation model with goods and service sectors as well as home production where the households consists of both male and female members. Using this model we address the following

[15] We further use shift-share analysis a la Olivetti and Petrongolo (2016) to decompose the change in female service share observed between 2004 and 2008 in the US and Turkey. This analysis shows that the within sector component was more dominant in generating the increase in female employment in the service sector.

question: If Turkey catches up with the service employment share of the developed countries, will the female employment share also catch up?

Our quantitative analysis reveal that the data reveal that while women have strong comparative advantage in services in the US, this is not the case in the Turkish data. We also find that structural transformation of economic activity away from other sectors into service by itself is not sufficient to generate significant increase in female employment rate unless female workers have strong comparative advantage in service production. This result is robust to various modeling assumptions. Hence, policies that aim to increase female employment in Turkey may yield better results if geared towards increasing intensity of female labor input in service production. Though this paper investigates, and rules out, some possible explanations, more work needs to be done to better understand the determinants of relative gender inputs used in production as well as the relationship between structural transformation and allocation of female employment across sectors.

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A Data

In this section we present the data sources and details of the data processing. We begin with female share and service share in employment data for the OECD countries. The data is civilian employment numbers by gender and by sector from OECD statistics.[16]. Female share of employment is number of female employment divided by the number of total employment while service share of employment is number of employment in services divided by the total employment.

Sectoral labor productivity data for the US comes from the Groningen Growth and Development Center (GGDC).[17] GGDC has data on value added by sectors and total hours worked. Sectoral labor productivity levels are obtained by dividing the former by the latter for each sector. Average productivity growth rate we use is the average annual growth rate between beginning and the end year values of these productivity series.

Sectoral labor productivity data for Turkey is calculated using TurkStat, OECD and Conference Board data. We retrieve sectoral output data from TurkStat.[18] Sectoral total hours data is computed using sectoral employment data from OECD and average annual hours worked by worker from Conference Board. We assume that average annual hours worked by worker is the same for all sectors and multiply these two series to get total hours worked in each sector. [19]

For our analysis we also need data on sectoral employment by males and females. We combine a few data series to construct this data since it is not readily available. We use data from the labor statistics database provided by the ILO to compute female share of employment at each sector. [20] We use these shares and the employment data by sector provided by OECD to compute number of employed for each sector-gender category. The sectoral hours worked per employee in the US is available from GGDC database. We use these hours data and computed gender-sector numbers data to calculate sectoral total hours worked by worker for each gender-sector for the US. There is no hours data by sector-gender while OECD provides hours worked by gender. We assume that hours difference by gender is the same across sectors and use this ratio to compute total hours worked by gender-sector. We gather annual hours worked by worker for Turkey from the Conference Board.[21] We assume that male employment hours are 1.1 times more than female employment hours in each sector and divide total sectoral hours by the sum of female and male sectoral employment.[22] This

[16] http://stats.oecd.org.

[17] See Timmer et al. (2015) and http://www.rug.nl/research/ggdc/data/ggdc-10-sector-database.

[18] See http://www.turkstat.gov.tr for further information. Sectoral output data is available with 1987 constant prices until 1997, and with 1998 constant prices from 1998 onwards. We harmonize the data using growth rates and use data with 1998 constant prices.

[19] The Conference Board Total Economy Database,January 2014, http://www.conference-board.org/data/economydatabase/ Output, Labor and Labor Productivity Country Details, 1950-2013.

[20] See Table 1C, economically active population, by industry and status in employment available in http://laborsta.ilo.org/

[21] See The Conference Board Total Economy Database,January 2014, http://www.conference-board.org/data/economydatabase/ Output, Labor and Labor Productivity Country Details, 1950-2013.

[22] OECD provides data on hours worked by each gender. For Turkey this data starts from 2006. Hence we check the data provided for Spain and Italy and find that the male to female hours are 1.1 and 1.2 for these countries between 1988 and 2007, respectively. To remain on the cautious side we set this ratio to 1.1.

gives us average hours worked by females in each sector for Turkey. Multiplying this series by 1.1 yields average male hours in each sector. As a next step we compute total female and male sectoral hours by multiplying average hours worked by both genders in each sector and sectoral male and female employment. Lastly we compute aggregate hours worked by males and females in goods and services as the ratio of total female and male sectoral hours to the population aged 15-64 and normalized by 5.2.[23].

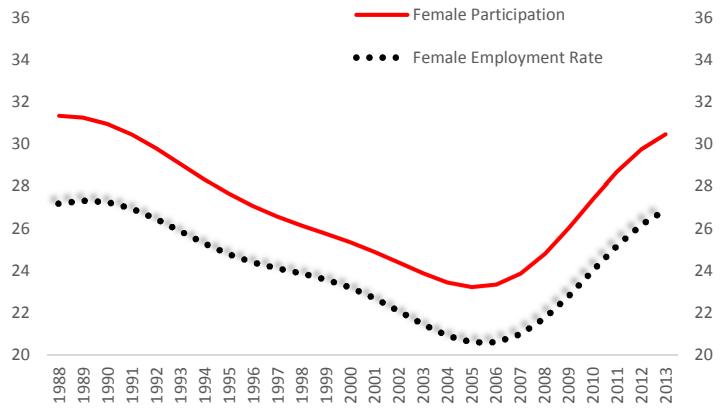
These calculations yield the employment shares of males and females in market work. Since our model economy consists of home production, we need to compute the home employment shares as well. For this, we assume that individuals have one unit of time which they allocate between market work (goods and service sectors), home production and leisure. The employment shares in goods and services are computed from the data as explained above. To retrieve the home employment shares for individuals for the US we make use of 2007 ATUS (American Time Use Survey) which gives information on the time spent for different household chores and market work for both men and women. Using this information we retrieve the ratio of home to market work. However 2007 ATUS provides data for the 2003 - 2014 period. To compute the value of this ratio for 1977, we refer to Table 2 of Aguiar and Hurst (2007). We get the 1975 and 2003 ratio of home to market hours from them and using the change in home to market hours implied by these ratios between 1975 and 2003, we compute the same ratio for 1977 implied by 2003 ATUS value.[24] Having computed this ratio, we multiply it with the total market employment share and get the home employment share for both gender.

We collect GDP per hours worked data from the Conference Board.The tax rate on labor income for the US is borrowed from McDaniel (2014) which computes several tax rates for many OECD countries except for Turkey. Therefore we need to compute the labor income tax rate for Turkey. In doing this we follow the methods described in Mendoza et al. (1994) and Prescott (2004). Lastly the female share in service sub-sectors and the relative employment shares of these sub-sectors in total service presented in Table (6) are calculated using data from ILO which gives the number of employed men and women in these sub-sectors.

[23]Normalization by 5.2 is because we follow Rogerson (2008) in constructing time allocation moments and assume that discretionary time is 5,200 hours per year.

[24]We assume that the ratio does not change between 1975 and 1977.

Figure A.1: Female Participation and Employment Rates in Turkey



Notes: Participation rate is ratio of labor force to population, employment rate is the ratio of employment to population. Rates are in percentages.

Figure A.2: Participation Rates by Gender in Turkey

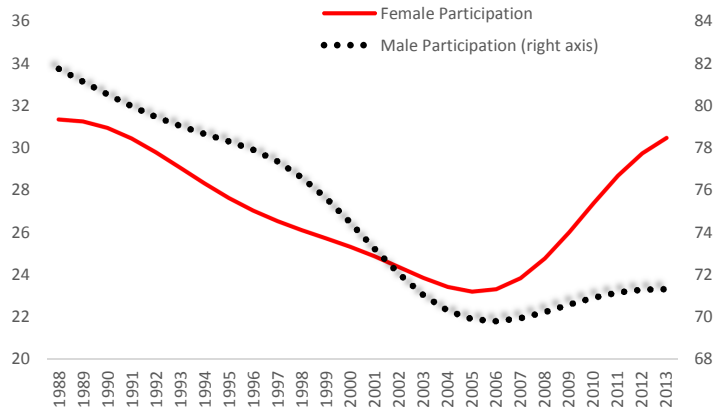


Figure A.3: Sector Shares of Employment in Turkey

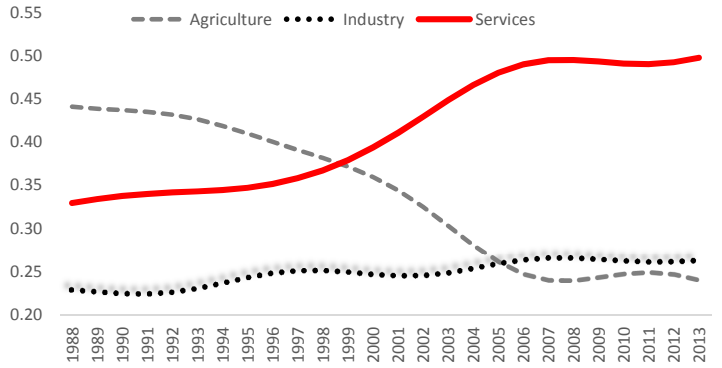
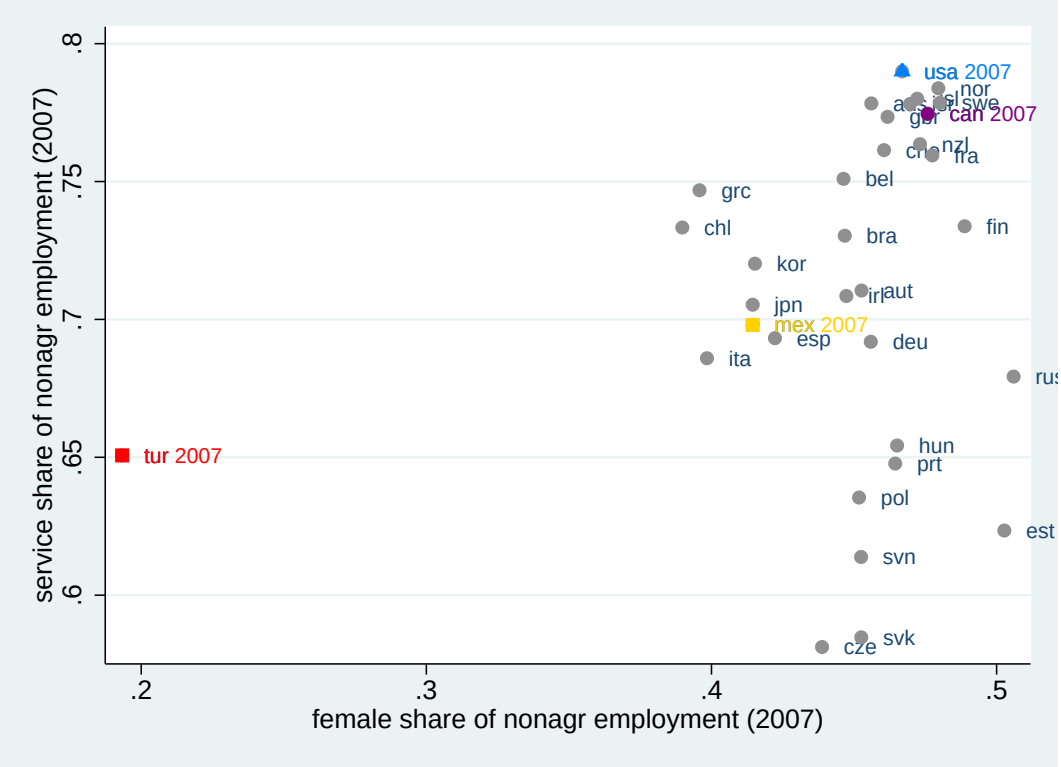


Figure A.4: Female and Service Shares of Nonagricultural Employment in 2007



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